UNITED NATIONS

UNFCCC Framework Convention on Climate Change

Distr.
GENERAL

FCCC/IDR.3/FIN
27 May 2003

ENGLISH ONLY

FINLAND

Report on the in-depth review of the third national communication of Finland

Review team:

Ismael Concha (Colombia)
Dace Lodzina (Latvia)
Jean-Marie Bouchereau (France)
Sergey Kononov (UNFCCC secretariat, coordinator)

GE.03-61906

I. INTRODUCTION AND NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

A. Introduction

1. Finland ratified the United Nations Framework Convention on Climate Change (UNFCCC) on 31 May 1994. It signed the Kyoto Protocol to the UNFCCC on 29 April 1998 and ratified it, with the other members of the European Community (EC), on 31 May 2002. The UNFCCC secretariat received the first national communication (NC1) of Finland in 1995 and the second one (NC2) in 1997. This **third national communication (NC3) was received on 20 November 2001**.

2. An inter-ministerial working group coordinated the preparation of the NC3, which was completed in about 16 months.[1] In October 2001, the Kyoto Ministerial Working Group approved the final version of the NC3.

3. The discussion of the NC3 with non-governmental stakeholders was limited because of the lack of time before the submission deadline. However, environmental and business non-governmental organizations (NGOs) as well as local governmental organizations (LGOs) participated actively in the discussion of the Finnish National Climate Strategy (NCS) that was a key input to the NC3.

4. The in-depth review of the NC3 was carried out from September to December 2002 and included a visit by the review team to Helsinki from 30 September to 4 October 2002. The team consisted of Mr. I. Concha (Colombia), Ms. D. Lodzina (Latvia), Mr. J.-M. Bouchereau (France) and Mr. S. Kononov (UNFCCC secretariat, coordinator). During the visit, the team met Finnish experts involved in the preparation of the NC3, officials from ministries and agencies, a representative of LGOs and representatives of business and environmental NGOs.

B. National circumstances

5. Finland is located in the north of Europe. It borders Sweden, Norway and Russia. A quarter of the country lies north of the Arctic Circle. Because of the northern location, the climate is relatively cold, notwithstanding warming winds from the Atlantic Ocean.

6. Forests occupy about 72 per cent of the territory land area. From 1990 to 1999, the forest area increased by 0.8 per cent and agricultural land (8 per cent of the territory) increased by 1.3 per cent.

7. Finland is a parliamentary democracy. The head of state, the president, is elected every six years by direct popular vote. The parliament is elected every four years. Regional and municipal administrations have considerable rights, in particular for decisions on environmental matters.

8. In 2000, the population of Finland was 5.18 million and the gross domestic product (GDP) per capita was about US$ 32,000.[2] Services account for the highest share of the GDP (62.2 per cent in 2000) followed by industry (34.2 per cent).[3] Forestry with strong export orientation has traditionally been a key industry in Finland.

---

[1] The following organizations took part in preparing the NC3: the Ministry of Environment, the Ministry of Trade and Industry, the Ministry of Transport and Communications, the Ministry of Agriculture and Forestry, the Ministry of Foreign Affairs, the Ministry of Finance, the Finnish Environment Institute, Statistics Finland, and some others.

[2] "Key World Energy Statistics from the IEA: 2002 edition", OECD/IEA, Paris, 2002.

[3] World Bank country data at www.worldbank.org

9. In the early 1990s, Finland experienced severe economic recession but economic growth began again in 1994. Between 1994 and 2000, GDP grew by 4.7 per cent per year on average. The telecommunication industry developed strongly in these years and now is another cornerstone of the economy, along with the traditional forest industry. Despite considerable economic growth, greenhouse gas (GHG) emissions decreased from 1990 to 2000 (see table 1).

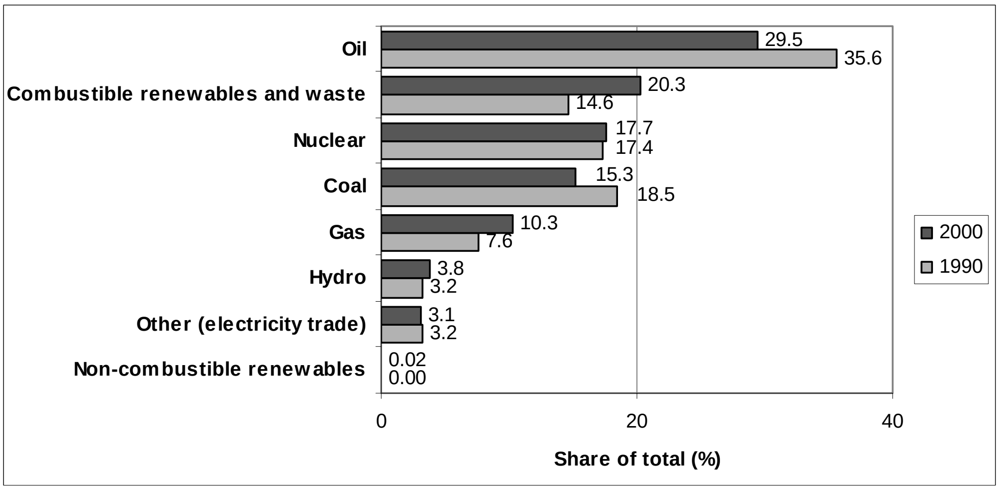
Table 1. Main macro-economic indicators and GHG emissions for Finland

	1990	2000	Change[a] (%)
Population (millions)	4.99	5.18	3.8
Gross domestic product – GDP (billions of US$ of 1995)	133.7	165.5	23.8
Total primary energy supply – TPES (Mtoe[b])	28.81	33.15	15.1
Electricity consumption (TWh)	58.95	75.47	28.0
GHG emissions[c] (Tg[d] CO_2 equivalent)	77.09	73.96	–4.1
GHG emissions per capita (Mg CO_2 equivalent)	15.46	14.29	–7.6
GHG emissions per GDP unit (kg CO_2 equivalent per US$ of 1995)	0.576	0.447	–22.4

Source: Data for population, GDP, TPES, and electricity are from “Energy balances of OECD countries, 1999–2000”, OECD/IEA, Paris, 2002. GHG data are from the NC3 and, for 2000, from the 2002 inventory report.
[a] The change is calculated as: [(2000 – 1990)/1990] x 100.
[b] Millions of tonnes of oil equivalent.
[c] Without accounting for land-use change and forestry (LUCF).
[d] One teragram (Tg) is equal to 1,000 gigagrams (Gg) or one million tonnes.

10. Renewable energy sources, mostly biomass, supply a large part of energy and electricity in Finland (see figures 1 and 2). The use of biomass, for power generation in particular, increased in the 1990s, the implemented promotional policy being one of the key reasons. The share of nuclear energy in energy and electricity supply is also high. From 1990 to 2000 the share of gas increased while the shares of oil and coal decreased. Combined heat and power (CHP) production plays an important role, accounting for about one-third of the generated electricity and about 80 per cent of the produced heat. The use of non-combustible renewables (wind and solar energy) remains marginal in Finland.

Figure 1. Structure of primary energy supply in Finland

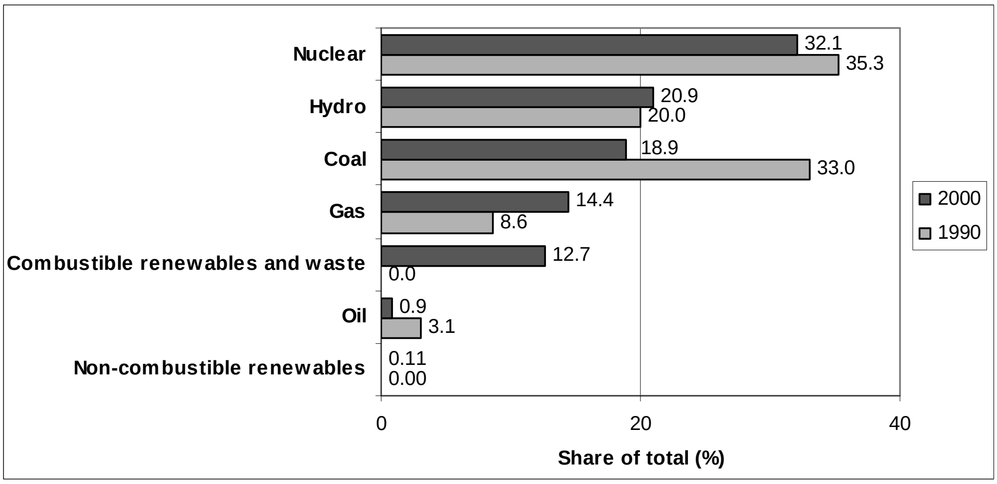


Source: “Energy balances of OECD countries, 1999–2000”, OECD/IEA, Paris, 2002.
Note: The sum of shares may not be exactly 100 per cent because of rounding.

11. Imports account for about 70 per cent of TPES. The supply of imported energy is diverse – gas, oil and nuclear energy are imported in comparable quantities. The use of peat, an indigenous energy resource in Finland, contributes to supply diversity and energy security (the share of peat in TPES was

4.3 per cent in 2000[4]). Electricity imports are considerable in Finland – about 10.6 TWh in 2000 (domestic electricity generation was 54.4 TWh in 2000).[5]

Figure 2. Structure of electricity supply in Finland



Source: "Energy balances of OECD countries, 1999–2000", OECD/IEA, Paris, 2002.
Note: The sum of shares may not be exactly 100 per cent because of rounding.

12. CO_2 emissions from fuel combustion in Finland in 2000 were 10.6 Mg CO_2/capita and 0.44 kg CO_2/US$ of GDP, which is lower than the average for the members of the Organisation for Economic Co-operation and Development (OECD): 11.1 Mg CO_2/capita and 0.51 kg CO_2/US$.[6] This indicates high efficiency of energy use in Finland, given that the demand for heating is high because of the cold climate and that many industries (such as the chemical industry and the production of wood, pulp and paper) are energy intensive.

C. Relevant general, energy and environmental policies

13. Since Finland's accession to the EC in 1995, national policies have been under the strong influence of EC policies. The objective of the **energy strategy** of Finland, adopted in 1997, is to ensure reliable supply of energy at competitive prices. Sectoral and cross-sectoral national programmes were designed to implement the strategy: the 1995 Energy Conservation Programme (revised in 2000), the 1999 Action Plan for Renewable Energy Sources, and others. As part of the energy policy, Finland has gradually introduced competition in the electricity market since 1995.

14. The **environmental policy** of Finland is based on such principles as integrated pollution prevention, promotion of ecological efficiency in production and consumption, extended producer responsibility, integration of environmental considerations into energy and economic policies, and use of economic instruments. The policy instruments include the Environmental Protection Act, the Land Use and Buildings Act, the Act on Environmental Impact Assessment, the Environmental Guidelines for the Transport Sector and the National Forest Programme.

15. In the late 1990s Finland developed, within a general framework of the United Nations Commission on Sustainable Development, national indicators of sustainable development. The final list of about 85 indicators, structured into 20 thematic groups, was published in 2000.[7] For climate change,

---

4 "Energy Statistics 2000", Statistics Finland, Helsinki, 2001.
5 "Energy balances of OECD countries, 1999–2000", OECD/IEA, Paris, 2002.
6 "Key World Energy Statistics from the IEA: 2002 edition", OECD/IEA, Paris, 2002.
7 http://www.vyh.fi/eng/environ/sustdev/indicat/inds2000.htm

three indicators were defined and are now monitored: total GHGs, Finland's average temperature and the ice break-up date of the river Tornio.

16. The UNFCCC objective of GHG stabilization at the 1990 level by the year 2000 has been a factor in the **climate-related policies** of Finland. Monitoring of national GHG emissions is based on annual emission reporting to the UNFCCC secretariat and on the monitoring mechanism of the EC.

17. The Kyoto Protocol commits the EC to an 8 per cent reduction in GHG emissions in the first commitment period from 2008 to 2012. Within the EC burden-sharing agreement, Finland made a commitment to stabilize its GHG emissions at the 1990 level in the first commitment period.

II. GREENHOUSE GAS INVENTORY INFORMATION

A. Inventory preparation

18. The NC3 inventory was compiled by the Finnish Environment Institute (SYKE) and Statistics Finland (SF) based on their information and data submissions from the Technical Research Centre of Finland (VTT), MTT Agrifood Research Finland and the Finnish Forest Research Institute (METLA).

19. The NC3 inventory covers the period from 1990 to 1999, and the gases CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NO_X, CO, NMVOC and SO_2. GHG emissions from biomass and international bunkers are presented. The NC3 inventory is more extensive than the one of the NC2 (HFCs, PFCs, SF_6 were not reported in the NC2), is presented in accordance with the UNFCCC reporting guidelines[8] and is consistent with Finland's 2001 inventory submission to the UNFCCC secretariat.

20. Since the NC2, some recalculations of emissions have been done. Fugitive emissions, emissions from agricultural soils and emissions from feedstocks were not reported in NC2, which explains the large difference between the NC2 and the NC3 for CO_2 emissions (see table 2). The change in CO_2 removals through land-use change and forestry (LUCF) reflects updated information on forest increments and cuttings.[9] All emission factors and activity data for CH_4 were reconsidered between the NC2 and the NC3, which led to changes in CH_4 emissions. N_2O emissions changed because an important source, "emissions from agricultural soils" was added.

Table 2. Comparison of 1990 and 1995 emissions between the NC2 and the NC3

	Tg CO_2 equivalent				Change[a] (%)	
	NC2		NC3			
	1990	1995	1990	1995	1990	1995
CO_2	53.8	56.1	62.5	62.7	16.2	11.8
CO_2 removals through LUCF	–31.0	–14.7	–23.8	–14.7	–23.2	0.0
CH_4	246.0	241.0	292.5	221.1	18.9	–8.3
N_2O	18.0	18.0	27.1	25.2	50.6	40.0

[a] The change is calculated as: [(NC3 – NC2)/NC2] x 100.

21. The Finnish inventory experts anticipate further inventory recalculations to remove minor data inconsistencies. For example, emissions for the energy sector from 1992 to 1998 will be recalculated to ensure a uniform allocation of certain fuels within the sub-categories of the energy sector.[10]

---

[8] Document FCCC/CP/1999/7.

[9] In the NC2, the volume increment of the growing stock in 1990 was based on a computational updating of the increment, not on direct measurements. Cutting statistics, growth models and updating of field plot data were used in these calculations. After the Finnish Forest Research Institute began to report the forest inventory data, the data for 1990 were changed to correspond to those of the other years. The NC3 is based on these data.

[10] Such recalculation was also recommended by a UNFCCC expert review team during the review of the Finnish GHG inventory in 2001 (document FCCC/WEB/IRI(1)/2001/FIN).

22. Finland conducted an analysis of key sources and uncertainties for the 1999 inventory using IPCC's tier 1 and (for key sources only) tier 2 methods.[11] Based on this analysis,[12] the uncertainty of the GHG total is estimated as 7 per cent in the NC3. For individual gases, the estimated uncertainty in emission factors varies, depending on the emission source, as 1–20 per cent[13] for CO_2, 10–100 per cent for CH_4 and 20–150 per cent for N_2O. The estimate for HFCs, PFCs and SF_6 is 40 per cent. Neither the NC3 nor the referenced VTT report provides uncertainty estimates averaged by gas or by sector. The review team felt that such aggregated estimates could be helpful for understanding the related uncertainty in the effects of GHG mitigation measures.

B. Overall emission trends

23. Table 3 shows that **Finland succeeded in stabilizing its total GHG emissions** (without LUCF) in the 1990s: the GHG total in 2000 is 4.0 per cent lower than in 1990. This remarkable achievement is in line with the UNFCCC aim (Articles 4.2a and 4.2b) to return GHG emissions to the 1990 level by end of the 1990s. From 1990 to 2000, CO_2 emissions fluctuated between 58 and 68 Tg; CH_4 emissions decreased consistently and considerably. The decrease in N_2O emissions was moderate because the decreasing emissions from agriculture and waste were partially offset by the increasing emissions from fluidized bed combustion and catalytic converters in cars.

Table 3. GHG emissions, by gas, 1990–2000

	Tg CO_2 equivalent											Change[a]
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	(%)
CO_2	62.47	61.07	58.67	59.17	65.47	62.68	68.13	66.84	64.60	64.07	62.31	–0.3
CH_4	6.14	5.78	5.38	4.99	4.66	4.64	4.47	4.28	4.06	3.93	3.93	–36.0
N_2O	8.41	7.91	7.29	7.48	7.59	7.80	7.85	8.07	7.91	7.75	7.18	–14.6
HFCs+PFCs+SF_6	0.072	0.049	0.034	0.027	0.034	0.045	0.093	0.185	0.259	0.378	0.541	651
GHG without LUCF	77.1	74.8	71.4	71.7	77.8	75.2	80.5	79.4	76.8	76.1	74.0	–4.0
CO_2 removals through LUCF	–23.8	–38.2	–31.9	–29.1	–17.3	–14.7	–21.0	–12.6	–9.7	–10.8	–12.0	–49.6
GHG with LUCF	53.3	36.6	39.5	42.6	60.5	60.5	59.5	66.7	67.1	65.3	62.0	16.3

Source: This table uses, in addition to the NC3, 2000 data from the 2002 inventory submission to the UNFCCC.
[a] The change is calculated as: [(2000 – 1990)/1990] x 100.

24. The sum of the emissions of HFCs, PFCs and SF_6 increased almost eight-fold between 1990 and 2000 (see table 4).[14] HFCs increased strongly because of the growth in refrigeration in the commercial sector, stationary and mobile air conditioning, and industrial refrigeration. The introduction of a new PFC-containing refrigerant to the Finnish market resulted in a large increase of PFCs in 1999–2000 (previously PFCs had been used in small quantities in semiconductor manufacturing). Improved manufacturing and maintenance of electric equipment helped decrease SF_6 emissions.

Table 4. Emissions of HFCs, PFCs and SF_6

	Gg CO_2 equivalent										
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
HFCs	0.3	0.3	0.4	0.4	6.8	30.0	78.0	167.9	246.5	316.9	501.6
PFCs	0.5	0.6	0.7	0.8	0.8	0.9	1.1	1.3	0.9	28.6	22.2
SF_6	71.1	47.8	32.5	26.3	26.2	13.9	13.9	16.1	11.8	32.3	16.7
HFCs+PFCs+SF_6	71.9	48.7	33.5	27.4	33.8	44.9	93.0	185.3	259.2	377.8	540.5

[11] Intergovernmental Panel on Climate Change (IPCC). *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, IPCC, 2000.
[12] J. Aaltonen, T. Palosuo, R. Pipatti, "Key source identification in the Finnish 1999 GHG inventory", VTT Energy Reports 34/2001, 2001.
[13] With the exception of the CO_2 emissions from agricultural soils where the estimate is 100 per cent.
[14] The substances that are sources of these emissions are not produced in Finland; they are imported.

C. Key emission sources and sectoral trends

25. Five sources produce about 70 per cent of the total GHG emissions:[15] stationary combustion of liquid (18.7 per cent), solid (18.5 per cent), gaseous (10.4 per cent) and other[16] (10.2 per cent) fuels, and road transport (14.3 per cent). The energy sector is the key contributor to GHG emissions (82 per cent of the total). More than 80 per cent of the GHG emissions are CO_2.

26. Table 5 shows the development of GHG emissions by sectors and subsectors. Reduction of the emissions from waste and agriculture compensated GHG increases in some other sectors. The 18.9 per cent decrease in categories 1.A4 and 1.A5 (combined into A4–5 in table 5) is due to a known inconsistency in the emission time series (the approach that is used to allocate emissions to A4 and A5 changed in 1999 and the data for 1990–1998 need to be recalculated accordingly).

Table 5. GHG emissions by sector and sub–sector

	Tg CO_2 equivalent											Change[a]
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	(%)
1. Energy	59.6	58.8	56.8	57.7	64.1	61.9	67.4	66.3	63.9	63.3	60.8	2.0
A1. Energy industries	18.9	19.5	17.9	20.4	25.2	23.0	28.2	25.3	22.0	21.6	20.2	6.9
A2. Manufacturing industries and construction	14.8	14.3	14.0	13.7	14.5	14.5	14.1	16.1	16.2	16.8	16.5	11.5
A3. Transport	13.2	12.2	12.2	11.6	12.0	11.7	11.7	12.2	13.1	13.5	13.1	–0.8
A4–5. Other	9.09	9.12	9.20	8.42	8.84	9.08	9.86	9.09	9.01	7.74	7.37	–18.9
B. Fugitive emissions	3.57	3.56	3.57	3.58	3.57	3.56	3.56	3.56	3.56	3.55	3.55	–0.6
2. Industrial processes	2.85	2.50	2.23	2.14	2.23	2.29	2.36	2.48	2.52	2.72	2.95	3.5
3. Solvents	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.0
4. Agriculture	10.16	9.32	8.39	8.38	8.21	7.82	7.80	7.97	7.79	7.59	7.70	–24.2
5. LUCF	–23.8	–38.2	–31.9	–29.1	–17.3	–14.7	–21.0	–12.6	–9.7	–10.8	–12.0	–49.6
6. Waste	3.79	3.53	3.24	2.85	2.50	2.43	2.22	2.03	1.84	1.74	1.77	–53.3
7. Other	0.64	0.61	0.61	0.56	0.69	0.70	0.70	0.56	0.72	0.75	0.73	14.1

[a] The change is calculated as: [(2000 – 1990)/1990] x 100.

27. The review team noted the following GHG trends: stabilization of the CO_2 emissions from transport; stabilization of the total CO_2 emissions; a decline in the emissions from agriculture; a decline in the emissions from waste management; and a drop in the size of GHG sinks.

28. ***Stabilization of CO_2 emissions from transport***. The review team considered stabilization of CO_2 emissions from transport as an important success of Finland that was due to economic, technological and policy-related factors.

29. From 1991 to 1993, Finland experienced a severe economic depression. As a result, freight and passenger transport[17] stagnated or decreased, and the GHG emissions from transport in 1993 were about 12 per cent lower than they were in 1990 (see table 5). After 1993, high technology industries with a relatively low transport demand, such as telecommunications, developed faster than the rest of the economy. This might have changed the link between economic and transport growth.

30. CO_2 emissions from new cars (petrol and diesel) decreased from 1993 to 2000 (see table 6). Simultaneously, the proportion of diesel-fuelled cars increased.

[15] Document FCCC/WEB/IRI(1)/2001/FIN.

[16] Peat is the dominant component of the "other" fuels.

[17] In 1999, CO_2 emissions from passenger and freight transport in Finland were 7.5 and 4.7 Tg, respectively.

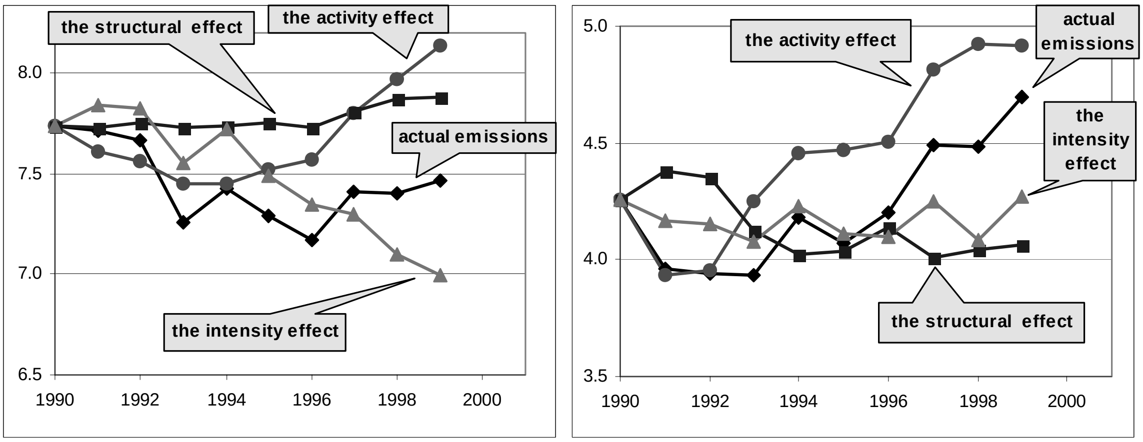
Table 6. Characterization of new passenger cars in Finland

	1993	2000
CO_2 emissions of new petrol cars (g CO_2/km)	194	178
CO_2 emissions of new diesel cars (g CO_2/km)	201	155
Share of new diesel-fuelled cars in the total number of cars (%)	7.8	19.6
Average CO_2 emissions from new cars (g CO_2/km)	195	174
Average CO_2 emissions from new cars (relative to 1993)	100	89.2

Note: This table is based on information provided to the review team by the Ministry of Transport and Communications (MTC) during the country visit.

31. After 1993, economic growth resulted in increasing demand for freight and passenger transport. Figure 3 shows the interaction between the activity effect (growing transportation volumes) and the intensity effect (decreasing emissions per passenger-km or tonne-km). The decline in intensity effect was more pronounced for passenger transport because it included not only improved fuel efficiency of cars but also an increase in the share of diesel-fuelled cars with lower fuel consumption per km driven (freight transport is already completely diesel-fuelled in Finland). Table 7 shows the resulting CO_2 emissions from road transport by component.

Figure 3. CO_2 emissions from passenger (left) and freight (right) transport in Finland (Tg)



Source: M. Kirjavainen, E. Tamminen, “Sectoral analysis of energy consumption and energy related CO_2 emissions in Finland 1990–1999”, MTI reports and papers 2/2002, Helsinki, 2002.

32. The curves for the structural effect in figure 3 reflect the share of road transport in total emissions. The shares of public passenger transport and of rail freight transport remained stable in Finland over the 1990s – about 20 and 25 per cent. This was achieved mainly due to the policy to limit GHG emissions from transport that Finland pursued in the 1990s.

Table 7. CO_2 emissions from road transport

	Tg CO_2		Change[a]
	1990	2000	(%)
Emissions from combustion of petrol	6.20	5.05	–18.5
Emissions from combustion of diesel fuel	4.91	5.59	13.8
Total emissions from road transport	**11.11**	**10.64**	**–4.2**

[a] The change is calculated as: [(2000 – 1990)/1990] x 100.

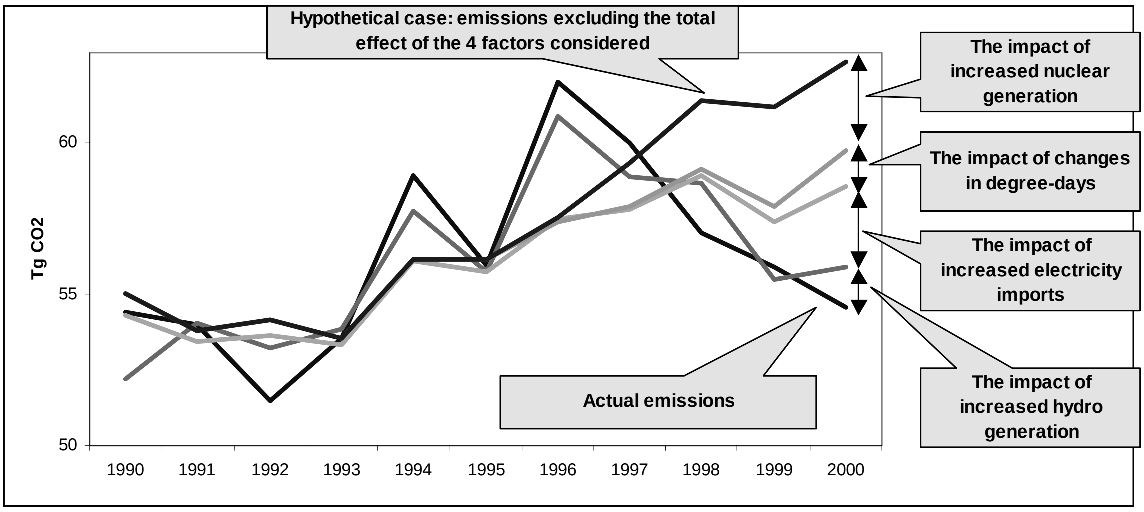
33. The review team was of the opinion that **the Finnish experience demonstrated the need for a combination of technological and policy factors to counterbalance the impact of economic growth**.

Further monitoring of GHG emissions from transport, combined with analysis of the efficiency of policy measures,[18] could help Finland sustain the success of the 1990s.

34. ***Stabilization of the total CO_2 emissions***. Table 3 shows that CO_2 emissions fluctuated considerably during the 1990s and that the 2000 emissions were almost the same as in the 1990 emissions. The sectoral data in table 5 indicate that these fluctuations are due to changes in the emissions from energy production and transformation (these emissions are mostly CO_2).

35. Using a trend analysis, experts from the Ministry of Trade and Industry (MTI) determined that CO_2 emissions in the 1990s were strongly influenced by increased imports of electricity and increased capacity of nuclear units.[19] Figure 4 illustrates this by comparing the impact of four major factors – nuclear generation, heating degree-days, electricity imports and hydro generation – on CO_2 emissions.

Figure 4. Impact of key factors on CO_2 emissions in the 1990s



Note: The curves in the graph are cumulative – each curve adds the effect of one factor to the effects of the previous factors reflected in the lower curves. That is why the top curve shows the cumulative effect of all four factors whereas the separate effects can be seen by comparing the differences between the curves.

36. Electricity consumption in the 1990s increased by almost 30 per cent (see table 1). The increase was met not only by electricity imports and nuclear power, but also by increased use of combustible renewables, mostly biomass (figure 2). Estimates of Finnish experts show that the CO_2 savings achieved through the use of biomass are approximately the same as the savings achieved through electricity imports and increased nuclear generation (figure 4).[20] Progress in energy conservation in the 1990s also helped reduce emissions but its effect is estimated to be smaller than that of the use of biomass.

37. ***Decline in the emissions from agriculture***. Two structural changes in agriculture affected GHG emissions: the promotion of optimized use of fertilizers to protect water resources, and the economically driven reduction of the number of farms and cattle. The decreasing use of fertilizers led to a 21 per cent decrease in the emissions of N_2O (from 1990 to 2000) whereas the decreased cattle numbers resulted in a 13 per cent decrease in CH_4 emissions (mostly from enteric fermentation). CO_2 emissions from

---

[18] The NC3 does not provide quantitative estimates for the effects of separate GHG mitigation measures in transport, although there are estimates for the total effect of such measures.

[19] J. Turkki, "Trend of energy originated CO_2 emissions in the 1990s", presentation in MTI on 1 October 2002.

[20] M. Kirjavainen, E. Tamminen "Sectoral analysis of energy consumption and energy-related CO_2 emissions in Finland 1990–1999", MTI reports and papers 2/2002, Helsinki, 2002.

agricultural soils[21] also reduced considerably, from 3.2 to 2.0 Tg (a 37 per cent decrease),[22] but the uncertainty in these emissions is about 100 per cent.[23]

38. ***Decline in the emissions from waste management***. Table 5 shows that GHG emissions from waste management decreased by more than 50 per cent in the 1990s. The active waste management policy, the 1994 waste law and waste taxation in particular, are the key reasons. CH_4 emissions from landfill sites contributed to the major part of emission reductions: the number of sites decreased drastically and their management improved.

39. The review team noted that Finnish experts were recalculating GHG emissions from waste (to change from the "mass balance model" to the IPCC-recommended "first order decay model"). If the recalculation affects the outlook of the emission trends, they should be re-analysed.

40. ***Drop in the size of GHG sinks***. The stabilization of Finnish GHG emissions in the 1990s relates to GHG emissions without accounting for the LUCF sink. Table 3 shows that the 'net' GHG emissions (the emissions with LUCF) were 16.3 per cent higher in 2000 than they were in 1990, because the drain, affecting also the size of the sinks, fluctuated in the 1990s depending on the situation on the international wood product markets and on the demand for domestic use. However, tree growth increased during the 1990s and the increase seems to continue. Forests in Finland are used in a sustainable way and they remain a substantial GHG sink.

41. The review team commended Finland for the remarkable analyses of emission trends and suggested that such analyses be used in future national communications to the UNFCCC.

III. POLICIES AND MEASURES

42. In general, the NC3 reports policies and measures in compliance with the UNFCCC guidelines. This chapter improved considerably in comparison with the NC2 because of the completion of the National Climate Strategy (NCS) that contains a comprehensive set of policies and measures for GHG mitigation. The policies and measures presented in the NC3 are based on the NCS.

43. The review team noted only a few deviations from the guidelines. For example, the NC3 does not evaluate the mitigation effect of past (from 1990 to 2000) measures, the reason being that a "no measures" scenario was not available. The review team was of the opinion that understanding of the efficiency of the already implemented measures can help to identify the most efficient measures for the future.

44. Since Finland's entry to the EC in 1995, the policy-making process in Finland has been closely linked to that of the EC. For some issues, such as implementation of emission trading or harmonization of energy taxation, a common EC position is a prerequisite for action at the national level.

45. Climate-related policies are implemented by relevant ministries and agencies. The Ministry of Environment (MoE) is responsible for a large part of environmental issues, including reporting to the UNFCCC secretariat. The Ministry of Trade and Industry (MTI), the Ministry of Transport and Communications (MTC), the Ministry of Agriculture and Forestry (MAF), the Ministry for Foreign Affairs (MFA) and the Ministry of Finance (MF) are responsible for climate-related issues within their

---

21 Agricultural soils is one of the key sources of GHG emissions in Finland; CO_2 from agricultural soils accounted for 4.2 per cent of the total GHG emissions in 1990 and 2.8 per cent in 2000.

22 R. Pipatti, "Greenhouse gas emissions and removals in Finland", VTT Research Notes 2094, VTT, 2001.

23 J. Aaltonen, T. Palosuo, R. Pipatti, "Key source identification in the Finnish 1999 GHG inventory", VTT Energy Reports 34/2001, 2001.

administrative domains. Non-governmental stakeholders (regional and municipal administrations, business and environmental NGOs) are included into the decision-making process through public discussions and consultative mechanisms, such as the National Climate Commission.

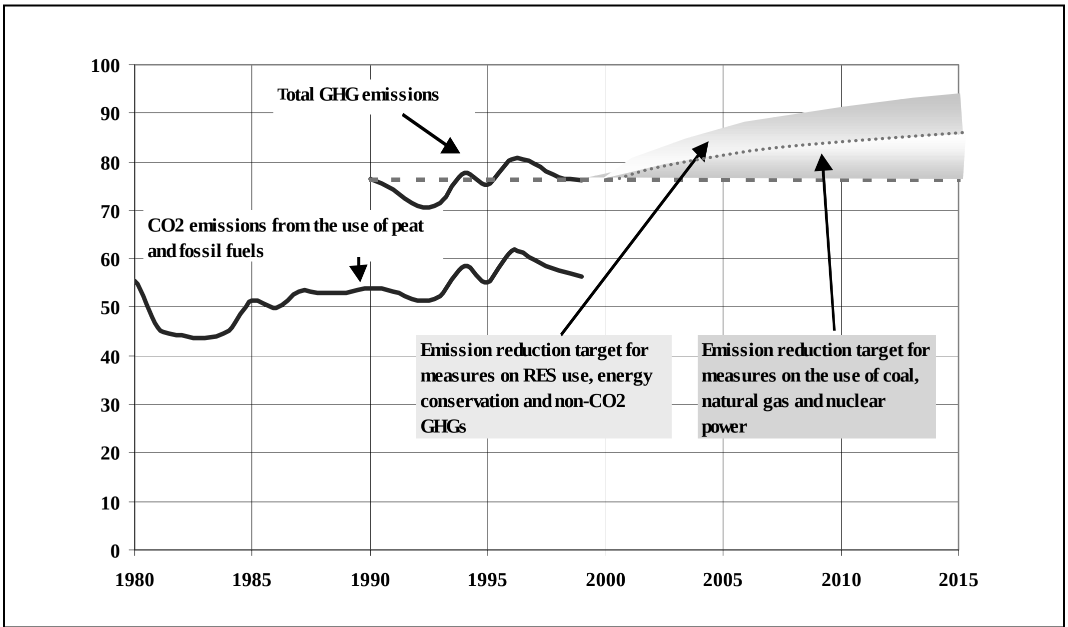
A. National Climate Strategy

46. The Finnish Government launched the preparation of the NCS, coordinated by the MTI, in 1999 in order to identify means for meeting the target of the Kyoto Protocol. The Kyoto Ministerial Working Group provided policy direction and overall guidance. MTI, MTC, MAF and ME prepared their sectoral reports that were then compiled in a comprehensive background report for the NCS. A large “Kyoto contact network”, composed of civil servants from ministries and research institutes, assisted in this process. Interaction with national stakeholders was organized through seminars on sectoral reports, presentations of the NCS scenarios, dissemination of information through the Internet, and inclusion of representatives of NGOs in the working groups. The NCS was adopted by the government on 15 March 2001, and then considered and supported by the parliament on 19 June 2001.

47. The NCS considers two scenarios. The reference (or “with measures”) scenario is based on the policies enacted before the publication of the NCS. The “with additional measures” scenario assumes strengthening of the current GHG mitigation measures with two options: increased use of natural gas and increased use of nuclear power.

48. The NCS concluded (see figure 5) that without additional policies and measures GHG emissions would increase from 76 Tg CO_2 equivalent in 1990 to about 90 Tg in 2010. The required GHG reduction to the 1990 level (the Kyoto target) is therefore about 14 Tg CO_2 equivalent. Table 8 shows the planned distribution of GHG reductions by sector and by policy instrument. About 50 per cent of the reductions should be reached in electricity supply. Efficient use of energy and development of renewable energy sources are to provide, in almost equal proportion, the remaining reductions.

Figure 5. GHG trends and the two scenarios of the NC3 (Tg CO_2 equivalent)



49. The review team was impressed by the process of the NCS preparation and by the comprehensiveness of the NCS. The programme targets are demanding and considerable efforts seem to be required for the NCS to succeed. Therefore, the review team emphasized that close monitoring of the

NCS is important if it is to reach the targets. The MTI appointed a committee in November 2001 to develop proposals for NCS monitoring; these proposals will be submitted to a new government in 2003.

Table 8. Estimated effects of GHG mitigation measures in the NCS

Targeted sector or gas	Estimated GHG emission reductions[a]	Policy instrument	Estimated GHG emission reductions[a]
Energy conservation	3–4	Subsidies and norms	3
Renewable sources of energy	4–5	Energy taxation	2
Non-CO_2 greenhouse gases	about 1	Support (legislative and political) to changes	
Electricity supply	6–10	in the structure of electricity supply	9
Total	**14**		**14**

Note: This table uses information obtained during the review visit to Helsinki.
[a] The estimated emission reductions are the reductions in annual GHG emissions in comparison with the reference scenario of the NCS; these estimates are expressed in Tg CO_2 equivalent per year estimated for the year 2010.

B. Other cross-sectoral policies and measures

50. The Energy Strategy of 1997 defined a policy framework for energy supply with emphasis on supply security, efficient use of energy and renewable energy sources. The Environmental Protection Act (2000) includes provisions of the EC Directive on Integrated Pollution Prevention and Control (IPPC). The Land Use and Building Act (2000) reinforced efficient land use and urban planning.

51. Finland supports research and development (R&D) in energy technology. Two organizations play a key role: MOTIVA – a non-profit company with the mission to implement the Energy Conservation Programme and to promote renewable energy sources; and TEKES (the National Technology Centre) – a centre through which governmental funding for applied and industrial energy research is managed. Most R&D deals with energy efficiency and renewable energy sources.

52. The sectoral analysis of policies and measures below is structured as follows: the energy sector,[24] transport, industry, agriculture, forestry, and waste management.

C. Energy

53. The main policies and measures in energy supply, transformation and use are shown in table 9.

54. ***Policies and measures in electricity supply***. In 2000, electricity and heat production accounted for about 27 per cent of the total GHG emissions. The largest part of emission reductions in the 1990s was achieved in this sector, through either increased electricity imports, or increased nuclear capacity, or increased use of biomass (see figure 2 and table 9). In accordance with the “with additional measures” scenario of the NCS, 6 to 10 Mt CO_2 should be further saved in electricity supply by the year 2010 by increasing the use of gas, or by building additional nuclear capacity, or by both.

55. In 2002, the Finnish Government and the parliament made a positive “decision-in-principle” for the construction of a fifth nuclear power unit of 1300 MW(e). The power utility is expected to apply for a construction permit in 2005. The unit could be commissioned in 2009.[25] When approving the “decision-in-principle”, the parliament also passed statements on measures restricting the use of coal, more efficient means of energy conservation and promotion of renewable energy.

[24] In accordance with the UNFCCC guidelines, this includes energy production and transformation as well as energy use in residential, commercial and public buildings; transport is excluded.
[25] Commissioning the unit by 2009 appeared to the review team to be a challenging task.

Table 9. Key policies and measures in the energy sector

Implemented policy or measure	Estimated GHG reductions in the past[a] (Tg CO_2 equivalent[b])	Additional policy or measure (adopted)	Estimated GHG reductions in the future (Tg CO_2 equivalent[c])
Electricity Market Act	not estimated	Revision of the energy conservation programme	3–4
Energy taxation	not estimated		
Energy conservation programme	1.0 (for 2000)		
Voluntary agreements	not estimated	Revised action plan for renewable energy	4–5
Promotion of renewable energy, including the use of wood	5–8.3 (for 1999)		
Land Use and Building Act (1999)	not estimated		
Electricity supply: imports of electricity and upgrades of nuclear units	5.4 (for 1999)	Electricity supply: new generation capacity (nuclear or gas or both)	6–10

[a] Effects of the policies and measures implemented in the past are not presented in the NC3. This column is based on the analysis in M. Kirjavainen, E. Tamminen "Sectoral analysis of energy consumption and energy-related CO_2 emissions in Finland 1990–1999", MTI reports and papers 2/2002, Helsinki, 2002.

[b] The reductions in the past are expressed in Tg CO_2 equivalent per year estimated for 1999 or 2000.

[c] The reductions for the future are expressed in Tg CO_2 equivalent per year estimated for the year 2010. The reductions are in comparison with the reference scenario of the NCS.

56. ***Introduction of the electricity market***. The electricity market in Finland operates as a part of the regional Nordic market (composed of Norway, Sweden, Denmark and Finland). The Electricity Market Act came in force on 1 June 1995; amendments were introduced in 1998 and 1999. All customers (including households) have been able to change their supplier since November 1998. Market liberalization resulted in a decrease in electricity prices.

57. The consumers are able to select electricity produced from renewable energy sources ("green" electricity) at a higher price. A recent study showed that 46 per cent of the consumers were willing to pay an additional 0.04 Euro (€) per kWh for "green" electricity. However, in reality only a fraction of the "green" electricity is sold at premium prices.

58. The NC3 does not estimate the impact of power sector liberalization on GHG emissions. The liberalized market may have helped increase imports of electricity to Finland but decreasing electricity prices may have acted as an incentive to use more electricity.

59. ***Energy taxation***. Finland introduced a CO_2 tax in 1990; it was the first country to implement such an instrument. After several changes (including those prompted by entry to the EC in 1995), a CO_2 tax of about €17.2 per tonne CO_2 is at present levied on transport and heating fuels. In addition, there is an energy tax (specific for each fuel) and a 'differentiated' electricity tax (for industry the tax is €4.2 per MWh and for the other consumers €6.9 per MWh). Renewable sources of energy, peat and small CHPs get a tax subsidy equal to the electricity tax (a tax exemption). Energy intensive industries are entitled, under certain conditions, to tax refunds to avoid a loss in international competitiveness. The energy tax will increase by 5.2 per cent in 2003.

60. Fiscal instruments are one of the pillars of the Finnish energy and climate strategies. The total amount of environment-related taxes was about €5 billion in 1999 (about 2 per cent of the Finnish GDP). The taxes relating to the main sources of GHGs (energy uses and transport) doubled between 1990 and 2000 to reach about €4 billion in 2000, mostly due to taxes on motor fuels and vehicle-related taxation, the share of which in the total amount of environment-related taxes is about 80 per cent.

61. The review team understood that environmental taxes supported the development of renewable sources of energy. The high level of energy taxation in Finland also seems to have led to efficient control of energy consumption. But the team noted that the impact of taxation on GHG emissions was not quantified in the NC3. The team was of the opinion that a study of such impact could provide useful information for future decision-making.

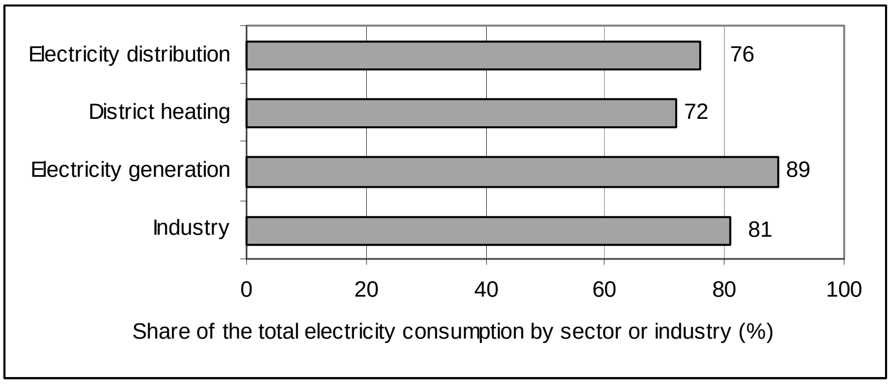
62. ***The Energy Conservation Programme***. Energy conservation measures in the NCS are expected to save 3–4 Tg CO_2 per year by 2010. These measures are based on the Energy Conservation Programme revised in 2000. A draft Act on Energy Conservation should be ready for the parliament in summer 2003. This act will endorse the measures proposed in the NCS.

63. The impact of the 1995 energy conservation programme was estimated to be about 1 Tg CO_2 avoided per year.[26] Support of energy saving renovation of buildings helped stabilize energy consumption in residential and tertiary sectors, notwithstanding the increasing demand for heating.

64. The review team was impressed by the results achieved and also noted the permanent reporting process to monitor progress and cost-effectiveness of energy saving measures. The team noticed that the NCS plans to achieve GHG reductions of 3–4 Tg CO_2 per year by 2010 whereas only about 1 Tg CO_2 per year was achieved in the 1990s. Accordingly, Finnish experts identified a need for increased funding: €60–90 million per year from 2002 to 2010 compared to €45 million in 1999.

65. ***Voluntary agreements***. Figure 6 shows that many energy consumers participate in various voluntary agreements. The agreements are usually concluded between the government and the concerned organization. The agreed targets vary but usually they relate to efficiency improvements, change in technological processes or promotion of products that meet certain requirements. In total, the agreements cover about 56 per cent of the national energy consumption. From 1997 to 2001, the funding of agreements (managed through the MTI and coordinated by MOTIVA) grew from €1 million to €2.8 million. Based on a mid-term evaluation in 2001, it is planned to continue the current agreements until 2005. MOTIVA experts estimate that the implemented voluntary agreements resulted in a saving of about 3 TWh of total energy (0.5 TWh in electricity and 2.5 TWh in heat and fuels) in 2001. This is roughly equivalent to 0.5 Tg CO_2.[27]

Figure 6. Participation in voluntary agreements in Finland



Note: The percentages are ratios of energy consumption of the participants of voluntary agreements to the national total for the respective industry.

66. ***Action plan for renewable energy***. An Action Plan for enhancing the use of renewable sources of energy was approved in 1999 and integrated in the NCS. This plan sets more ambitious targets than the Energy Strategy of 1997: renewable energy sources should contribute 27 per cent to primary energy

[26] M. Kirjavainen, E. Tamminen "Sectoral analysis of energy consumption and energy-related CO2 emissions in Finland 1990-1999", MTI reports and papers 2/2002, Helsinki, 2002.

[27] Calculated by using the average emission factor in Finland of 178 g CO_2/kWh as in M. Kirjavainen, E. Tamminen "Sectoral analysis of energy consumption and energy-related CO_2 emissions in Finland 1990–1999", MTI reports and papers 2/2002, Helsinki, 2002.

consumption and 31 per cent to electricity production by the year 2010. The Action Plan should save 4 to 5 Tg CO_2 per year in 2010.

67. The European Directive 2001/77/EC on promotion of electricity from renewable energy sources sets an indicative target for Finland of producing 31.5 per cent of the total electricity consumption (defined as production plus imports minus exports) from renewable energy sources by 2010. The present share is about 29 per cent (in 2000).[28] Development of CHPs using biomass (6.2 TWh), of wind power (1.1 TWh), solar power (0.05 TWh) and of hydropower (1.0 TWh) is expected to increase the production of renewable electricity by 8.35 TWh in 2010 (from 23.6 TWh in 2000).

68. The key instruments used are investment grants, taxation, subsidies and research. The review team noted that the combination of investment subsidies and tax reductions seemed effective. The total amount of energy subsidies in 2000 was about €22 million, of which 85 per cent were used to support renewable energies, especially the use of wood. Tax rebates amount to €40 million per year.

69. The review team pointed out the Finland might encounter problems with meeting the target for wind energy, which is set at 500 MW(e) of capacity in 2010. In 2000, only 38 MW(e) were installed. Insufficiency of funding support may have been one of the reasons, along with relatively low wind availability and organizational obstacles in obtaining licenses for wind energy installations.

70. Peat is considered as a slowly renewable resource in Finland. The Finnish Government subsidizes the use of peat for several reasons: historical and social considerations, technical reasons (benefits of combined combustion of wood and peat) and security of energy supply. Support for peat has declined lately while support for biomass and wind energy has increased.

D. Transport

71. The following GHG mitigation measures in transport have been implemented in Finland in the 1990s: a voluntary agreement with car manufacturers,[29] differentiation of vehicle taxation,[30] promotion of public and non-motorized transport, voluntary energy saving agreements, promotion of eco-driving, and transport and land-use planning. The individual GHG reductions from these measures are not given in the NC3 but there is an estimate for their combined effect in the future: between 1.4 and 3.7 Tg CO_2 equivalent per year in the period 2000–2020.

72. The additional measures in the NC3 are increased promotion of public transport, increase of fuel taxation, broader energy saving agreements and additional efforts to maintain urban structures. These measures are only under consideration; it is not clear if and when they would be implemented. Similarly to the implemented measures, the NC3 does not estimate individual GHG reductions from these measures but provides an estimate for the total effect: a saving of about 0.3 Tg CO_2 equivalent per year by 2010. The review team remarked that estimates of separate effects, for both implemented and additional measures, would make the estimate for the total more transparent.

---

[28] Calculated using the following data for the year 2000 (taken from IEA energy statistics): the total electricity supply (including electricity imports) is 82.2 TWh; electricity generation by renewables is composed of hydro generation (14.66 TWh), electricity from non-combustible renewables (0.078 TWh) and electricity from combustible renewables, mostly biomass (8.881 TWh).

[29] Signed in 1998 between the EC and the European Automobile Manufacturers Association (ACEA).

[30] This measure, which is to modify vehicle taxation to encourage purchase of energy-efficient cars, was not yet implemented at the time of the review visit, although it is included in the “with measures” scenario of the NCS. Negotiation at the European level is required to ensure that the measure would not distort competition.

73. The transport policy of Finland integrates promotion of public transport, high fuel and vehicle taxation, efforts in urban and regional transport planning, promotion of eco-driving, support to logistical optimization of freight transport and voluntary agreements with transport companies. As an important result of policy efforts, combined with technological and economic developments, **Finland succeeded in stabilizing emissions from transport at the 1990 level by the year 2000**.

74. The MTC adopted an environmental management programme in 1994. The "Environmental Guidelines for the Transport Sector", issued in 1999, set the objective of stabilizing CO_2 emissions from transport at the 1990 level by 2010. For the longer term, the MTC published (2000) a strategic programme "Towards a sustainable and intelligent transport sector". The programme outlines a vision of a sustainable transport system where the demand for road transport, both passenger and freight, would decrease after 2020.

75. Finland uses the European TERM methodology on "Transport and the Environment" to follow up progress in the transport sector. The review team pointed out that such indicators might help assess the impact of mitigation measures on CO_2 emissions.

E. Industry

76. GHG emissions from industrial processes fluctuated during the 1990s (see table 5). The most significant change was an eight-fold increase in the emissions of HFCs, PHCs and SF_6. This increase was offset by a decrease in N_2O emissions that followed a decrease in nitric acid production.

77. The NC3 did not present measures to mitigate the industrial N_2O emissions (these emissions account for about 18 per cent of the total N_2O emissions). In the "with additional measures" scenario of the NCS N_2O emissions from industries are assumed to decrease by 0.7 Tg CO_2 equivalent per year by 2010. Finnish experts clarified that this reflects the introduction of new, catalytic methods of nitric acid production, based on decomposing N_2O to N_2 and O_2 with a catalyst. Use of these methods is not included into the "with measures" scenario because the cost of catalytic technologies is relatively high at present.

78. Emissions of HFCs, PFCs and SF_6 are expected to reach 1.7 Tg CO_2 equivalent in 2010. At present, there are no measures in force targeting these emissions. A recent SYKE study showed that limiting leaks would be the most cost-effective measure. The promotion of containment by modifying the regulations and supporting taxation of refrigerants was suggested as a second-step measure.

F. Agriculture

79. During the 1990s, the number of active farms in Finland decreased from 130,000 to 80,000, while the average size of a farm increased from 17 to 30 hectares. The total cattle numbers gradually decreased. These changes resulted from general economic factors (low prices for agricultural products) and, since 1995, from the effect of EC's common agricultural policy.

80. In 1992, Finland enhanced the role of environmental considerations in its agricultural policy with emphasis on protecting water resources from excessive use of fertilizers. After Finland's entry to the EC in 1995, this policy was strengthened through the agri-environmental programme implemented from 1995 to 1999 that aimed to rationalize the use of nitrogen and phosphorus fertilizers.

81. As a result of these factors, GHG emissions from agriculture declined from 10.2 Tg CO_2 equivalent in 1990 to 7.7 Tg in 2000, although there was no special GHG mitigation policy. Further decline in GHG emissions is expected due to the continuation of the agri-environmental programme, although at a smaller rate than in the 1990s.

G. Forestry

82. The forest sector contributes about 8 per cent to Finland's GDP and about 26 per cent to its export revenues. Therefore, the forest policy is influenced by both economic and environmental considerations.

83. The National Forest Programme (1998) is the core element of the forest policy. Forest legislation and its enforcement have guaranteed for more than 100 years that the total annual increment of the growing stock has been higher than the annual drain. About 95 per cent of all forests in Finland are certified according to the Finnish Forest Certification System, established in 1999, which forms a standard for sustainable forest management.

84. The National Forestry Plan sets a roundwood removal target of 63–68 Mm^3 per year to stabilize the forest increment. The Finnish forests are projected to remain a net carbon sink of between 3 and 10 Tg CO_2 in 2010. The NCS does not consider carbon sinks (because the approach to sinks was still under negotiation at the time of NCS preparation), but Finland already started assessing the role of sinks in the context of the Kyoto Protocol. The review team supported this effort.

H. Waste management

85. CH_4 emissions from landfill sites decreased by more than 50 per cent during the 1990s, mainly due to the implementation of a new waste law in Finland (1994). The law endorsed minimization of waste generation, recycling and reuse of waste material, and treatment methods alternative to landfilling. As a result, the number of active landfill sites decreased from a thousand in 1990 to about 300 in 1999. The development in the treatment of industrial waste and municipal and industrial sludge was similar.

86. Landfill gas recovery was negligible at the beginning of the 1990s, but is increasing rapidly – to about 3 Gg CH_4 in 1995 and almost 9 Gg CH_4 in 1999.

87. Waste taxation contributes to the policy of waste minimization. The present tax of €15.1 per tonne of landfilled waste will increase to €25 in 2003 and €30 in 2005.[31] This measure along with others from the "with additional measures" scenario is estimated to save about 0.8 Tg CO_2 equivalent per year by 2010.

IV. PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES

88. The presentation of projections in the NC3 follows the UNFCCC guidelines. Two scenarios are presented: "with measures" and "with additional measures". The "with measures" scenario is based on sectoral analyses for the NCS. The "with additional measures" scenario was prepared with the EFOM model applied by VTT experts. EFOM is an optimization program based on the technique of linear programming.[32] It was used to make a consistent transition from the "with measures" scenario to a Kyoto-compliant "with additional measures" scenario. Projections of useful energy demand, coming from sectoral analysis, were input data to EFOM. To evaluate macro-economic effects of additional measures, two macro-economic models were applied using EFOM results as input.

89. The base year for modelling was 1999. The NC3 provides emission estimates for 2005, 2010 and, for the "with measures" scenario only, 2020. Emissions of CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NO_X,

---

[31] The tax applies to public landfills, but not to the landfills owned by industry. Thus, the tax covers all municipal waste, but it extends to industrial waste only if this waste is transported to public landfills, which occurs only in relatively small amounts.

[32] Voort, E. van der, Donni, E., Thonet, C., Bois D'Enghien, E., Dechamps, C. and Guilmot, J-F. "Energy Supply Modelling Package EFOM-12C MarkI, Mathematical Description", Louvain-la-Neuve, Belgium, 1984.

SO_2 and particulates are projected. Each gas is projected individually; the results are presented by gas and by sector. A projection of emissions from international bunker fuels is provided.

A. Scenario definitions and key assumptions

90. The "with measures" scenario incorporates the GHG-related policies and measures that had been implemented or adopted by the time of the approval of the NCS (2001).[33] In that sense, it may be understood as a "business-as-usual" or a "reference" scenario. The "with additional measures" scenario incorporates additional (not yet implemented) measures that were defined in the NCS. The initial version of the two scenarios, presented in the NCS, was updated for the NC3 with a revision of agricultural emissions and the addition of HFCs, PCFs and SF_6.

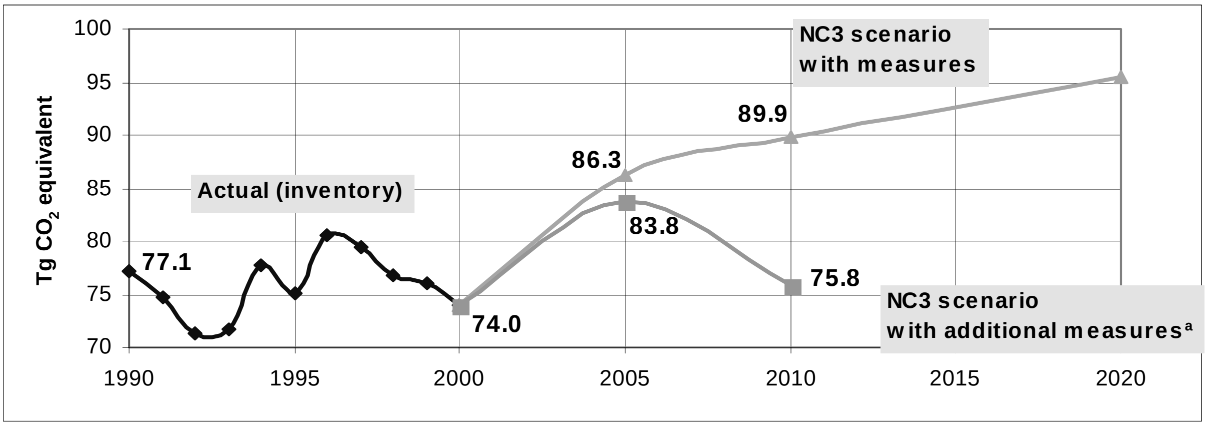
91. The two scenarios differ only in the number and extent of GHG mitigation measures. Most of the other assumptions are common. GDP growth is assumed as 3 per cent per year in 2000–2005 and about 2 per cent per year in 2005–2020. Electricity imports from the Nordic market are assumed to drop from 12 TWh in 1999 to 6 TWh per year from 2005 to 2020.

92. The "with additional measures" scenario is sub-divided into two cases: KIO1 and KIO2. The KIO1 case assumes the replacement of coal-based generation with new gas-fired plants and the KIO2 case assumes the construction of a new, fifth nuclear unit with a capacity of 1300 MW(e).

B. Projected emission trends

93. Figure 7 and table 10 show that **without additional measures GHG emissions in Finland in 2010 would be about 17 per cent above the 1990 level (**about 13 Tg CO_2 equivalent[34]**). The additional measures allow bringing the GHG total in 2010 to 75.8 Tg (1.7 per cent below the 1990 level).**

Figure 7. Actual GHG emissions and GHG projections from the NC3



[a] The line for the scenario "with additional measures" is for the KIO1 case (as given in the NC3). The trend for the KIO2 case is similar.

[33] There is one exception: one measure, differentiation of vehicle taxation, was not yet implemented at the time of the review visit (October 2002), although it is included in the "with measures" scenario.

[34] This number differs from the 14 Tg CO_2 equivalent given in the NCS because the GHG emissions of 1990 assumed in NCS (76.5 Tg CO_2 equivalent) were recently recalculated to 77.1 Tg.

Table 10. Projected GHG emissions by gas

	Tg CO_2 equivalent		
Gas	**1990**	**2010 "with measures"**	**2010 "with additional measures"**
CO_2	62.5	76.4	64.7
CH_4	6.1	3.5	2.8
N_2O	8.4	8.3	7.4
$HFC+PFC+SF_6$	0.07	1.7	0.9
GHG total	**77.1**	**89.9**	**75.8**

C. Effects of policies and measures

94. As the NC3 projections are very close to the projections of NCS, the overall effect of policies and measures is the same as shown in table 8. The sectoral effects are also similar (table 11); the major part of the GHG reductions is to be achieved in the energy sector.

Table 11. Mitigation effect[a] of additional policies and measures

	Tg CO_2 equivalent	
	2005	**2010**
Energy (excluding transport)	1.7	11.0
Transport	0.1	0.2
Industrial processes	0.6	1.9
Agriculture	0.0	0.1
Waste	0.0	0.8
Total	**2.4**	**14.0**

[a] The mitigation effect is the difference in annual GHG emissions between the scenario "with measures" and the scenario "with additional measures".

95. Finland used sophisticated modelling to evaluate macro-economic impacts of the additional GHG mitigation measures. Two macro-economic models were used: a KESSU model (applied by VATT – the Government Institute for Economic Research) and an EV model supported by the Research Institute of the Finnish Economy (ETLA).

96. Three qualitative findings, confirmed by both models, are of particular importance: implementation of additional GHG mitigation measures will result in some economic losses; the negative effects are smaller for the nuclear alternative than for the gas alternative in the "with additional measures" scenario; and use of international flexibility mechanisms may decrease economic costs of GHG mitigation. For example, it is projected for 2010 that GDP in the scenario "with additional measures" is lower that in the "with measures" scenario by 0.3–0.6 per cent; that the consumption of households decreases by 0.6–0.9 per cent; and that employment decreases by 6,000 to 11,000 man-years.[35]

97. The review team was impressed by the comprehensiveness of macro-economic modelling and noted that other countries might consider using such analysis.

D. Overall evaluation of the projections

98. The review team concluded that projections in the NC3 are considerably better than those in the NC2. The modelling methodology is more comprehensive and better presented. The projections are built on solid assumptions incorporating results of discussions among governmental decision makers and national stakeholders. The results are transparent, consistent with major assumptions (such as GDP, energy prices, technological development) and credible. Analysis of macro-economic impacts of GHG

[35] These examples are taken from the results of one model, KESSU, as reported in A. Perrels, H. Kemppi, A. Lehtilä "Assessment of the macro-economic effects of domestic climate policies for Finland", VATT Research Reports 82, Helsinki, 2001. Results of the EV model of ETLA are similar.

mitigation is a remarkable achievement. The projections supported national decision-making on climate policy.

99. The review team identified a few areas where further improvement appeared possible: modelling of additional measures for GHG mitigation, presentation of assumptions for energy demand projections, presentation of the results of sensitivity analysis, evaluation of impacts of the Kyoto flexibility mechanisms, and comparison with earlier projections (from the NC1 and the NC2).

100. ***Modelling of additional measures for GHG mitigation***. The review team noted that the NC3 did not present information on how the distribution of mitigation effects within the energy sector was determined (distribution of the mitigation effects among energy conservation, renewable energy sources, and power generation from gas or nuclear energy). The team understood that these effects were sectoral estimates prepared by relevant organizations. The EFOM model was apparently used mainly to check that the estimates were coherent and led to the required total reduction. Therefore, the model was not used to determine the most cost-efficient combination of GHG mitigation measures. Such analysis is possible with EFOM and it could provide useful information.

101. ***Presentation of assumptions for energy demand projections***. The EFOM model uses, as input, projections of demands for lighting, space and water heating, individual mobility, freight transport, and some others. The NC3 does not provide information on the assumptions used for such parameters. The review team understood that the assumptions were determined within the sectoral analyses in support of the NCS. Some information was provided to the team during the country visit, for example, on electricity demand. However, the team still felt that relevant assumptions for electrical and non-electrical categories of useful energy demand could be presented for the projections to be fully transparent. This might be especially important if there is competition between supply options, such as the use of electricity, gas or district heat for space and water heating.

102. ***Presentation of the results of the sensitivity analysis***. The NC3 refers to a sensitivity analysis conducted by Finnish experts but does not show quantitative results of this analysis. The review team noted that such results could help the reader understand the projections better. In particular, the sensitivity of GHG emissions to growth rates in energy-intensive industries could be shown.

103. ***Evaluation of impacts of the Kyoto flexibility mechanisms***. At the time of the preparation of the projections, international negotiations on the role of the Kyoto mechanisms were not yet completed. Accordingly, the NC3 projections do not consider such mechanisms. The Kyoto mechanisms are now agreed, so it is possible to investigate their role for meeting national Kyoto targets. Finnish experts have already carried out some preliminary work in this direction,[36] and that work could be developed further.

104. ***Comparison with earlier projections (from the NC1 and the NC2)***. The UNFCCC guidelines require that comparison with the previous projections be made and differences be reported.[37] The NC3 provided a comparison with GHG projections from the NC1 (of 1995) but not a comparison with the latest projections, those of the NC2 (1997).

105. Comparison with the NC1 indicates that the NC1 baseline projection largely overestimated CO_2 emissions in the late 1990s, mostly because of overestimating the amount of national coal-based electricity generation. The actual developments that led to a considerably less coal-based electricity generation were not foreseen (increased electricity imports, increased nuclear capacity, fast development of biomass-based generation, efforts in energy conservation).

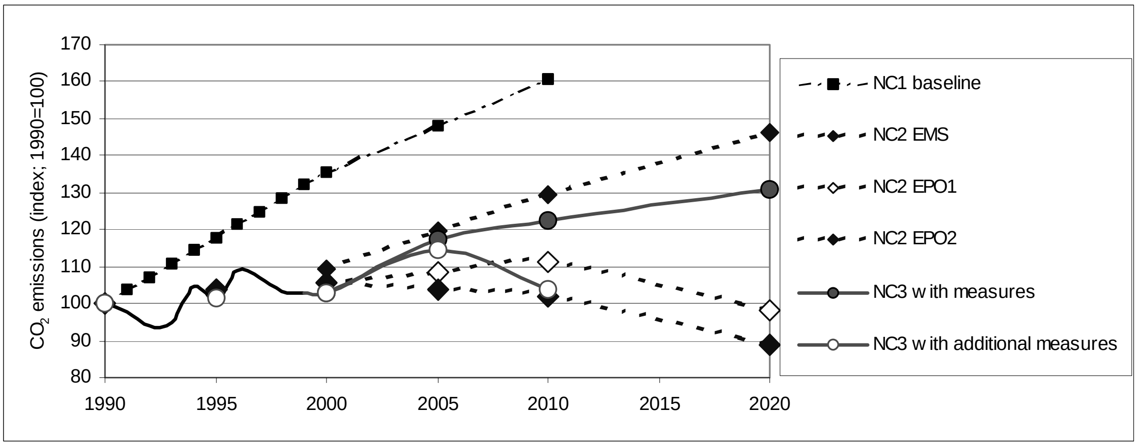
---

[36] A. Perrels, H. Kemppi, A. Lehtilä "Assessment of the macro-economic effects of domestic climate policies for Finland", VATT Research Reports 82, Helsinki, 2001.

[37] See paragraph 45 on page 90 in document FCCC/CP/1999/7.

106. The review team tried to compare the energy-related CO_2 emissions from the NC1, NC2 and NC3 projections (see figure 8). However, the limited information on projections in the NC2 made it impossible to explain satisfactorily the differences between the NC2 and the NC3 projections. The review team commented that analysis of changes from one set of projections to another could be beneficial for the quality of the projections.

Figure 8. Comparison of the projections of energy-related CO_2 emissions (relative to 1990) from the NC1, the NC2 and the NC3



V. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

107. NC3 reports the issues of climate change vulnerability and adaptation in accordance with the UNFCCC guidelines. Information already reported in the NC2 is used together with new results. Most studies are conducted within national programmes with governmental support.

108. The Finnish Global Change Research Programme (FIGARE), within its project "Developing consistent global change scenarios for Finland" (FINSKEN), estimated that the average annual temperature in Finland might increase by 2°C by 2040 and by 4.8°C by 2100. Precipitation could increase by 17 per cent by 2100.

109. For Finland, the most relevant climate change impacts are those on agriculture, forestry, peatlands, inland waters, and the level of the Baltic Sea. In agriculture, a change in the variety of cultivated crops may be required. For forestry, pine and spruce would move to tundra in the north; in the south, deciduous trees would advance. Annual growth of trees may increase by about one-third in a few decades due to higher CO_2 content, increased temperature and longer growing seasons. Slight increases in CO_2 sequestration and in CH_4 emissions are projected for peatlands.

110. Shorter winters with less snow and higher variability of precipitation are key factors for inland waters. A small positive effect on water availability for hydropower is possible but increased variability of precipitation may require enhancing dam protection from floods. The habitat of warm-water fish would expand and that of cold-water fish might shrink. The amount of ice in Bothnian Bay would decrease, making winter navigation easier. The sea level would rise but the still continuing natural uplifting of coastal land in Finland should offset it.

111. The NC3 reports only rough estimates of some socio-economic impacts of climate change, such as some increase in revenues from forestry (because of increased wood growth). Studies within the current FIGARE project are expected to bring about more accurate estimates. In comparison with the NC2, the NC3 provides little additional information on adaptation measures. No such measures have

been implemented. The review team understood that this was mainly due to the fact that many impacts appear to be either positive, or insignificant, or too uncertain.

112. Finland provides support to developing countries in assessments of climate change vulnerability and adaptation. About 30 per cent of the climate-related bilateral and regional aid from 1997 to 1999 is classified as relevant to adaptation. An example is a three-year (2001–2003) project “Preparedness to climate variability and global change in small island developing states, Caribbean region”. In this project, the national meteorological services of small Caribbean states are strengthened by new instrument systems and education. These states are vulnerable to tropical storms, which are estimated to intensify in the future. Therefore, the project is considered to enhance adaptation to climate change.

VI. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

113. This chapter of the NC3 corresponds to the UNFCCC guidelines and is more extensive than the one in the NC2. The MFA administers about 75 per cent of Finnish development assistance, the rest being administered by other ministries and by the Finnish Fund for Industrial Cooperation.

114. According to the “Decision-in-principle on Finland's development cooperation" taken by the government in 1996, the goals of Finnish development cooperation are alleviation of widespread poverty, prevention of global environmental threats and promotion of equality, democracy and human rights. In 1998, the need to increase global security and economic interaction was emphasized.

115. Official Development Assistance (ODA) declined in the 1990s from 0.5–0.8 per cent of the Gross National Product (GNP) to about 0.3 per cent.[38] The reason was severe economic recession in the early 1990s. The government is committed to allocating at least 0.34 per cent of GNP to ODA, aiming, as far as the economic situation allows, to reach the 0.7 per cent recommended by the United Nations.

116. Finland contributed US$ 18.3 million to the Global Environment Facility (GEF) between 1997 and 2000, as new and additional funding for solving global environmental problems. Finland participated, with an increased amount, in the third GEF replenishment decided in August 2002. Finland also invested, in the period from 1999 to 2001, €9.3 million in the Prototype Carbon Fund (PCF) of the World Bank.

117. Between 1997 and 1999, contributions to multilateral financial institutions were about US$ 180 million per year. Bilateral and regional aid with relevance to climate change varied between US$ 17 and 38 million per year, which is about 11 per cent of the total bilateral ODA.[39]

118. NC3 does not provide examples of projects in the format suggested by table 6 of the UNFCCC guidelines,[40] although some projects are briefly described in the text. During the country visit, the review team obtained a large amount of additional information[41,42] and was impressed by MFA’s work in the selection, monitoring and evaluation of projects. At the same time, the team noted that impacts on GHG emissions or on GHG sinks were shown only for a few projects.

---

[38] “Finland’s Development Cooperation 2001”, MFA report to Parliament, Helsinki, 2002.

[39] “Aid targeting the Rio Conventions 1998–2000”, Report of the Development Assistance Committee of the Development Cooperation Directorate of the OECD, DCD/DAC/STAT(2002)7, Paris, 2002.

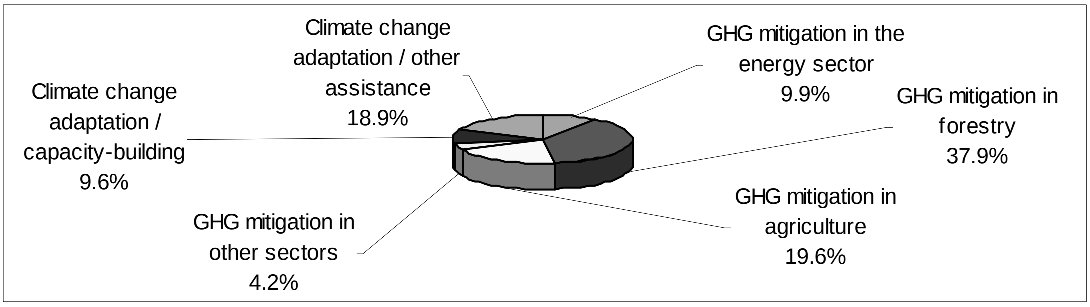
[40] See paragraph 55 on page 92 and table 6 on page 96 of document FCCC/CP/1999/7.

[41] “Finland’s Development Cooperation 2001”, Development cooperation report for 2001 submitted by the Ministry of Foreign Affairs to Parliament, Helsinki, 2002.

[42] “Thematic evaluation of Environment and Development in Finnish Development Cooperation”, Reports of a study commissioned by the Ministry of Foreign Affairs of Finland, Helsinki, 1999.

119. Figure 9 shows that mitigation-related projects in forestry account for the largest part of aid. Support of projects relating to agriculture and to climate change adaptation is also substantial.

Figure 9. Structure of Finnish climate-related bilateral and regional aid, 1997–1999



120. Finland makes efforts to transfer technology to developing countries. Finland's approach to technology transfer aims to integrate provision of technology information, response to technology needs and capacity-building in the recipient country.

121. Finland pays particular attention to regional cooperation with countries with economies in transition, in particular Estonia, Latvia, Lithuania, Poland and Russia. About €110 million were allocated in the 1990s for environmental cooperation with these countries. Some projects, such as conversion of power plants from fuel oil to natural gas, resulted in reduced GHG emissions.

122. Since 1999, Finland has pursued a pilot programme, with a three-year budget of €8.4 million, to gain experience with the clean development mechanism (CDM) and joint implementation (JI).[43] About 30 potential projects have already been identified in Estonia, Latvia, Lithuania, Poland and Russia (for JI) and in El Salvador, Nicaragua, Thailand and Viet Nam (for CDM).[44]

VII. RESEARCH AND SYSTEMATIC OBSERVATION

123. Reporting on climate research and observation in the NC3 is comprehensive and in compliance with the UNFCCC guidelines. In the 1990s, funding of research and development (R&D) was between 2 and 3 per cent of GNP, increasing from about €1.7 billion in 1991 to €4.2 billion in 2000. Governmental funding for R&D is distributed to TEKES (28 per cent in 2001), universities (27 per cent), governmental research institutes (17 per cent), Academy of Finland (13 per cent) and some other organizations (15 per cent).

124. Two national programmes represent important milestones in climate-related research in Finland: the Finnish Global Change Research Programme (FIGARE), implemented from 1997 to 2002, and the Technology and Climate Change Programme (CLIMTECH), implemented from 1999 to 2002. In addition, there are climate-related research projects in universities and institutes.

125. FIGARE had a three-year budget of €6.9 million and consisted of 38 research projects in various research areas: terrestrial ecosystems, biogeochemistry, policy process, economy, atmosphere, aquatic ecosystems, climate scenarios, climate history, and some others. Results were outlined in the final report published in 2002.[45]

---

43 The role of Emission Trading (ET) will depend on the approach of the EC.

44 "Summary of the Second Report on CDM/JI Pilot Programme", MFA, Helsinki, February 2002.

45 J. Käyhkö and L. Talve (Eds.). "Understanding the global system: the Finnish perspective", Finnish Global Change Research Programme, Turku, Finland, 2002.

126. CLIMTECH, with a three-year budget of €2.5 million, included studies of technological solutions for climate change mitigation. The programme had six subject areas: renewable energy sources and distributed energy production; energy efficiency and industry; non-CO_2 greenhouse gases; capture and utilization of CO_2; models and systems; and commercialization (of new energy technologies). CLIMTECH results are being finalized and should be fully available in 2003.

127. Systematic observation of climate in Finland is conducted by the Finnish Meteorological Institute (atmospheric observation), the Finnish Institute of Marine Research (observation of marine systems) and the Finnish Environment Institute (observation of terrestrial and inland waters).

128. Finland takes part in various international programmes such as the Global Atmosphere Watch and the Global Climate Observing System (GCOS). It cooperates with Nordic and other European countries, in particular with European organizations such as the European Meteorological Satellite Organization (EUMETSAT) and the Network of European Meteorological Services (EUMETNET). Finland intends to prepare and submit its national report on the GCOS.

129. During the 1990s, Finland contributed about €16.5 million to transfer of knowledge and technology in meteorology and climate observation to some 30 developing countries. Examples are the project “Rehabilitation and improvement of the meteorological and hydrological services” in Central America (seven countries, €4.5 million in 1990–2000) and the project “Post-emergency reconstruction programme in the field of meteorology” in Mozambique (€1.0 million for 2000–2001).

VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

130. The NC3 reports issues of education, training and public awareness in compliance with reporting guidelines and more comprehensively than in the NC2.

131. According to a recent (August 2002) opinion poll in Finland, climate change is among the most important issues affecting human life. Respondents placed climate change after increased drug use, economic recession and terrorism, but before natural disasters and immigration. However, 13 per cent of the respondents did not have any opinion on global impacts of climate change.

132. A National Climate Commission, comprising representatives of ministries, research institutes, environmental and business NGOs, and trade unions, coordinated national consultations during the preparation of the NCS. The Commission organizes public seminars on topical problems of climate change. Such seminars are well attended and attract the attention of the mass media. The Finnish National Committee of the IPCC organizes seminars based on IPCC work.

133. Finnish NGOs work actively on raising public awareness on climate change. They took part in the discussion of the NCS although not all their views were taken into account. For example, NGOs were of the opinion that the potentials of renewable energy sources and energy saving were underestimated and that the need for a new nuclear unit was not justified sufficiently.

134. MOTIVA, a state owned company for promotion of efficient use of energy, helps build up understanding of links between energy use and climate change. In 2002, MOTIVA started a new programme that targets awareness on climate change.

135. LGOs[46] are also active in raising public awareness on climate change. Three regions and 25 municipalities calculated their GHG inventories, and work on options to reduce emissions. The

[46] Local Governmental Organizations (LGOs) include municipal and regional authorities; their actions are coordinated through the Association of Finnish Local and Regional Authorities (ALFRA).

"Cities for Climate Protection"[47] campaign is an important tool for raising public awareness at the local level.

136. Education in Finland was decentralized about 10 years ago and there is no special policy for education on climate change. However, about three quarters of primary and secondary schools provide environmental education. More than 40 Finnish schools participate in the international GLOBE Programme that helps to increase understanding of weather events and their relevance to climate change. The National Board of Education works on a new framework curriculum for primary schools that will encompass climate change issues.

137. Institutes and universities have courses related to sustainable development that include environmental and climate elements.

IX. CONCLUSIONS

138. **The NC3 conforms to the UNFCCC guidelines and is very well prepared**. The most notable improvements in comparison with the NC2 are a revised set of policies and measures within a comprehensive national GHG mitigation programme, sound and well-documented GHG projections, evaluation of the costs of GHG mitigation with macro-economic models, and a more extensive chapter on education, training and public awareness.

139. **The review team identified some areas for further improvement**: evaluation of sectoral uncertainties of GHG emissions, use of trend analysis for the GHG inventory, analysis of GHG sinks in the context of the Kyoto Protocol, evaluation of the efficiency of implemented measures, comparison with earlier projections, and some others.

140. **Finland succeeded in stabilizing the total GHG emissions in the 1990s**: total GHG emissions (without LUCF) in 2000 were 4.0 per cent lower than they were in 1990. This remarkable achievement is in line with the UNFCCC aim to return GHG emissions to their 1990 levels by end of the 1990s (Article 4.2a and 4.2b). Climate-related policies contributed to this achievement, together with some economic and technological factors.

141. **Finland also succeeded in stabilizing the CO_2 emissions from transport**: in 2000, they were 0.4 per cent lower than they were in 1990. An active policy of the MTC contributed to this achievement. Economic recession from 1991 to 1993, technological progress in the car industry, and increasing use of diesel-fuelled passenger cars, were also important.

142. In the period 1999–2001, the National Climate Strategy (NCS) of Finland was prepared. The NCS concluded that the **current policies would not allow Finland to meet its Kyoto target** (stabilization of GHG emissions at the 1990 level in the first commitment period of 2008–2012). Therefore, **additional policy measures were identified to provide the required GHG reduction of 13–14 Tg CO_2 equivalent per year by 2010**. About 50 per cent of these reductions should be achieved in electricity supply (through an increase in gas-fired generation or construction of a new nuclear unit). Efficient use of energy and development of renewable energy sources are to provide, in almost equal proportion, the remaining reductions. Finland is in the process of setting up a monitoring mechanism for the NCS.

143. In 2002, the government and the parliament supported construction of a new, fifth nuclear unit in Finland. The analysis of GHG mitigation options in the NCS played a role in this decision. It is expected that the unit will start operation in 2009.

---

47 At present, 41 cities and municipalities participate in this campaign.

144. The NCS is based on domestic mitigation measures. In 1999, Finland started a pilot programme to gain experience with the Kyoto flexibility mechanisms, JI and CDM in particular. Some 30 projects have been identified. For ET, a consolidated EC decision is awaited.

145. Finland is finishing comprehensive research programmes to study climate change implications for the country (the FIGARE programme) and to identify technological solutions to mitigate GHG emissions (the CLIMTECH programme). The final results are expected in 2003.

146. Finland developed about 85 national sustainability indicators structured into 20 thematic groups. Three climate-related indicators were defined and are monitored: total GHG emissions, Finland's average temperature and the ice break-up date of the river Tornio.

147. Finland provides considerable financial resources to developing countries including climate-related funding, although the Finnish ODA decreased in the 1990s from 0.5–0.8 per cent of GNP to about 0.3 per cent as a result of the severe economic recession from 1991 to 1993. In 2002, Finland contributed, with an increased amount, to the third replenishment of the GEF.

148. According to a recent (August 2002) opinion poll in Finland, climate change is among the most important issues affecting human life. Respondents placed climate change after increased drug use, economic recession and terrorism, but before natural disasters and immigration.

- - - - -