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

Review team:

Saleemul Huq (Bangladesh)
Alexey Kokorin (Russian Federation)
Manuela Guedelha (Portugal)
Amrita Narayan Achanta, UNFCCC secretariat, coordinator

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I. INTRODUCTION AND NATIONAL CIRCUMSTANCES

1. Finland ratified the Convention on 31 May 1994, submitted its first national communication (NC1) in January 1995 and its second national communication (NC2) in April 1997. The in-depth review of the NC2 was conducted between April and July 1998, by a review team which consisted of Dr Saleemul Huq (Bangladesh), Dr Alexey Kokorin (Russian Federation), Ms Manuela Guedelha (Portugal), and Ms Amrita N. Achanta (UNFCCC secretariat, coordinator).

2. The country's northern location with a quarter of its land area lying north of the Arctic Circle, makes it among the coldest in Europe. This fact and its limited indigenous energy sources have influenced the energy infrastructure and technology development. District heating output is among the highest in Europe, with cogeneration accounting for 75 per cent. The country is sparsely populated with an average density of 16 persons/ km^2 in 1998, and a dispersed community structure with ensuing implications on transport. According to the definitions of the United Nations Food and Agriculture Organization Forest Resource Assessment 2000, the area of forest and other wooded land was 22.6 million ha in 1991-1996, 74 per cent of Finland's total land area and the area of forest land was 21.7 million ha (71 per cent). The corresponding figures based on the national definitions were for forestry land 23 million ha and for forest land 20.1 million ha. In Finland, carbon uptakes and releases are computed for forest and other wooded land based on national definitions. The country has a small but well developed and open economy, with a ratio of exports to gross domestic product (GDP)of 38 per cent in 1995. In 1997, around 50 per cent of the basket of exports originated from the energy intensive manufacturing sector. The Finnish economy was severely affected in the early 1990s by a recession, with the GDP declining by 12 per cent during the 1990-1993 period. The economic development since 1993 has followed an upward trend, with growth in 1996 at 3.6 per cent, bringing GDP measured at 1990 prices to the 1990 level. The other serious issue for the economy was the high level of unemployment: 16.3 per cent in 1993 declining to 11.4 per cent in 1998.

3. The Finnish energy situation is characterized by a liberalized electricity market set in place even prior to the European Community (EC) electricity directives, and high energy taxation compared to the EC average. Of the Organisation for Economic Co-operation and Development (OECD) countries Finland has a relatively high proportion of bioenergy in total energy consumption owing to the high volume of wood residue produced by the forestry industry, and a share of combined heat and power production (CHP) in total power production which is among the highest in the world. Additionally, there is a high share of bioenergy use in district and local heating plants and forest industry.

4. The limited extent of indigenous energy resources (peat, hydropower and wood) necessitates approximately 70 per cent import of primary energy sources. In 1995, the total primary energy supply (TPES) included oil (28.5 per cent), coal (21.1 per cent), nuclear (17.5 per cent), other renewables and wastes (16.6 per cent), natural gas (10.3 per cent), hydro

(3.9 per cent), and electricity import (2.1 per cent). According to the host country the TPES estimate for coal included both peat (6.2 per cent) and coal (14.8 per cent). Nuclear and hydro power accounted for 53 per cent of the electricity generation, followed by coal at 14 per cent, peat at 8 per cent, natural gas at 8 per cent, indigenous fuels at 8 per cent and others including imports making up the remainder. In 1995, the energy consumption by sector was: industry 46 per cent, space heating 24 per cent, transport 14 per cent and others 16 per cent. Carbon dioxide (CO_2) emissions per capita (11-12 tonnes) were close to the 1995 OECD average.

5. In 1995 Finland joined the EC. In May 1998, a coalition government was in power, with the 1999 elections assuming significance due to the pending decisions on the future expansion of nuclear capacity. The host country experts stressed that developments outside Finland, particularly at the EC and OECD levels, would influence future restructuring of the taxation system. Other changes with implications on climate change policy were the development of the 1997 Energy Strategy, the ongoing adjustment of the Finnish CO_2/energy tax, reconstitution of the Inter-Ministerial Group on Climate Change, and the 1996 decision on the principle of future strategies for Finland's development cooperation. The team learnt that the 1997 Energy Strategy aims at reducing specific energy consumption by 10 to 15 per cent by 2010, in comparison to 1995, and stabilizing energy consumption within the next 10 to 15 years.

6. The response strategies are coordinated by an inter-ministerial working group coordinated by the Ministry of Environment. The Climate Committee, which has replaced the CO_2 Commission (current phase 1998-2000), is made up of representatives of various ministries and is also coordinated by the Ministry of Environment, guides the inter-ministerial working group. Each ministry has the responsibility of carrying out policies and measures in its own sector. The ministries of finance and trade and industry are directly involved in ecological tax reform. The Ministry of trade and industry is responsible for energy policy formulation, with a limited role for the Environment Ministry. A number of tasks are carried out by the regional and local authorities and individual government agencies.

7. Finland used the 1994 Intergovernmental Negotiating Committee (INC) guidelines (A/AC.237/55, decision 9/2, annex) instead of the 1996 revised UNFCCC guidelines for the preparation of national communications by Parties included in Annex I to the Convention.

II. INVENTORIES OF ANTHROPOGENIC EMISSIONS AND REMOVALS

8. The data in the NC2 covered the three major and direct greenhouse gases (GHGs): CO_2 (including removals), methane (CH_4) and nitrous oxide (N_2O), for the period 1990 to 1995. For the indirect GHGs: non-methane volatile organic compounds (NMVOCs), nitrogen oxides (NO_x) and carbon monoxide (CO), data were provided for 1990 and 1995. Data on sulphur dioxide (SO_2) were provided for 1990 and 1995. No data were included in the NC2 inventory for the hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6), but potential emission estimates were provided in the projection section.

9. Base year emission estimates of CO_2, CH_4, N_2O were first submitted in the NC1, revised in the NC2, and then officially submitted in June 1998, after the review visit. The current discussion of inventories is based on the discussions conducted during the review although the tables in the report are based on the data in the NC2, which provides the most complete data set from 1990 to 1995 (CO_2 emissions data for 1991 are lacking in the NC2). The revised data submitted to the secretariat subsequent to the visit resulted in an increase in CO_2 emission estimates for 1990 of approximately 9 per cent (from 53,800 Gg , as reported in both the NC1 and NC2, to 59,100 Gg). The land-use change and forestry sector was not included in this estimate. Revisions to the GHG inventory are summarized in table 1. The team was informed that most of the change were due to the altered calculation of fugitive emissions from solid fuels (peat soils reserved for peat production for energy use). Smaller changes were due to: altered emissions from coal owing to revised calculation methods and data on coke consumption, altered emissions from peat owing to revised data on peat consumption, and an increase in emissions from oil owing to a small change in emission factors of gasoline, diesel oil and other oil products.

Table 1. Greenhouse gas emissions data, 1990 and 1995 (Gigagrams)

	1990			1995	
	NC1	**NC2**	**June 1998**	**NC2**	**June 1998**
CO_2	53 800	53 800	59 100	56 050	a
CH_4	252	246	364	241	361
N_20	23	18	19	18	18

Note: All the numbers given above are the unadjusted numbers. NC1: first national communication; NC2: second national communication; June 1998: post review visit submission.
a: Revision of the data for 1995 was ongoing at the time of the review visit in May 1998.

10. In addition, estimates for 1990 CO_2 emissions were further adjusted upwards to account for temperature and electricity imports, amounting to a total value of 68,900 Gg CO_2. Electricity imports for the period 1985-1996 were considered while making adjustments to the CO_2 emissions inventory. The approach adopted by the host country was that if the imported electricity had been produced nationally, it would have led to an increase in the total CO_2 emissions in 1990 of 8,300 Gg CO_2 (value of 11,000 Gg CO_2 presented in NC2). In what follows, adjustments are not taken into account, since they are not part of the Intergovernmental Panel on Climate Change (IPCC) methodology.

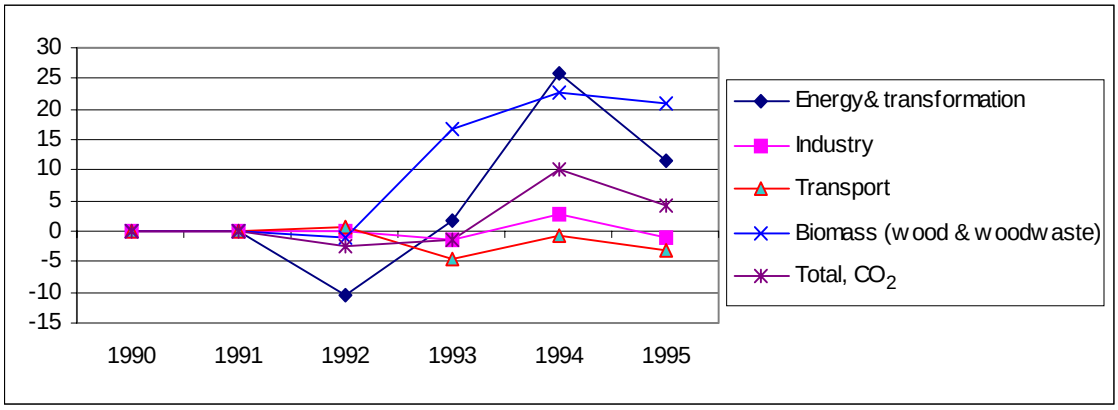
11. In 1995, of the total CO_2 emissions, energy accounted for 98.5 per cent (98 per cent in 1990) and industrial processes 1.5 per cent (2 per cent in 1990). The sectoral allocation for CH_4 emissions in 1995 were: waste approximately 55.2 per cent (61 per cent in 1990), agriculture 36.5 per cent (33 per cent in 1990), energy 6.6 per cent (5 per cent in 1990), and industry 1.7 per cent (1 per cent in 1990). The sectoral allocations of N_2O emissions in 1995 were: agriculture 50 per cent (55 per cent in 1990), energy 33 per cent (28 per cent in 1990), and industry 17 per cent for both years.

Table 2. Emissions of carbon dioxide by source, 1990-1995 (Gigagrams)

	1990	1992	1993	1994	1995
Energy & transformation	19 500	17 430	19 850	24 530	21 720
Industry	13 700	13 720	13 490	14 100	13 570
Transport	11 500	11 590	10 990	11 410	11 130
Small combustion	5 800	6 790	6 060	6 710	7 110
Other (agric & forestry)	2 100	1 870	1 860	1 590	1 600
Biomass (wood & wood waste)	17 100	16 920	19 960	20 980	20 670
Industrial processes	1 200	1 020	860	840	840
Fugitive emissions from fuels	100			80	80
Total CO_2	**53 800**	**52 420**	**53 110**	**59 250**	**56 050**
Land-use change and forestry	-31 000				-14 700

Note: No CO_2 emission or removal data for 1991 were provided in the NC2. The total for CO_2 does not include biomass burnt and land-use change and forestry removals. The NC2 did not contain any data on 1991. The data in table 2 are unadjusted data. In the LUCF estimate the total stem volume increment and total drain by tree species groups were compared. The differences were converted to total tree biomass, total dry matter and total carbon content using coefficients by tree species. Drain refers to all types of harvesting, harvesting residuals and natural mortality.

Figure 1. Carbon dioxide emissions, percentage change from 1990, by source



12. The review team was informed that calculation of revised data for 1991-1995 were ongoing. For this reason in the description of trends, data from the NC2 are used in this report. Estimates of emissions by sector are presented in table 2 and trends for major sectors are shown in figure 1. Between 1990 and 1995, the changes in sectoral values were mostly related to biomass combustion and energy and transformation. The decrease in industrial emissions between 1990 and 1995 was attributed to the fall in cement production during 1991-1993, with no subsequent recovery. Additionally, the Ministry of Trade and Industry (MTI) Energy Review Journal (1998), provided preliminary estimates of CO_2 emissions from fuel combustion for 1996 and 1997 of 61,000 and 58,000 Gg CO_2, respectively. These estimates excluded industrial processes and fugitive emissions, unlike the estimates available in table 2.

13. Forest covers more than two thirds of the land area (20 million out of 30.5 million ha). Detailed forest inventories have been conducted periodically since 1921, with the ninth in progress in June 1998. The team was informed of the age class distribution of forests, for

southern and northern Finland, the total volume of growing stock, the volume increment over the period 1921-1994 and the average growing stock "drain". The team learnt that the Finnish forests constituted a net sink thanks to net growth of above-ground biomass stock, intensive harvesting and past management, leading to the current predominance of young and middle-aged stands (in comparison with a natural age distribution), especially in the southern part of the country. The annual wood increment has been relatively stable for the period 1990-1995, averaging approximately 75.4 Mm^3. The host country attributed the annual variation in net carbon sink to the annual variation of fellings, which were dependent on international markets, demand for forest products and the world economic situation. In contrast to the steady growth, the drain or harvesting component has registered significant fluctuations, in the recent decades, with the most recent fluctuations related to the recession of the early 1990s. Net CO_2 sequestration in the forests was estimated at 31,000 Gg CO_2 in 1990 and 14,000 Gg CO_2 in 1995. The data for 1990 were identical in both communications. The calculations were based on the national conversion factors (m^3 of wood to carbon) and other parameters, in keeping with the revised IPCC Guidelines.

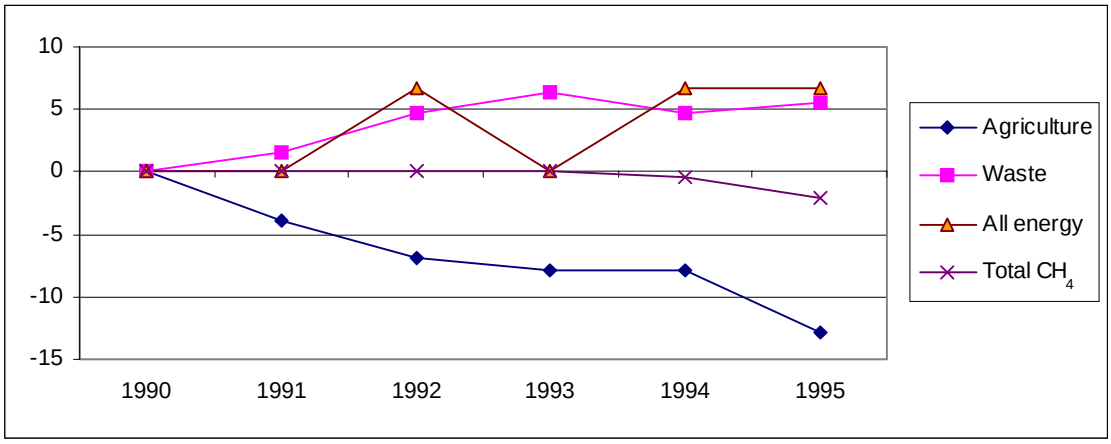
Table 3. Emissions of methane by source, 1990-1995 (Gigagrams)

	1990	1991	1992	1993	1994	1995
Agriculture	101	97	94	93	93	88
Waste	126	128	132	134	132	133
All energy	15	NE	16	15	16	16
Industrial processes	4	4	4	4	4	4
Total CH_4	**246**	**NE**	**246**	**246**	**245**	**241**

Note: NE: not estimated

14. The estimates of CH_4 emissions for 1990 were changed between the NC1 and NC2. New estimates for 1990 and 1995 were also presented to the team during the visit and for 1990 again in the post review submission in June 1998. Estimates of emissions by sector are presented in table 3 and trends for major sectors are shown in figure 2. The changes are due to methodological changes and improved input data collection and allocation in accordance with the IPCC Guidelines. In the NC2 (compared with the NC1), emissions from industrial processes have been included, revised emission factor data for transportation have been used, a redistribution of industrial sludge between inventory categories (waste water treatment to solid waste disposal on land) to meet the IPCC reporting instructions has been made. Additionally, in the waste sector the emissions from solid waste disposal on land also included emissions from industrial, construction and demolition waste in addition to those from only municipal solid waste in the NC1. Not only were detailed data on methane emissions available, but also the use of a detailed dynamic model for landfills.

Figure 2. Methane emissions, percentage change from 1990, by source



15. The emissions from solid waste disposal on land, which were presented to the review team and given in the June 1998 submission, were calculated with the mass balance model as in the NC1. Finland decided to use the mass balance method in its national communications as it is given as the default method in the IPCC 1996 Revised Guidelines. The uncertainties in the methodology are also less than in the dynamic model as the data input on past amounts and composition of landfilled waste and degradation coefficients are not needed. As a result, the 1990 estimate of CH_4 emissions from landfills increased by approximately two times, leading to a total estimate of methane emissions of 311 Gg CH_4 (252 Gg CH_4 in NC1 and 246 Gg CH_4 in NC2). In 1995, according to the NC2, CH_4 emissions had fallen to 241 Gg CH_4, thanks to the recovery of landfill gas after 1990, and the reduction in emissions from enteric fermentation because of the lower number of dairy cows. The contribution of manure management remained almost constant because of the high contribution of pig manure. Following the revision of the landfill data, the revised estimated total CH_4 emissions in 1995 were 235 Gg CH_4 (241 Gg CH_4 in NC2). Calculations using the IPCC default factors led to a estimated value of 375 Gg CH_4 in 1995. CH_4 leakage from natural gas pipelines only occurred during pipeline repair and was negligible. In the case of wastewater treatment, the Finnish experts did not always have estimates of chemical oxygen demand required for the calculations and used the biological oxygen demand instead.

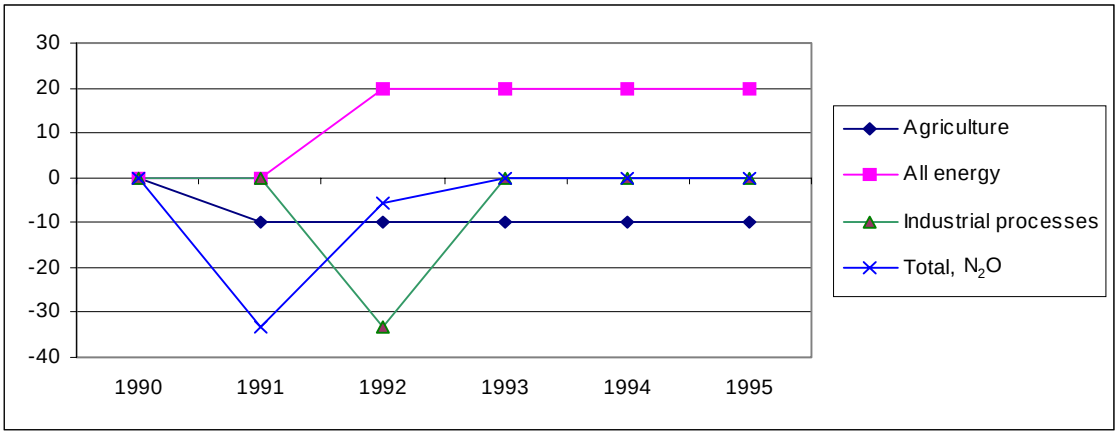
Table 4. Emissions of nitrous oxide by source, 1990-1995 (Gigagrams)

	1990	1991	1992	1993	1994	1995
Agriculture	10	10	9	9	9	9
All energy	5	NE	6	6	6	6
Industrial processes	3	3	2	3	3	3
Total N_2O	**18**	**9**	**13**	**14**	**14**	**18**

Note: NE: not estimated

16. In the N_2O emission estimate for 1990, there is a substantial difference, between the NC1 (23 Gg N_2O) and the NC2 (18 Gg N_2O). These changes were partly due to the use of detailed transportation data and revised emission factors (a decrease of 3 Gg N_2O), and also to a change in the methodology used to estimate N_2O emissions from cultivation of agricultural lands, mainly emissions from peatlands (2 Gg N_2O). According to the NC2, the estimates for 1995 are identical to those for 1990. Estimates of emissions by sector are presented in table 4 and trends for major sectors are shown in figure 3.

Figure 3. Nitrous oxide emissions, percentage change from 1990 by source



17. Estimates of potential emissions of HFCs, PFCs and SF_6 for 1995 were included in the NC2, based on the bulk import of chemical substances and not actual emissions. For 1995, they were estimated at 0.004 Gg SF_6, 0.061 Gg HFCs and 0.00004 Gg PFCs. The estimates for more recent years were preliminary. The contribution of these gases to total GHG emissions is very limited (0.5 per cent). Preliminary estimates for 1997 for potential emissions of HFCs, PFCs and SF_6 were presented during the visit. PFC emissions in Finland were negligible (0.00004 Gg) because of the absence of aluminium production. The 1990 and 1995 international bunker fuel data (marine and aviation) were presented in the NC2 and amounted to 2,800 Gg and 1,850 Gg of CO_2 respectively, there being no change for 1990 between communications.

18. The team remarked on the absence of a summary table for all the GHGs for 1995. Data for 1996 were not available at the time of the visit. The review team also recalled decision 9/CP.2 of the Conference of Parties which required Parties to submit their national inventories to the UNFCCC secretariat by 15 April of each year**.** Finland had promised to make such a submission in the near future, but at the date of writing the report no submission had been made. The need for submission of detailed worksheets for the land-use change and forestry sector, agriculture, and fuel combustion for the year 1995 was stressed by the team. The GHG inventory in the recommended IPCC format was not presented in the NC2. Both the IPCC 1995 Inventory Guidelines and the 1996 revised Guidelines were used in preparation of the national GHG inventory. The methodologies of the Revised Guidelines have only been partially adopted as some of the data needed in the estimates were not available in time for the NC2. The use of

the IPCC 1996 revised Guidelines emission factors led to a very limited change in the 1990 emission estimates for CO_2, compared to those obtained using the national emission factors (diesel oil, refinery gas, other oil). Other exceptions to the use of the IPCC methodology reported in the NC2 were: reporting of fuels and emissions for auto-generation under industry, combination of residential, institutional and commercial sectors under one head, and the absence of separate tables for traditional biomass burned for energy purposes.

19. The NC2 contained estimates of CO_2 uptake on natural peatlands and those peatlands drained for forestry. In the natural peatlands, the CO_2 sink (peat carbon accumulation) was about 4,000 Tg CO_2/yr, while emissions of CH_4 and N_2O amounted to 500 Gg and 0.5 Gg, respectively. For those peatlands drained for forestry, the relevant values were : sink of 4,500 Gg CO_2/yr, 100 Gg CH_4 and 1 Gg N_2O emissions. The figures for emissions from peatlands drained for agriculture included in the NC2 refer to N_2O only; calculation of CO_2 emissions was in progress.

III. POLICIES AND MEASURES

20. The NC2 mentions a number of policies and measures to reduce GHG emissions and how they are to be implemented, indicating that Finnish policy favoured usage of economic instruments. The approach used in the NC2 reflected the choice of policy instrument instead of reporting by sector and gas as requested by the guidelines. A summary table included information on the type of policy instrument, status of implementation, sector, estimated impact, and status of policies and measures to reduce CO_2 emissions. During the visit, the team was provided with additional information and insights from national experts, non-governmental organizations and local authorities. A limited identification by measure of CO_2 reduction potential was included in the NC2, focusing on electricity generation (fuel switching and renewable energy) and energy efficiency measures (information, incentives, voluntary agreements, research and development on new technology, and regulations). The team felt that the details of how estimates of reduction potential were calculated, costs and the level of implementation could be included. The team was informed of ongoing work on the effects of individual measures. It was difficult for the team to distinguish between planned and implemented measures in the NC2.

21. The Council of State proposed in its 1993 report to Parliament on energy policy, that the energy sector would bring to a halt the increase in carbon dioxide emissions in the second half of the 1990s. The team was also informed of the goals of the 1997 Energy Strategy. Subsequent to the review visit the team gathered that at the June 1998 “burden sharing” EC negotiations, Finland’s commitments under the Kyoto Protocol were limited to returning its GHG emissions to 1990 levels by the year 2008-2012.

A. Energy supply and transformation

22. The significant developments in this sector relate to the adoption of the Energy Strategy in 1997, the modification of the carbon dioxide/energy tax, liberalization of the electricity market, and membership of the European gas network. In 1997, the Finnish government

adopted a broad-based national energy strategy aimed at reducing CO_2 emissions. The broad objectives were to improve the availability of energy, ensure competitiveness of energy prices, help the government meet international commitments and expedite the development and commercialization of energy-saving and renewable energy technologies. The strategy is based on a number of policy actions, namely: (i) promotion of the energy market, (ii) promotion of energy efficiency, (iii) maintenance of a high standard of energy technologies, (iv) development of an energy production structure involving reduced emissions of carbon compounds, (v) securing the supply of energy and (vi) promotion of the use of renewable energy. The Government has also put in place an Energy Conservation Programme which aims at reducing specific energy consumption by 10 to 15 per cent by 2010 compared to 1995 and stopping the growth of primary energy consumption in 10 to 15 years. These goals were to be achieved using (i) norms (e.g. building codes and energy labelling of equipment),(ii) taxation, (iii) subsidies, (iv) energy conservation agreements (voluntary agreements), (v) advanced technologies and (iv) information dissemination. A progress report on the Energy Strategy from the Ministry of Trade and Industry was due by the end of 1998.

23. The team found it important to understand the evolution and current status of the country's carbon dioxide tax first introduced by Finland in 1990. The tax based on carbon content was initially imposed on fossil fuels (except automotive fuels), with 75 per cent based on carbon content and 25 per cent on the energy content. This particular tax structure was introduced during tax reform in 1994. There were special taxes on nuclear and imported electricity. Subsequently there were many changes and increases, with liberalization of energy markets and competitive aspects of electricity generation being considered at the last revision in 1997. After the most recent revision, the tax is now applied at the level of consumption and not on the source of the electrical energy. Further the tax differentiates between sectors, with industry and professional glasshouse growers paying a lower tax (electricity), and a higher tax being levied on households, service industries, agriculture and the public sector. There are no longer specifically determined tax rates on imported electricity, nuclear, and hydro power. Although fuels used in the production of electricity are exempted, a tax is levied on heating fuels such as heavy fuel oil, light fuel oil, natural gas, coal and peat. In this instance the taxation component based on energy content was removed whereas the component based on carbon content was doubled, causing the price of district heating produced using fuels subject to the energy tax, to increase by an average of 2 per cent. However, tax collected is returned to certain types of producers, including municipal combined heat and power plants using wood or peat (<40 MW), small-scale hydro power (< 1 MW) and wind power. Additionally, in 1998, all power plants using wood-based fuels were entitled to support, based on the proportion of wood-based fuels used.

24. In general, the 1997 tax reform favoured the use of low-emission fuels for heating and encouraged energy conservation by raising the level of taxation on electricity and fuels. On the other hand there was a simultaneous lowering of its impact as a regulatory mechanism, on electricity production, the limited incentive provided to renewable energy (scope of the incentive was enlarged in 1998), and limited environmental impact. Industry remarked on the high uncertainties associated with the taxation system, with implications on the climate for long-term

investment. The reform itself was expected to earn the State an additional Fmk 900 million in excise duties for 1997, which was not earmarked for environmental purposes. So far it has generally been used for reducing unemployment and this was likely to continue in the short term. The team was told that another revision was expected in 1998. Clearly Finland favored an EC-wide tax.

25. Finland is noteworthy for having made progress towards the liberalization of energy markets for some years even prior to joining the EC. In the natural gas sector, Finland has a single supplier, the Russian Federation. There are plans for increasing the potential supplies either by developing a Nordic Gas Grid by building a pipeline from the Russian Federation through Finland to Sweden, Norway and Denmark or by building an under-water pipeline from Finland to the continental European network. The Nordic Gas Grid (NGG) will improve security of gas supply, and the prospects of installing new electricity capacity based on gas. The NGG feasibility study has been cofinanced by the EC in the framework of the Trans-European Network project and by the Nordic gas companies. Such a promotion and expansion of natural gas supplies would be an important element in Finland's future energy strategy, with important associated implications for GHG emissions. In the electricity sector, which continues to grow at an average of 2.4 per cent per annum in the 1990s, the liberalization of the markets has already occurred in the domestic sector, where even small consumers are now able to select their electricity supplier. As a result a number of electricity producers are trying to introduce "green electricity" (renewable based) to distinguish their product from other suppliers. It is still unclear what the long-term impact of the common electricity market arising from the formation of the Nordic pool would have on CO_2 emissions, in spite of the preliminary evidence suggesting that by making the electricity supply and distribution more efficient the overall CO_2 emissions would be less. Currently there is an overcapacity that will persist till the year 2005. In the event of such a shortfall an expansion of existing electricity supply using coal, gas or nuclear power would be likely, with consequent impacts on CO_2 emissions.

26. The factors actually influencing the expansion of electricity capacity are: the opening of the electricity market, the change in taxation, the developments with regard to interconnecting the gas system with the European Gas Grid and future decisions on expansion of nuclear capacity. The opening of the electricity market directly resulted from the Electricity Market Act of June 1995, in line with the EC directive on the internal market for electricity. The opening of the network has led to commercial arrangements between producers and consumers, and the removal of a number of licences for power plant construction as well as for export and import of electricity (except those which are required by specific legislation for nuclear and hydro power). Further it has resulted in the formation of a single market area for Finland, Norway and Sweden, with Fingrid joining the Nord Pool, making the question of electricity imports less relevant. As power generation is based on competition and no licences are needed for power generation and construction of conventional thermal and CHP plants, there are no central planning procedures for the electricity system. Companies have already started to adapt to the new business environment in reaction to the new regulatory framework.

27. In 1995, the use of combined heat and power (CHP) based power generation accounted for about 30 per cent of total power production in Finland, with 14 per cent arising from industrial CHP plants and 16 per cent from district heat production. This high penetration of CHP technology is explained by the large number of forest industry installations and the wide use of district heating systems. The CHP plants in general have total net efficiencies of 80 - 90 per cent in contrast to condensing power plants using fossil fuels, which have efficiencies of 30 - 40 per cent. Though the extent of emissions varies depending on the fuel, in general the emissions are lower. According to the officials, most CHP capacity has been built in Finland with increase in capacity only possible through upgrading of old plants.

28. The team learnt that there were subsidy schemes in place for investment in wind turbines and for small biomass-fired CHP plants. Further the team learnt that a new programme for implementation of the EC white paper on renewable energy sources was in the planning phase.

B. Industry

29. In 1995, 46 per cent and in 1996, 47 per cent, of total primary energy, the largest share was consumed by the industrial sector. Industry also accounted for 53 per cent of the total electricity consumed. Approximately 50 per cent of exports originate from the energy-intensive industrial sectors. For instance, up to 87 per cent of the paper and board production is exported. Some of the positive efforts in varying stages of implementation that the team noted involved the use of voluntary agreements, energy audits, the high use of bioenergy (inclusive of wood, wood waste and black liquors) resulting from the production of chemical pulp, apart from the use of advanced technologies to harness such materials, and the fact that two of the eight national energy technology development programmes related to industrial energy efficiency in the paper industry and the base metals industry.

30. Voluntary agreements constitute one of the main policy instruments of the Government's 1996 Energy Conservation Programme. They involve agreements between the Ministry of Trade and Industry (MTI) and the Confederation of Finnish Industry and Employers, with the goal of promoting energy efficiency, so as to reduce specific energy consumption. Also agreements between the MTI and the associations of power producers, district heating utilities and electricity transmission and distribution utilities were signed at the same time. Additionally a cooperation agreement between the Ministry and the Association of Finnish Local and Regional Authorities, on the promotion of energy conservation in municipalities, also exists and includes the city of Helsinki. In the preliminary stages of implementation and evolution, the voluntary agreement programme is meant to facilitate measures to fulfill both the Energy Conservation Programme, and the 1997 Energy Strategy, i.e. reduce total energy consumption by 10-15 per cent by 2015, with individual firms adopting specific energy conservation targets. Under the programme 80 per cent of the energy used is to be audited by 2005. Till the date of writing of the report, 15 companies, representing over 70 per cent of the energy use in industry. Also, over 70 per cent of power production, 40 per cent of electricity distribution and 30 per cent of district heating was covered by the agreements. Within the monitoring framework established in 1997, companies are required to report on current energy use and factors influencing energy

efficiency to their confederations and to MOTIVA, conduct energy audits followed by the development of a plan with quantitative efficiency targets, costs and time schedule. The Ministry of Trade and Industry meets 40-50 per cent of the direct cost of the audit and 10 per cent of the actual investment costs. One of the current limitations of the system is the lack of enforcement procedures. It is also difficult to distinguish between those measures adopted as part of the normal business cycle and those adopted in response to climate change considerations.

31. The team was informed of work at MOTIVA, first established in 1993 as a project organization and then made permanent in 1997, to encourage the adoption of energy efficiency measures, as envisaged in the Finnish Energy Conservation Program. Although its main source of funds is the Ministry of Trade and Industry, it receives other public and private funds. The primary business idea underlying its functioning are to activate a market for energy-efficient and renewable energy technologies so as to achieve the Government's targets for energy efficiency and renewable energy. MOTIVA uses diverse approaches which include the producing and disseminating of information, developing management methods for example for energy auditing and speeding up the entry of efficient and competitive technologies on the market, across four areas of housing, transportation, services and industry. Using a market and energy conservation survey, a buyers group consisting of energy consumers committed themselves to purchasing a new energy-efficient product for which they had co-defined the specifications along with experts. The winning bid was then selected and the price paid. This process has already resulted in an improved energy efficiency of products, of 20-50 per cent, and thanks to the pre-established buyers group the manufacturer was guaranteed a large enough first sale, facilitating easy and quick introduction into the market. So far the procured technologies included energy-efficient methods for window renovation, and a pumping process in the wood processing and chemical industries. The team found the role of MOTIVA in the development and implementation of international technology procurement competitions innovative.

C. Residential, industrial and office building sector

32. Residential and office buildings account for approximately 75 per cent of the total final consumption of heating energy in Finland. The measures implemented and planned for this sector included ongoing energy audits in industrial and service buildings (in residential buildings the audits are linked to condition assessments conducted by the Ministry of Environment) provision of building and renovation subsidies, the future enforcement of the revised building code, and certification procedure. In 1996 a working group on energy audits was constituted which established that 80 per cent of the buildings should be audited by 2010. For individual buildings the target was set at 50 per cent. For existing buildings there are incentives to carry out energy audits and investment grants for energy efficiency improvement. A government subsidy of approximately Fmk 250 million a year was allocated for this sector, with a provision of 10 per cent of the cost for carrying out the normal renovation measures, and up to 20 per cent if energy conservation measures were included. As of May 1998, 15 per cent of the building volume of the commercial and residential sector had had energy audits. The annual savings in the commercial and residential building sector are in the range of Fmk 500 million over a five-year period, and the payback period for this investment is two to three years. A monitoring study

done by MOTIVA based on audits of 153 industrial and 686 service buildings, indicated an efficiency improvement potential of 20 to 25 per cent in heating, 6 to 8 per cent in electricity and 7 to 15 per cent in water consumption. The team was told that these efficiency improvements were being achieved at limited or nil costs, with an estimated average payback time for recommended investments (5221 individual measures) being 2-3 years.

33. Being a cold country, with 60 per cent more heating degree days than the average for the EC, Finland has a long history of strict building codes aimed at the improvement of energy efficiency of buildings, and is considered a leader in district heating in the EC, with approximately 46 per cent of the building stock supplied by central heat, mostly from CHP plants. Finland is bringing its building codes into line with the EC regulations. A revised code is to be adopted in 1999. The building code which regulates both residential and non-residential sector building projects and covers such aspects as thermal insulation, indoor climate and ventilation, and energy management in buildings, is expected to result in 10 per cent more energy savings. The payback time for the proposed measures ranges from less than 10 years to about 20 years. A special certificate based on the energy audits and the condition assessment, also including the energy classification data based on the EU's SAVE directive, will be issued to prospective buyers or renters of apartments and other premises. This certification has a direct market value as these buildings are frequently on the market. The implementation of this certification scheme for residential and official buildings is expected to commence in 1999.

D. Transport

34. Development in the transport sector showed a slightly decreasing trend in the nineties until 1994, mainly owing to the economic recession, but has since begun to rise and this trend is expected to continue in the future. The share of the transport sector in CO_2 emissions in 1995 was approximately 20 per cent compared to 21 per cent in 1990. Some of the characteristics of this sector are the relatively high percentage of public transport use (facilitated by the provision of a subsidy), the number of passenger-kilometres being one and a half times higher than for the EC as a whole. The average car density of 380 cars/1000 inhabitants is close to the EC average. The freight mileage was double the average for the EC. The proportion of road transport has changed little during the 1990s. The high passenger traffic was attributed to the sparsely distributed population, whereas the freight mileage is accounted for by the high tonnage per km of freight vehicles, and the full loads. The road freight traffic is also relatively efficient, with a low freight/CO_2 intensity. Industrial transport costs in general are higher than in other EC countries, in turn making transport fuel price a critical element in the competitiveness of Finnish industry. In contrast to the past where there existed a significant eastwards trade orientation, currently about 60 per cent of merchandise exchanged is with EC countries. Privatization of the railways is likely, with competition due to start in 2000.

35. MOTIVA has identified a potential for fuel savings in transportation through measures such as education in driving economy (10-15 per cent), training in driving economy for heavy transportation (8-12 per cent) and use of an engine block heater (5 per cent). In 1994, the Ministry of Transport and Communications approved an action programme to reduce the harmful

effects of traffic, which has targets for the year 2000. The measures included promoting the sale of fuel-efficient cars and improving the operating potential of public transport. This was mentioned in the first in-depth review report, and though the NC2 did not indicate what progress had been made in the interim period the team was informed that a special working group had been set up in the Ministry of Transport and Communications for reviewing various GHG reduction measures included in the action programme.

36. The team learnt that there were two primary areas of taxation in transport, one on fuels and the other on vehicles (vehicle registration tax). The total tax on diesel is Fmk 2.48/l and that on gasoline Fmk 4.34/l . Though there are no specific plans to change the tax levy, the transport fuel taxes constitute an important source of revenue and have usually been raised annually. The vehicle registration tax of 144 per cent in 1990 was lowered to 122 per cent (100 per cent plus 22 per cent value added tax (VAT), but is still considered high for Europe, leading to a lower import of more expensive, relatively fuel-inefficient passenger cars and restraining growth of the car fleet. However there is also an annual tax and the tendency is to decrease the vehicle registration tax in future and increase the annual tax.

E. Waste

37. Solid waste disposal in landfill sites and dumps is the major source of methane emissions. There has been a steep decline in municipal landfill sites with the number for 1996 being 390 in comparison to that in 1990 when they were 600. This was expected to decrease further owing to the Waste Management Programme, which intends to retain only 200 landfill sites in 2000 and 50-80 landfills in 2005. A reduction in number is meant to lead to more efficient supervision and better environmental management, although more transportation will probably be needed because of the reduced number of landfill sites. Under the Waste Tax Act of September 1996 municipal landfill site operators (municipally owned) had to be registered and pay a landfill tax on the waste delivered to the landfill. The tax rate is Fmk 90 per tonne of waste. Those companies which have their own landfills for their own industrial waste are exempted from paying the tax. The waste exempted from the tax includes biological waste and sewage sludge, among other wastes which could influence CH_4 emissions. Though the landfill tax has now been in existence since 1997 when it was fully implemented the total tax revenue of Fmk 160 million in 1997 was only half the expected amount. Landfill gas recovery is practised on a limited scale, with approximately five landfill sites having this facility in 1996. Landfill gas recovery grew from 3 Gg CH_4 in 1995 to 7 Gg CH_4 in 1997. From 2002 gas recovery from landfill sites is be made mandatory, ensuring that the amount recovered will increase substantially.

F. Agriculture

38. The agricultural sector in Finland is governed by the EU rules and subsidies. The Rural Environment Programme and the Agri-environmental Support Programme both include actions to reduce greenhouse gas emissions from agriculture. Consequently, through participation in such programmes, it is expected that there will be a decline in the number of dairy cattle and a

corresponding reduction in methane emissions from livestock. It is also anticipated that the adoption of EU rules on the environmentally sound application of fertilizers will lead to less nitrous oxide emissions.

G. Forestry and land-use change

39. Forests not only cover approximately two thirds of Finnish territory but also constitute an important industrial sector, with an annual turnover of Fmk 71.3 billion. Of the estimated 20 million ha of forest cover, 61 per cent is owned privately, 25 per cent by the State, 9 per cent by companies and 5 per cent by others. The review team learnt that the area under forests over the 1990-1998 period had remained quite stable, with a negligible amount of conversion from grassland, although this trend need not continue. The national experts stated that their most recent national inventories had shown that the growth increment was not as rapid as in the past. The Ministry of Agriculture and Forestry is responsible for drafting, implementation and supervision of forest policy and legislation. The Finnish Forest Strategy, implemented via legislation, focuses on protection from inappropriate use and negative changes, and promotion of sustainable forest management in private and state forests. The team was informed of the 1997 Forest Act and the 1997 Act on the Financing of Sustainable Forestry. The Forest Act, which came into force in January 1997, seeks to ensure sustainable forestry and allow for regeneration of forests. It also provides that the regional forest centres, in cooperation with other stakeholders, should prepare regional target programmes covering economic, ecological and social sustainability, which is expected to influence wood production and the environment.

40. The Act on the Financing of Sustainable Forestry coordinated by the Ministry of Agriculture and Forestry, allocates government funding to measures aimed at sustainable wood production, the maintenance of biodiversity and nature management projects. In spite of very detailed presentations on various aspects of this sector, it was not possible to determine the direct impact of individual forestry legislation and forest programmes to changes in forest stocks. The hosts indicated that a combination of forest policy instruments have ensured sustainable management of the Finnish forest and the protection and enhancement of existing carbon stocks. Sustainable forestry also served as the main criterion for government grants under the Act with the total amount of grants in 1997 estimated at Fmk 182.8 million and loans at Fmk 6 million. Additionally, the afforestation of arable land received Fmk 34.1 million, in 1997, forest road construction Fmk 19.3 and renovation ditching Fmk 12.35 million. The Forest Environment Programme and Forest 2000 Programme described in the NC2 have been replaced by the new National Forest Programme 1998, which is under preparation. The new programme covers forest management and protection, forest utilization and marketing, and research and development.

H. Cross sectoral measures

41. The Association of Finnish Local and Regional Authorities, comprising 452 municipalities as members, presented information on the “Cities for Climate Protection Finland Campaign”. This campaign, run in collaboration with the International Council for

Local Environment Initiatives (ICLEI), profiled energy use and emissions for 1990, forecast energy use and emissions, established a reduction target, developed and finalized local action plans to reduce energy use and emissions at the municipality or city level and also commenced implementation of the identified measures. In 1998, 21 cities were members. The 1997 Tampere climate conference of municipal leaders passed a resolution requesting the national Government to address taxation, and the need for municipalities to have a national support programme and financial resources for mitigation research. The Helsinki metropolitan area estimated that, if no measures to reduce CO_2 emissions were undertaken, then emissions between 1990 and 2010 would grow from 7.4 to approximately 9 million tonnes. Helsinki under the URBAN CO_2 project, had a goal of reducing GHG emissions by 17 per cent by 2010, in comparison to 1991 levels.

IV. PROJECTIONS AND EFFECTS OF MEASURES

42. The NC2 included projections of CO_2, CH_4, N_2O and new and precursor gases until the year 2020. The NC2 energy scenarios were constructed using a combination of econometric analysis with a bottom-up or sectoral approach, the reconciliation of the two being done by a series of side calculations involving expert judgement, and coordinated by the Energy Department at the Ministry of Trade and Industry (MTI). This section focuses primarily on the CO_2 emissions from the energy sector based on the model projections of energy demand for the economy, with a lesser emphasis on the forest carbon balance and the non-CO_2 gases outside the model. Because of the limited amount of data on the expected behaviour of Finnish energy markets after liberalization, the country also used expert judgment. Additionally, given the features of the Finnish economy, where industry is very energy-intensive**,** detailed modelling of industrial processes was important to evaluate future energy and emission trends. Consequently, the model considered pulp and paper production, basic metal and the chemical industry, which together are responsible for around 80 per cent of industrial energy consumption.

43. The team examined compliance with the UNFCCC guidelines, and the transparency and comparability of the projections. Although the projections were presented by gas and sector for both the energy and non-energy sectors, the limited detail in the NC2 made it difficult to judge the actual progress since the NC1. The host country used unadjusted inventory data in the projection exercise. The team felt that a description of the model used, and intermediate indicators of progress of implemented measures for CO_2 and non-CO_2 gases, could find inclusion in future submissions**.** The team commented on the difficulty of identifying the effect of individual measures although some estimates were provided for implemented measures only for CO_2 reduction. The linkage between the measures implemented after 1990 for reduction of CO_2 emissions and the scenarios developed to assess future trends in CO_2 did not have a transparent connection. This was because the implemented measures such as market liberalization, energy taxes, and voluntary agreements were included in the energy market scenario (EMS) or baseline scenario. Thus there was no “without measures” scenario. The remaining two energy policy scenarios, EPO1 and EPO2, which are also “with measures scenarios”, differed primarily in the choice of the electricity generation options for new baseload capacity to meet the projected electricity demand. Because of the recession experienced in

Finland in the early nineties, a new exercise on energy scenarios was performed with 1995 as the base year. The team noted that the recession made the identification of the effects of the measures related to energy consumption difficult, and enquired whether it would be possible to use methods that would distinguish effects such as those of recession on the aggregate level of activity and structure of the economy, from the effects of measures. According to the hosts the energy scenarios of the MTI are developed to facilitate government decision making. This is why they show the range of effects of new measures. In the developed scenarios there are many extreme assumptions such as the quick penetration of advanced energy policies in all end use sectors. In the demand scenarios, the net effect of various development assumptions have been analysed in the model according to the main factors. The effect of economic growth, energy price and technology development are differentiated. Factors such as the liberalization of the energy market are outside the analysis because their full effects are not known due to lack of data.

44. The scenarios are based on a historical time series covering decades. The changes between the NC1 and the NC2 included a change of base years chosen for the energy scenarios developed for policy making purposes, with the NC1 projections being based on 1980 and 1990 data, and the NC2 projections on 1995 data. Because of the recession, the starting point of the absolute value of GDP (at 1990 prices) was the same, implying that in the absence of radical changes in the other assumptions, the conclusions drawn from the energy scenarios of NC1 would be the same as those in NC2, with a lag of five years, unless structural changes had occurred in the economy in the interim period.

45. CO_2 emissions until 2025 were examined for the three energy scenarios mentioned above. A key factor influencing the level of CO_2 emissions is the choice of the electricity generation options for new baseload capacity. In the EMS, the assumption was that, for economic, technological and other reasons, hydropower, nuclear power or other CO_2-free forms of energy generation could not be expanded in Finland, leaving generation primarily coal-based. EPO1 explored a greater use of natural gas (including in power generation) and wood, whereas EPO2 studied the expansion of the electricity generating system, with nuclear as an option. In all scenarios, net imports were assumed to continue at the same level as at present, namely an average net import of 8 TWh. The team gathered, however, that there were major uncertainties associated with that assumption. Economic growth was assumed to be identical for EPO1 and EPO2 at approximately 2.5 per cent per annum till 2025, with the structure of the economy showing no dramatic change. To enable an assessment of the effects of energy taxation in conjunction with economical use of energy, taxation in the EPO's scenarios show a rising trend in comparison to the EMS scenario.

46. The NC1 and the NC2 differ in their handling of the demographic scenarios, with a falling trend in the NC1, and a rising trend in the latter. Population trend, economic growth, structure of the economy and world market prices for fuels were assumed to be the same in the EMS and EPO scenarios. A single macroeconomic scenario underlies both the EMS and EPO scenarios according to the English version of the NC2, whereas sensitivity analysis regarding economic growth and structure of the economy was carried out in the Finnish version of the

report, according to information provided to the team. The structure of the economy was assumed to show no dramatic change throughout the period but included an altered industrial structure, with electronics gaining importance at the expense of other manufacturing industry, manufacturing industry assumed to grow in importance at the expense of agriculture, building sector, with services having the same share in 2025 as in 1995. Altered population growth and taxation was also assumed in the NC2. Industry was expected to grow at an average rate of 3 per cent annually, with a faster growth of 4 per cent during the period 1995-2005. The energy-intensive sectors of industry were not expected to grow as fast as the other industrial subsectors, with the result that the future manufacturing sector would become less energy-intensive than at present.

47. For the EPO scenarios, the underlying assumptions included accelerated penetration of new energy technologies and changed consumer behaviour. The EPO1 included assumptions on restrained demand for energy, more use of natural gas and biofuels, increased world market energy prices, more stringent taxation (domestic choice and the coordinated energy taxation at the EC level), increased penetration of new energy technologies and more stringent energy regulation. In the EPO2 scenario, assumptions included an increase of approximately 2000 MW in nuclear power production, no additional large coal power plants, and natural gas replacing coal. Less natural gas would be used for electricity generation in comparison to EPO1.

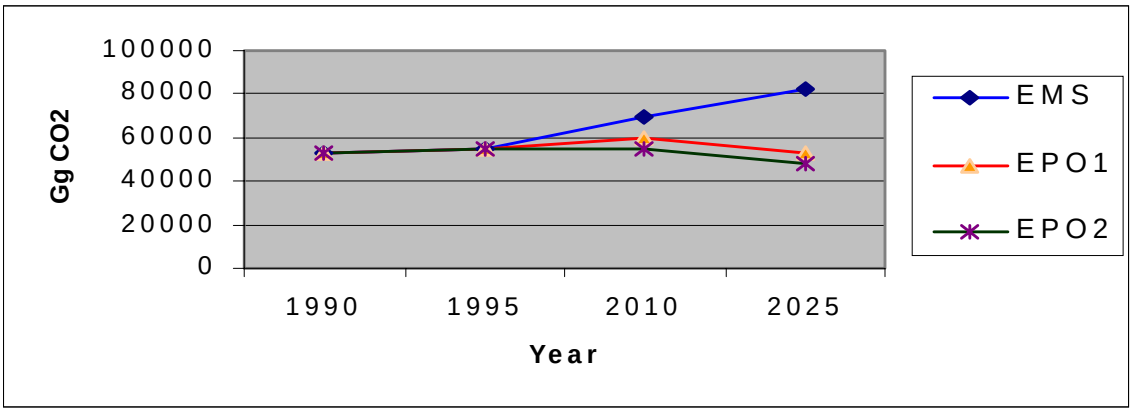
48. The role of renewable energy in the energy scenarios received limited treatment in the NC2. At present hydropower potential is almost exhausted. Additionally, during the visit the review team received detailed information about the probable baseline and the use of the different biofuels in the period up to 2025, values consistent with projections made by the Technical Research Centre of Finland (VTT) with biofuel use increasing in all scenarios. Prior to 2010 (1998-2010) the scenarios predict a stable growth in use of industrial wood waste, and minimal growth of other biofuels before 2000. After 2010, the EMS scenario predicts limited growth in use of industrial wood waste.

49. For the transport sector, the NC2 assumed a decline in energy intensity based on improved average fuel consumption of cars and annual distances travelled, but the evolution of the number of vehicles (+65 per cent) is the same in the baseline scenario for both communications. Assumptions on the decreasing mobility associated with an ageing population were also made.

50. The EMS uses current procedures and taxation levels, whereas the EPO uses current procedures and increased taxation levels. The team felt that the results of EPO2 would only be plausible if the previous procedures of taxation were in place, i.e. taxation of input fuels for power generation, which was not the case. Instead, the EPO2 assumes that nuclear power is needed if CO_2 emissions are to be reduced further than in EPO1 in the 2020s. Additionally, in the same context, the EC has agreed to cofinance along with Nordic gas companies a feasibility study of the Nordic Gas Grid. This Gas Grid linking Denmark, Norway, Sweden and Finland will improve security of gas supply, and when operational will allow for the EC gas directive to be applied to the Finnish gas market, improving the prospects of new electricity capacity based

on gas being installed, and helping to achieve stabilization of CO_2 emissions in the 2020s, as illustrated in the EPO1 scenario.

Figure IV. Projected emissions of carbon dioxide under the EMS, EPO1 and EPO2 scenarios, 2010 and 2025 (Gigagrams)



51. For the EMS scenario, CO_2 emissions from fossil fuel and peat combustion, were expected to be 70,000 Gg in 2010, 79,000 Gg in 2020 and 82,000 Gg by the year 2025. For the EPO scenarios, the increase in emissions was expected to continue till 2005. For the EPO1 scenario the CO_2 emissions from fossil fuel, peat, and wood-based fuel combustion, are predicted to be: 60,000 Gg in 2010 and 53,000 Gg in 2020. The CO_2 emissions under the EPO2 scenario were predicted to be 55,000 Gg in 2010 and 48,000 Gg in 2020. Both EPO1 and EPO2 foresaw a decreasing trend in CO_2 emissions. Figure IV represents the CO_2 emissions under the EMS, EPO1 and EPO2 scenarios.

52. The team examined the scenario results with respect to the UNFCCC stabilization target for 2000, the factors which would determine success in achieving this target and finally the actual emission estimates for the most recent years for which data were available. Clearly the recession that occurred in Finland in the early nineties slowed down emissions and made an assessment of measures in place difficult, although some limited efforts in this direction were made. Another fact complicating the team's examination of the scenarios and the likelihood of the country meeting the stabilization target in 2000 has been the submission of varying estimates of CO_2 emissions for 1990. It was also felt that the two major determinants of patterns of future CO_2 emissions would be a) the likely increase in industrial electricity demand, stemming from the assumption of sustained economic growth, and b) the extent of structural change in the economy. In light of these facts the team concluded, given the good short-term economic outlook and the fact that the energy sector has considerable inertia in responding to specific measures, that the UNFCCC stabilization target was unlikely to be achieved. Additionally, the team noted that in the EPO1 scenario, stabilization is likely to be achieved through an enhanced use of natural gas, technological change, and taxation. In the post 2000 period, the EPO1 and EPO2 scenarios foresee stabilization of CO_2 emissions at close to 1990 levels by 2025 (EPO1) or below 1990 levels (EPO2) in 2025.

53. Both scenarios of the forest carbon balance for the period 2000 to 2020 assume a 2 per cent increase in wood demand till 2000, thereafter levelling off in the first scenario and increasing by 1 per cent in the second scenario. The changes in carbon stock forming the bases for the projections were determined by wood increment dynamics, which in turn were influenced by the changing age structure of forests over time, and full reforestation of all harvested areas, were similar for both scenarios, with differences showing after 2010. The annual growth of the stemwood stock was assumed to remain at 3.9 per cent, with a levelling off in the future. The sink capacity of the forests is expected to level off in 2000 in both scenarios at approximately 16,000 Gg CO_2 per year.

54. Forestry projections for the next 10-15 years suggest that apart from government plans to improve existing or establish new forest reserves, the forest area will not undergo any significant change, because there will be only limited conversion of agricultural land to forests. Linear growth of wood increment is predicted, with current CO_2 sequestration (referred to as uptake in the NC2) of 97,000 Gg rising to 112000-114000 Gg CO_2 in 2010. The other component, drain which refers to all types of harvesting, harvesting residuals and natural mortality is likely to be determined by macroeconomic factors but the associated high uncertainty prevented Finnish experts from including such issues in the scenarios developed. As a result, the extremely simple assumption of an increase in drain of 2 per cent per year up to 2000 was made. According to the first scenario, the minimum scenario, the drain would be approximately 91,000 Gg CO_2 in 2010, whereas under the maximum scenario it would be 100,000 Gg CO_2 in 2010 and 110,000 Gg CO_2 in 2020. Thus the net sink could range from 12,000 to 23,000 Gg CO_2 in 2010 and 4,000 to 34,000 Gg CO_2 in 2020. The country team indicated that more precise projections were likely due to the ongoing preparation of the Finnish National Forest Programme.

55. The projections for new gases in the NC2 reflect estimates based on bulk imports of substances. During the visit, fresh preliminary projections were presented, which are expected to be revised in the future. The values for HFCs and PFCs are in general close to those of the NC2 (indicative of a growth in HFC emissions by several times till 2020, and PFC emissions remaining close to zero). The growth of SF_6 emissions is similar to that given in the NC2, but the absolute values were several times smaller than in the communication. No projection of international bunker fuel emissions was included in the NC2.

VI. ADAPTATION MEASURES

56. Some research on adaptation has been done under the Finnish Research Programme on Climate Change (SILMU) programme on forestry and agriculture, as reported in the NC2.

VII. FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

57. The budget allocation for development cooperation has been cut significantly since 1991, when it amounted to 0.7 per cent of GDP. In 1995, it amounted to 0.4 per cent, owing to budget cuts entailed by the recession and the country's financial situation. It fell to 0.35 per cent in

1997, and remained at 0.35 per cent in 1998 and is expected to continue at this level till 2000. The 1996 cabinet "Decision in principle on Finland's development cooperation", details and clarifies the principles and means by which Finland can attain the goal of 0.4 per cent, although the overall goal remains 0.7 per cent of the GDP. Environmental issues covered under the heading of sustainable development received a perceptible increase in funding with support being directed towards environmental programmes and projects, and institutions, including non-governmental organizations and those institutions relating to legislation and the development of project design guidelines. These projects have included support in meteorological measurement and capacity building in countries of southern Africa and central America.

58. Finland made bilateral financial contributions of approximately US$ 8.4 million during 1996. This consisted of governmental grant assistance, concessional credit schemes and cooperation with non-governmental organizations, primarily directed towards the forestry and energy sectors with projects on energy efficiency, energy conservation, renewable energy, forest conservation, forest management, reforestation, research, institutional support and development activities. Two such bilateral projects relate to the implementation of the UNFCCC in Nicaragua (1998-2001) and in Costa Rica. The Nicaraguan project, estimated to cost Fmk 12 million, is expected to quantify the potential for GHG offsets under the clean development mechanism, establish costs, and develop a pilot pipeline of potential activities implemented jointly (AIJ). Some of the other elements include assistance in preparation of the national communication and national GHG inventory, and strengthening of climatological research and the hydrological network. The Costa Rican project, whose memorandum of understanding was signed in March 1998 with a budget of Fmk 100,000, is expected to identify possibilities for cooperation, conduct regional workshops and seminars, and examine the possibilities for investment in certified emission reductions.

59. Contributions have been made to the Global Environment Fund, other multilateral institutions such as the World Bank, Inter-American Development Bank, United Nations Development Programme, United Nations Environment Programme, EC aid programme, and the Nordic Development Fund. The total multilateral contribution in 1996 was US $ 9 million. The team was informed that, except for the US $ 2 million contribution in 1996, all funding to the GEF was considered as "new and additional". Finland is also actively considering possible projects under the proposed clean development mechanism and has made a preliminary commitment in principle to provide funding for the proposed Carbon Initiative Fund being set up by the World Bank.

60. Finland is actively collaborating with Estonia, Latvia, Lithuania and the Russian Federation. Some of the joint technical aid projects mentioned in the NC2 are: the support for the restructuring of the Narva power plant in Estonia involving a pilot-scale sulphur reduction device, oil-shale mining in Estonia, modernization of several power plants in Poland and upgrading of district heating systems**.** No information on the private sector initiatives in technology transfer was given in the NC2. Activities implemented jointly in Finland could be

considered as a rational continuation of the policy of joint environmental projects on air and water pollution with neighbouring countries, although to date there are no official AIJ projects.

VIII. RESEARCH AND SYSTEMATIC OBSERVATION

61. The SILMU programme, conducted during 1990-1995 with an annual budget of approximately Fmk 15 million defined the direction of climate change research. SILMU was reviewed during the first in-depth review visit. After 1995, forestry, climatology and biological research continued at the Finland Meteorological Institute, the Universities of Joensuu and Helsinki, and the Academy of Science. In 1999, based on the recommendations and conclusions of SILMU, a new programme focusing on the impact of climate change on high latitude areas, mitigation options and costs, and agricultural economics was planned. Finland's tradition of meteorological and climatological studies, with a network of 3 meteorological observatories, 46 synoptic stations, 87 climatological stations and 57 automatic stations has led to the construction of a climatological time series of more than 100 years. Finland also actively cooperates with the World Meteorological Organization (WMO) Global Atmosphere Watch (GAW) Programme, the IPCC, European Monitoring and Evaluation (EMEP) Programme and others. There is ongoing monitoring of CO_2, CH_4, N_2O, and O_3 concentrations, and research on the atmospheric chemistry, balances and aerosol formation processes of GHGs and their precursors. The country also cooperates on meteorology within various development cooperation projects, in an attempt to fill the gaps in the observational network. In the 1990s the projects have included systems for atmospheric soundings (Nicaragua, Costa Rica, Ecuador, Chile, Bangladesh, Myanmar, Papua New Guinea, Sudan, Tanzania, Tunisia, Uganda, Zimbabwe, Angola, Botswana, Cape Verde, Cote D' Ivoire, Ethiopia, Eritrea, Guinea and Mozambique), rehabilitation and improvement of the Sudan meteorological department among other projects.

62. The team was briefed on research and development activities which have received priority and a steady increase in investment. In 1997, the expenditure on such activities amounted to Fmk 16.7 billion, approximately 2.7 per cent of GDP. The team learnt of the programmes financially supported by the Ministry of Trade and Industry on energy efficiency, electricity production, transportation and renewables. As of January 1995, these programmes have been the responsibility of the Technology Development Centre (TEKES), which is a government agency under the supervision of the Ministry. Renewables received around 21 per cent of funding of which 12 per cent went to bioenergy and 1 per cent to wind energy), the low support for wind energy being due primarily to import of such installations from Denmark and Germany and limited local production. The government has decided to invest a significant part of the funds generated by the sale of state-controlled companies in research and development.

63. In 1998 the Technology Development Centre (TEKES) had eleven national energy technology research and development programmes. In addition, the Technical Research Centre of Finland (VTT) has its own in-house programmes which are self funded and are supported by the industry and in some cases by TEKES. These programmes play a significant role in the research and development with research directed to forests, peat and bioenergy technologies,

industrial use of energy, district heating and CHP, recycling, and remote sensing. The main focus of TEKES is the preparation of national technological policy and coordination of international technological cooperation, including within the EC. VTT, which is funded by TEKES, private companies, and international sources focuses on biofuels, combustion research, biomass gasification and energy economy issues. The importance of international linkages between the EC, Nordic countries and others was stressed by the host country.

IX. EDUCATION, TRAINING AND PUBLIC AWARENESS

64. Education and training activities were dealt with to a limited extent in the NC2, with mention being made of the media outreach programmes on televison and radio, and a publication resulting from the SILMU programme. In general, the level of public awareness on the subject of climate change appeared high as was evidenced by responses under the PAATE Summary programme, mentioned in the NC2. The team was informed that climate change courses are conducted in the Finnish universities and research and graduate schools. The education, training and fellowship component played an important role in Finnish technical aid projects in developing countries, especially in programmes under WMO. MOTIVA, whose primary focus was information dissemination, had ongoing programmes for school children, industry, car drivers and the police. The team gathered that there was a public awareness programme on environmental impact assessment of large power plants.

X. CONCLUSIONS

65. The Finnish Government has taken a number of steps towards establishing an institutional and legal framework to address climate change. Working groups have been constituted to deal with emerging issues of joint implementation, emissions trading, the clean development mechanism, sinks, peat and peat lands. Economic considerations apparently predominate with the Ministry of Finance and the Ministry of Trade and Industry playing a major role in both energy policy and ecological tax reform. Representatives from both non-governmental organizations and local government voiced concern on their input being adequately reflected in the output of the Climate Committee.

66. The national GHG inventory broadly complied with the IPCC reporting guidelines. Some of the elements which need further strengthening include the presentation of summary information on GHGs, detailed worksheets for the land-use change and forestry sector, agriculture, and fuel combustion, and submission of the national inventory to the secretariat on an annual basis. Prior to and during the visit, some additional, substantive revisions to the CO_2 and CH_4 estimates contained in the NC2 (including 1990) were presented by national experts, involving revised emission factors or activity data. As a result the estimates of CO_2 emissions for 1990 were increased by 10 per cent. The NC2 included the total CO_2 emissions for 1995, estimated to be 56,050 Gg. This emission estimate was under revision at the time of the visit. Further, the Ministry of Trade and Industry made preliminary estimates of total CO_2 emissions for 1996 and 1997 of 61,000 and 58,000 Gg CO_2, respectively. The country's work on life-cycle analysis of peat use, forest inventories and information systems, and carbon flow in wood

products may be useful for other Parties with similar indigenous resources. With regard to the period 1990-1995, the major changes in emissions related to biomass combustion and energy and transformation. Industrial emissions declined as a result of the fall in cement production.

67. Finland reported policies and measures by policy instrument instead of by sector and gas. Additionally a limited identification of the CO_2 reduction potential by measure was included. A significant amount of additional information and insight was provided to the review team, affording a more complete picture of the national climate change policy. The country favoured usage of economic instruments such as the carbon dioxide/energy tax, although substantive changes in its structure since its origin had lessened its environmental impact. The high penetration of CHP in power generation has been possible thanks to the wide use of district heating and to the large number of forestry industry installations. Another positive feature in the industrial sector was the voluntary agreements between the Ministry of Trade and Industry and the Confederation of Finnish Industry and Employers, aimed at reducing specific energy consumption. In the building sector, monitoring of audits of both industry and service buildings had shown an efficiency improvement potential of 20 to 25 per cent in heating, 6 to 8 per cent in electricity and 7 to 15 per cent in water consumption, and an estimated average payback time of two years, at little or no additional costs. Future reporting could be improved by the inclusion of costs, the level of implementation of individual measures, and clear distinctions between planned and implemented measures.

68. The projections were presented by gas and for energy and non-energy sectors. No scenario could be considered as a “without measures” scenario as all three scenarios took into account various measures. Based on the available information, it appears that the UNFCCC stabilization target is unlikely to be reached because of the favourable short-term economic outlook and the fact that the energy sector has considerable inertia in responding to specific measures. A description of the model used, intermediate indicators of progress, and distinctions between currently implemented measures and any identified additional measures, could be included in future reporting. The EPO1 and EPO2 scenarios foresee stabilization of CO_2 emissions at close to 1990 levels by 2025 (EPO1) or below 1990 levels (EPO2) in 2025.

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