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

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

A. Introduction

1. The secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) received Sweden's third national communication, hereinafter referred to as the NC3, on 30 November 2001. An in-depth review was carried out between December 2002 and November 2003, including a visit to Stockholm from 2 to 6 December 2002. The review team consisted of Ms. Eglantina Bruci (Albania), Ms. Thelma Krug (Brazil), Mr. Janis Rekis (Latvia), Mr. Ture Hammar (Denmark) and Mr. Harald Diaz-Bone (UNFCCC secretariat, coordinator).

2. The review team had a number of meetings and discussions on all aspects of Swedish climate policy as outlined in the NC3. During these meetings with governmental officials, academics and environmental non-governmental organizations (NGOs), the team was given a wealth of additional materials and information that supported the information provided in the NC3.

B. National circumstances

3. ***Geography:*** With a national territory of 449,964 km^2, Sweden is the third largest country in Europe. The centrepiece of Scandinavia, it features a long coastline bordering on the Baltic Sea, Gulf of Bothnia, Kattegat and Skagerrak, as well as a long mountain chain with several peaks above 2,000 m in the west. The country borders on Norway in the west and north, Finland in the north-east, and Denmark in the south. Its terrain, mostly flat or gently rolling lowlands, stretches some 1,500 km from relatively densely populated areas in the south to vast and sparsely populated regions beyond the Arctic Circle. Forests, wetlands and mountain areas are the prevalent forms of land use, accounting altogether for almost 81 per cent of the national territory. Iron ore, wood and hydropower are Sweden's main natural resources, forming the basis of its long tradition in mining and forestry. The temperate and moist climate, with an annual mean temperature of 4°C and precipitation of 650 mm, is influenced by the warming Gulf Stream. The effect of this is that winters are 20–30°C warmer than those at the same latitudes in Canada and Siberia.

4. ***Demography:*** Sweden's slight growth in population from 8.57 million in 1990 to 8.87 million in 2000 comes mainly from constant immigration that more than compensates for the low and continuously decreasing birth rate. Nearly 85 per cent of the population lives in urban areas; one Swede in three lives in one of the three main conurbations, Stockholm, Gothenburg and Malmö. Rural depopulation is widespread, and conurbations, especially in the south, benefit from migration. The Swedish population is ageing as a result of a drop in the birth rate and an increase in life expectancy. Long-term demographic trends show a peak in population at 9.5 million in 2050.

5. ***Economy:*** Following a three-year period of economic recession in the early 1990s, Sweden subsequently benefited from relatively high economic growth and low unemployment rates. In the period 1990–1993, the gross domestic product (GDP) fell by an annual average of 1.6 per cent and unemployment soared from 1.5 per cent to more than 15 per cent. Between 1993 and 2000, the GDP grew by an annual average of 3.2 per cent. This was mainly due to rationalization in trade and industry, modernization of engineering industries, and a boost in the telecommunications and pharmaceutical sectors. The average annual increase in these last two sectors was approximately 20 per cent and 13 per cent, respectively. By 2001, when economic growth started to slow down again, the official unemployment rate had returned to a relatively low level of 4.1 per cent.

6. The share of exports in the GDP more than doubled, from 20 per cent of GDP in 1990 to 43.7 per cent in 1999. The service sector generated more than two thirds (67.8 per cent) of total GDP, and industry generated less than one third (30.3 per cent). While capital- and labour-intensive industries were declining in significance, basic industries including iron and steel, pulp and paper, mining and forestry continued to play an important role in some regions of the country.

7. Disposable annual income amounted to SEK 111,700 (EUR 12,290) per capita. Sweden ranked first in the 2003 UNDP Human Poverty Index[1] (HPI) for rich countries, and third in the Human Development Index (HDI).

Table 1. Main macroeconomic indicators and GHG emissions for Sweden[a]

	1990	2000	Change (%) 1990–2000
Population (millions)	8.57	8.87	+3.6
Gross domestic product – GDP (billions USD of 1995)[b]	171.03	203.80	+19.2
Industrial Production Index (1995 = 100)	88.00	125.30	+42.4
Total primary energy supply – TPES (Mtoe)[c]	46.67	47.49	+1.7
Electricity consumption (TWh)	135.54	138.91	+2.5
Greenhouse gas (GHG) emissions[d] (Tg[e] CO_2 equivalent)	72.76	68.95	–5.2
GHG emissions per capita (Mg CO_2 equivalent)	8.49	7.77	–8.5
GHG emissions per GDP unit (kg CO_2 equivalent per USD of 1995)	0.425	0.338	–20.5

[a] Data for population, GDP, TPES, and electricity are from "Energy balances of OECD countries, 1999-2000", OECD/IEA, Paris, 2003. GHG data are from Sweden's GHG inventory submission in 2003.
[b] Calculated using the method of purchasing power parities (PPP).
[c] Millions of tonnes of oil equivalent.
[d] Without accounting for land-use change and forestry (LUCF).
[e] One teragram (Tg) is equal to 1,000 gigagrams (Gg) or one million tonnes (Mt).

8. ***Energy:*** Between 1990 and 2000, the total primary energy supply (TPES) grew by 2.5 per cent, with a slight shift from nuclear to combustible renewable energy sources (RES). In 2000, Sweden's energy profile showed a relatively high share of hydropower (14 per cent) and other RES (18 per cent), when compared to other industrialized countries. The share of nuclear energy dropped from 35–42 per cent during the 1990s to 31 per cent in 2000. The drop in nuclear TPES in 2000 was due to above-average rainfall (contributing to greater availability of inexpensive hydropower) and, to a lesser extent, the closure of the Barsebäck nuclear power plant (NPP) unit 1 in November 1999.[2]

9. Since the primary aim in energy policy during the 1970s and 1980s was to reduce the dependence on fossil fuels, in the 1990s the TPES depended to only a minor extent on oil products (28 per cent), coal (5 per cent) and natural gas (1 per cent); the share of fossil fuels for generating electricity is amongst the lowest in the world (5 per cent). The small share of fossil fuels in the TPES (35 per cent) is the main reason for low per capita CO_2 emissions, about half of the mean value for members of the Organisation for Economic Co-operation and Development (OECD).

10. In 2000, per capita CO_2 emissions amounted to 6.1 Mg; total greenhouse gas (GHG) emissions per capita amounted to 7.8 Mg CO_2 equivalent. Partly because of a continuous decoupling of industrial production growth and fossil fuel consumption since the mid-1970s, Sweden's economy reduced its GHG emissions intensity considerably, by 20.5 per cent, between 1990 and 2000 (see table 1). Other reasons include the growing share of the service sector in the gross national product (GNP).

[1] The HPI ranks rich countries according to their national levels of poverty, illiteracy, unemployment and life expectancy. The 2003 UNDP Human Development Report notes that Sweden, despite a lower per capita income than the United States, has, on average, a higher proportion of adults who are functionally literate and fewer living in poverty.

[2] For the same reason, Sweden changed its role from a traditional electricity exporter to an electricity importer. In 2000, net electricity imports accounted for 0.8 per cent of the TPES (net exports in 1990 were 0.3 per cent of TPES).

11. ***Political structure:*** Sweden has been a constitutional monarchy since 1809. The 1975 democratic constitution vests legislative power in the national Parliament, the Riksdag. The Council of Ministers, headed by the Prime Minister, assumes executive authority over domestic and foreign policy. Legislative and executive competences are distributed between the central state, the 21 provinces and 289 municipalities. The traditional welfare state has preserved an armed neutrality over the last two centuries. Since 1995, Sweden has been a member of the European Community (EC).

12. ***Institutional arrangements:*** The Department of Environmental Quality within the Ministry of the Environment (MoE) is responsible for the overall coordination of national climate change policy. The Environment Protection Agency (Swedish EPA) has a mandate to oversee activities aimed at meeting the commitments under the UNFCCC. The Division for Energy, Forestry and Primary Industries within the Ministry of Industry, Employment and Communications is responsible for the flexible mechanisms and for climate change policy measures in the energy sector. The Ministry of Finance is responsible for climate-related taxation measures.

13. Responsibility for the different aspects of climate policy is shared between several central agencies, including the Swedish EPA, the Swedish Energy Agency, the Swedish Institute for Transport and Communication Analysis (SIKA), four different transport agencies, the Swedish International Development Agency (SIDA), Statistics Sweden (SCB), the National Board of Housing, Building and Planning, the National Board for Industrial and Technical Development (NUTEK) and the recently created agency for innovation systems (VINNOVA), the National Board of Agriculture (SJV), the National Board of Forestry (SKS) and the Swedish Meteorological and Hydrological Institute (SMHI).

14. County administrative boards and municipalities also play an important role in formulating and implementing local plans for social planning, energy conservation, transport planning and waste management. The Division for Energy, Forestry and Primary Industries and the Division for Transport Policy, both within the Ministry of Industry, Employment and Communications, hold the main responsibility for energy, industry and transport policy.

C. Key developments in climate change policies

15. Sweden ratified the UNFCCC in June 1993 and has submitted three national communications, in 1994, 1997 and 2001. During the visit, the review team analysed the information provided in the NC3 together with data from the most recent inventory submission of Sweden to the UNFCCC secretariat, which contains data on 1990–2000 emissions trends. The results of this analysis suggest that Sweden contributed to achieving the aim of the Convention, as its total GHG emissions decreased by 5 per cent in the period from 1990 to 2000 without considering CO_2 from LUCF, and by 21 per cent if CO_2 from LUCF is considered. Within the different economic sectors, the greatest emission reductions were achieved in energy supply (–18 per cent), energy use in the residential/commercial sector (–28 per cent) and waste management (–21 per cent).

16. Sweden signed the Kyoto Protocol in April 1998 and ratified it jointly with the other EC Member States in May 2002. Its Kyoto target under the EC burden-sharing agreement[3] is to keep total GHG emissions during the first commitment period (2008–2012) below 104 per cent of the 1990 level.

17. The 1993 Riksdag Decision on Climate Policy included the target of stabilizing Sweden's CO_2 emissions from fossil fuel combustion in 2000 at 1990 levels, and reducing them thereafter. This national GHG emission reduction target was reiterated and amended in 1999, when the Riksdag incorporated the reduction of climate change impacts into the national set of environmental quality

[3] "European Council decision 2002/358/CE of 25 April 2002 concerning the approval, on behalf of the European Community, of the Kyoto Protocol to the UNFCCC and the joint fulfilment of commitments thereunder."

objectives. Analysis from the most recent inventory submission suggests that this target was achieved. In 2000, CO_2 emissions from fuel combustion were 5.7 per cent below the 1990 level.

18. In the context of the 1999 Riksdag decision, Sweden's firm commitment to the long-term objective of the UNFCCC (Article 2) was reiterated. The Swedish Environmental Objectives Bill identified an atmospheric GHG concentration of less than 550 ppm CO_2 equivalent as the level that would prevent dangerous anthropogenic interference with the climate system.

19. In March 2002, the Parliament adopted the Climate Bill (Swedish Climate Strategy). This central document for Sweden's climate policy stipulates national targets and timetables for the period up to 2050 and an action programme for the period up to 2010, subject to evaluation, revision and extension at regular intervals, starting in 2004 and 2008. The short- and long-term targets of the Climate Bill include a reduction of total GHG emissions by 4 per cent during the first commitment period compared to 1990, and a reduction of per capita GHG emissions to less than 4.5 Mg CO_2 equivalent in 2050.[4] The review team noted that the Swedish short-term target is 8 per cent below, and therefore stricter than, the Swedish GHG reduction target under the EC burden-sharing agreement on the distribution of the Kyoto emission reduction target among the EC Member States.

20. In the Climate Bill it is suggested that the short-term national target for the first commitment period should be reached without the use of the flexible mechanisms or the use of carbon sinks. However, in the so-called 2004 "control station", a target that includes the flexible mechanisms will be considered. Furthermore, the government will conduct a survey on enhancement of carbon sinks. The review team was informed that Sweden does not intend to make use of carbon sinks in order to achieve its national target for the first commitment period; CO_2 removals from LUCF will be excluded from the GHG emissions balance in this context.

21. Several important policies and measures have already been implemented or adopted in recent years. For example, in the period between the NC2 and the NC3, the value added tax, the energy tax and the CO_2 tax were modified, in order to shift the tax burden from labour towards energy use, and within the latter towards the use of carbon-intensive energy sources. In 1998, several support schemes for biomass-based combined heat and power generation (CHP), district heating (DH), wind energy, and small-scale electricity generation were commissioned or improved. In 2001, in parallel with the drafting of Sweden's NC3, several new legislative documents were prepared and adopted, including the Infrastructure Bill,[5] the Energy Bill[6] as well as in the annual Budget Bill. All of these are expected to have noticeable impacts on the Swedish GHG emission levels (for more details see section III on policies and measures).

22. The review and the additional information provided during the visit led the review team to conclude that Sweden's NC3 is a comprehensive document, clearly reflecting all important aspects of the Swedish climate change policy at the time it was prepared and published. It covers the GHG inventory, policies and measures, overall and sectoral projections and all other issues required by the UNFCCC guidelines.[7]

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[4] This value is 47 per cent lower than the per capita GHG emissions in 1990 (see table 1).

[5] Government Bill 2001/02:20 "Infrastructure for a long term sustainable transport system".

[6] Government Bill 2001/02:143 "Cooperation for a secure, efficient and environmentally friendly energy supply".

[7] Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications. Document FCCC/CP/1999/7.

II. GREENHOUSE GAS INVENTORY INFORMATION

A. Inventory preparation and reporting

23. ***Reporting:*** The MoE is responsible for preparing and reporting on the Swedish national inventory. On behalf of the MoE, the Swedish EPA collects and compiles all the data and submits the relevant reports (common reporting format (CRF) and national inventory report (NIR)) to the UNFCCC secretariat. For this purpose, published data from several relevant institutions, such as SCB, SKS and the Swedish Environmental Research Institute (IVL) were used. Activity data and emission factors for energy- and non-energy-related GHG emissions from industry were based on annual environmental reports and, in some cases, on expert judgements. In January 2003, Sweden initiated the development of a national system (Article 5.1 of the Kyoto Protocol).

24. ***Comprehensiveness:*** The NC3 provides data on the Swedish GHG emission inventory for the period from 1990 to 1999, and includes emission data for the GHGs carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6), as well as for nitrous oxides (NO_X), carbon monoxide (CO), sulphur dioxide (SO_2), and non-methane volatile organic compounds (NMVOC). All major sources are covered. An estimate for CO_2 removal from land-use change and forestry (LUCF) in Sweden is also provided. Emissions of CO_2 from biomass burning and organic waste decomposition are documented and emissions of CO_2 from bunker fuels are also reported. The base year for CO_2, CH_4 and N_2O is 1990; the base year for fluorinated gases has not yet been decided. The review team noted that, compared to the NC2, the NC3 chapter on inventory marked a considerable improvement and extension of reporting on the Swedish GHG inventory. Still, some potential for further increasing the consistency and transparency of inventory reporting was identified, including a more detailed description of the factors underlying the emission trends and a more detailed explanation of the recalculations that were undertaken, including their effects on the emission trends.[8]

25. ***Methodology:*** The inventory data for the years 1990–1999 as reported in NC3 were calculated according to the Revised 1996 IPCC Guidelines.[9] The information provided in the NC3 chapter on GHG inventory was largely consistent with that provided in the revised 2001 annual inventory information submission (NIR 2001, see table 2). The Swedish GHG inventory was subject to major recalculations in autumn 2000 and 2001, to improve consistency of GHG emission trends. Therefore, inventory data as presented in the NC2, in the NC3 and in Sweden's latest inventory submission from 2003 (NIR 2003) differ slightly. In particular, the development of national emission factors for N_2O emissions from manure management and agricultural soils and for fuel combustion increased the estimate of total N_2O emissions by 142–151 per cent. The revision of the IPCC methodology for N_2O emissions from agricultural soils, the update of emission factors and minor corrections in the activity data in this subsector resulted in a further increase in total N_2O emissions by 26–28 per cent.

26. The review team acknowledged the submission of the GHG inventory using the CRF tables and encouraged Sweden to continue to improve the national system, to recalculate the emission trends where necessary and to address the existing gaps. The inventory for the year 2000 was generally assessed to be transparent. Uncertainties were documented only qualitatively. The review team was informed that since 2001 under the umbrella of Swedish Environmental Emissions Data (SMED; a consortium of SCB,

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[8] For a detailed description of methodologies, the NC3 refers to the 2001 NIR.

[9] *Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories*.

IVL and SMHI) a number of successive studies were performed on particular emission sources in Sweden, with the aim of reducing uncertainty in the estimation of GHG emissions and removals.

Table 2. Estimates for emissions in 1990 and 1995: results of recalculations

	Gg CO_2 equivalent				Change (%)		
	NC2	NC3	NIR 2001	NIR 2003	NC2 – NC3	NC3 – NIR 2001	NIR 01 – NIR 03
1990 total CO_2	55 445	55 994	55 074	56 762	1	–2	3
1995 total CO_2	58 108	58 521	58 521	59 031	1	0	1
1990 total CH_4	6 804	6 810	6 810	6 605	0	0	–3
1995 total CH_4	6 216	6 644	6 644	6 589	7	0	–1
1990 total N_2O	2 852	7 167	7 156	8 986	151	0	26
1995 total N_2O	2 852	6 892	6 892	8 825	142	0	28
1990 total GHG	66 447	70 494	69 562	72 873	6	–1	5
1995 total GHG	68 956	72 656	72 656	75 085	5	0	3

27. Except for the LUCF sector, where default IPCC emission factors were applied, mostly country-specific emission factors were used. Emission factors for CO_2, CH_4 and N_2O were derived from a number of different national studies. Some national emission factors for industrial processes were supplied by the relevant industrial partners. The following analysis of the GHG emission profile and trends is based on the data reported in the 2003 inventory submission.

B. Emission profile and trends

28. ***Overall GHG emissions:*** The Swedish GHG emissions profile shows a clear domination by the energy sector, with CO_2 as the main GHG. In 1990, CO_2 accounted for 78 per cent of the total GHG emissions (without LUCF), followed by N_2O (13 per cent) and CH_4 (9 per cent). An identical pattern can be seen for the year 2000, when the proportion of CO_2 was 78 per cent, followed by N_2O (12 per cent) and CH_4 (9 per cent). Table 3 shows the emission trends by gas in the period from 1990 to 2000.

Table 3. GHG emission trends by gas, 1990–2000

	Gg CO_2 equivalent											Change (%)[a]
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
CO_2[b]	56 489	56 762	56 003	55 677	60 304	59 031	62 464	57 623	58 775	56 649	53 766	–5
CH_4	6 631	6 605	6 708	6 754	6 678	6 589	6 553	6 461	6 310	6 113	5 862	–12
N_2O	9 109	8 986	8 823	8 926	9 133	8 825	9 031	8 938	9 120	8 705	8 600	–6
Fluorinated gases	527	520	509	525	563	640	639	750	701	772	721	37
Net GHG[c]	52 464	43 545	48 689	42 549	50 373	53 793	56 418	46 484	50 576	44 934	41 643	–21
Total GHG[d]	**72 756**	**72 873**	**72 042**	**71 881**	**76 679**	**75 085**	**78 687**	**73 772**	**74 907**	**72 239**	**68 949**	**–5**

[a] Change between 1990 and 2000, in per cent of 1990 values.
[b] CO_2 emissions without LUCF.
[c] Total GHG (with net CO_2 emissions/removals from LUCF).
[d] Total GHG (without CO_2 from LUCF).

29. Total GHG emissions (excluding CO_2 from LUCF) decreased by 5 per cent between 1990 and 2000, while total GHG emissions including net removals from LUCF decreased by 21 per cent. The decrease was mainly attributed to the decline in CO_2 emissions, which fell by 5 per cent. Emissions of CH_4 decreased by 12 per cent and emissions of N_2O by 6 per cent. A major portion of these decreases were achieved during the last 2 years (trends for 1998–2000: CO_2 –9 per cent, CH_4 –7 per cent, N_2O –6 per cent, total GHG –8 per cent). Emissions of fluorinated gases accounted for about 1 per cent over the whole period since 1990.

30. ***Carbon dioxide:*** Total CO_2 emissions in Sweden were 53,766 Gg in 2000. The major emitters were transport (36 per cent of total CO_2 emissions), followed by energy use in industry (24 per cent), energy industries (16 per cent), energy use in other sectors (14 per cent), and industrial processes (9 per cent). Removals of CO_2 in LUCF have increased by 35 per cent since 1990 and equalled

40 per cent of total GHG emissions (excluding LUCF) in 2000. They varied between 20 and 30 Tg CO_2 over the period 1990–2000, reflecting mainly the fluctuations in annual felling rates. The review team noted that the high uncertainty particularly of CO_2 emissions from forest soils (uptake and amount in soils) might change future estimates substantially. Emissions of CO_2 from international bunkers were not included in the national totals; they equalled 12 per cent of total CO_2 emissions or 9 per cent of total GHG emissions, respectively.

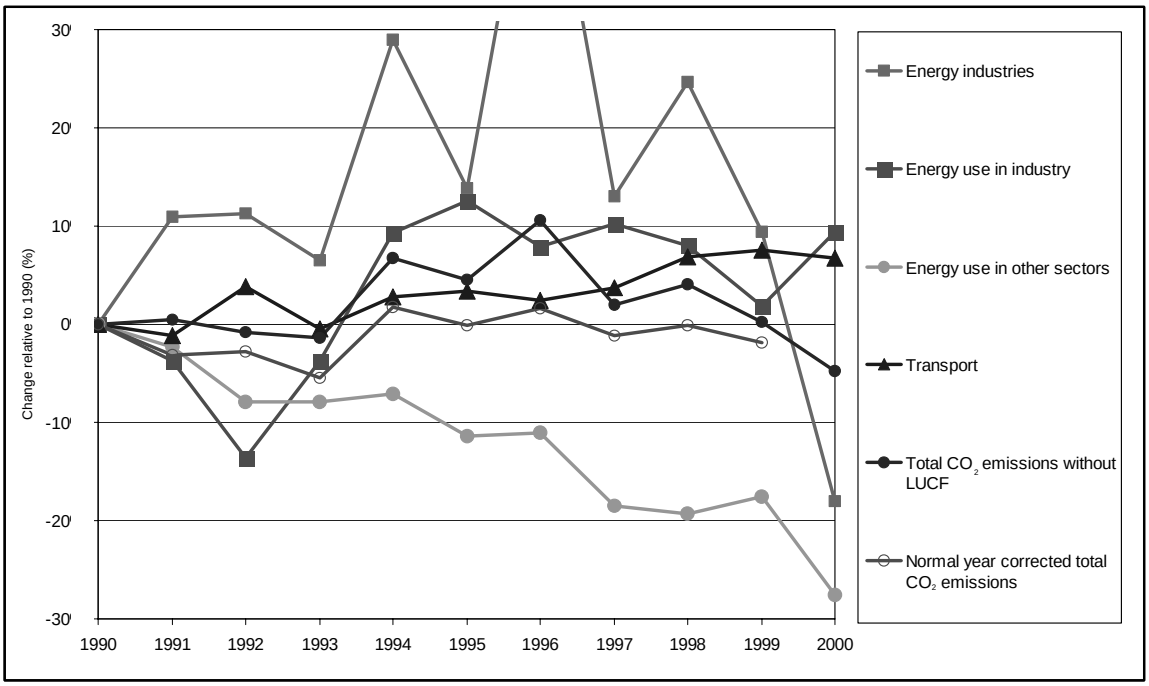
Table 4. Carbon dioxide emission trends

GHG gas source and sink categories	Gg CO_2											Change (%)[a]
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	
Energy	51 855	52 224	51 454	51 111	55 591	53 979	57 370	52 732	54 088	52 080	48 939	**–6**
Energy industries	*10 169*	*11 279*	*11 318*	*10 829*	*13 118*	*11 575*	*15 724*	*11 490*	*12 671*	*11 127*	*8 336*	**–18**
Energy use in industry	*11 567*	*11 133*	*9 998*	*11 143*	*12 637*	*13 019*	*12 478*	*12 748*	*12 494*	*11 780*	*12 652*	**9**
Transport	*18 337*	*18 131*	*19 038*	*18 256*	*18 840*	*18 955*	*18 784*	*19 015*	*19 603*	*19 726*	*19 582*	**7**
Energy use in other sectors	*10 597*	*10 348*	*9 765*	*9 753*	*9 842*	*9 386*	*9 422*	*8 633*	*8 553*	*8 740*	*7 682*	**–28**
Industrial processes	4 314	4 227	4 248	4 287	4 439	4 789	4 846	4 659	4 474	4 375	4 641	**8**
Land-use change and forestry (LUCF)	–20 292	–29 328	–23 353	–29 332	–26 305	–21 293	–22 269	–27 288	–24 331	–27 305	–27 306	**35**
Total CO_2 emissions/ removals with LUCF	36 197	27 434	32 650	26 344	33 999	37 739	40 195	30 335	34 444	29 343	26 461	**–27**
Total CO_2 emissions without LUCF	**56 489**	**56 762**	**56 003**	**55 677**	**60 304**	**59 031**	**62 464**	**57 623**	**58 775**	**56 649**	**53 766**	**–5**
International bunkers	3 497	3 649	3 819	4 162	4 803	4 831	5 072	5 778	6 493	6 598	6 549	**87**

[a] Change between 1990 and 2000, in per cent of 1990 values.

31. As shown in table 4 and figure 1, the trend in CO_2 emissions between 1990 and 2000 fluctuated with peak levels in the years 1994, 1996 and 1998. In particular, emissions from energy industries varied between a 55 per cent increase in 1996, and an 18 per cent decrease in 2000 (compared to the 1990 level). These fluctuations were due to climatic variations (mean winter temperature, precipitation, wind conditions, solar radiation) resulting in different levels of both hydropower supply and heating demand.

Figure 1. Carbon dioxide emissions: percentage change from 1990, by source[a]



[a] For an explanation of the fluctuations in CO_2 emissions from energy industries see paragraphs 30 and 31.

32. To make it possible to analyse trends in CO_2 emissions, SMHI developed the Swedish normal-year correction model ENLOSS; the NC3 reports to some extent on its method and results. Normal-year corrected total CO_2 emission trends showed a decline by 5 per cent between 1990 and 1993, broadly following the economic recession in these years (see paragraph 5). Thereafter, normal-year corrected total CO_2 emissions varied within ±2 per cent of the 1990 level (see figure 1). Analysis of these model results suggest that in particular in the year 1996, the increase in actual total CO_2 emissions by 11 per cent (compared to the 1990 level) resulted mainly from the low precipitation and cold winter temperatures, since normal-year corrected CO_2 emissions for the same year showed only a 2 per cent increase.

33. Emissions of CO_2 from fuel combustion in transport as well as from energy use in industry and from industrial processes increased by 7–9 per cent during the period 1990–2000, broadly following the increasing trend in GDP. In transport, growth in road freight transport was responsible for most of the increase in emissions, which was only partly compensated by an energy efficiency increase in the vehicle fleet of 11 per cent between 1995 and 1999. In industry, the production of iron, steel and other metals was the predominant source of CO_2 emissions and increased by 22 per cent between 1990 and 2000.

34. The steady decline of CO_2 emissions from energy use in the residential and commercial sector (by 28 per cent during the period 1990–2000) can be explained by replacement of oil furnaces by non-fossil fuel heating and by the increase (by 20 per cent) in private households connected to the rapidly expanding district heating grid. The marked increase in biomass use for district heating (by 200 per cent) simultaneously prevented growth in CO_2 emissions from this sector. These shifts in the type and content of energy supply were driven by a CO_2 tax on heat production from fossil fuels, and the subsidy for biomass-fuelled CHP.

35. ***Methane:*** Emissions of CH_4 amounted to 5,862 Gg CO_2 equivalent in 2000. Enteric fermentation accounted for the largest share (50 per cent), followed by waste disposal on land (35 per cent), and energy (9 per cent). Emissions from wastewater handling were reported not to occur, and emissions from other forms of waste were not estimated.

Table 5. Methane emission trends

GHG gas source and sink categories	Gg CO_2 equivalent											Change (%)[a]
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	
Energy	710	699	695	684	675	684	689	635	626	608	556	–22
Transport	*415*	*402*	*391*	*373*	*366*	*359*	*345*	*314*	*305*	*276*	*251*	*–39*
Energy use in other sectors	*221*	*221*	*221*	*223*	*210*	*224*	*229*	*217*	*212*	*225*	*211*	*–5*
Agriculture	3 362	3 302	3 401	3 549	3 593	3 501	3 490	3 485	3 393	3 352	3 266	–3
Enteric fermentation	*3 027*	*2 972*	*3 060*	*3 166*	*3 199*	*3 106*	*3 089*	*3 096*	*3 007*	*2 973*	*2 902*	*–4*
Waste	2 554	2 598	2 607	2 515	2 406	2 399	2 369	2 335	2 284	2 147	2 034	–20
Solid waste disposal on land	*2 554*	*2 598*	*2 607*	*2 515*	*2 406*	*2 399*	*2 369*	*2 335*	*2 284*	*2 147*	*2 034*	*–20*
Total emissions	**6 631**	**6 605**	**6 708**	**6 754**	**6 678**	**6 589**	**6 553**	**6 461**	**6 310**	**6 113**	**5 862**	**–12**

[a] Change between 1990 and 2000, in per cent of 1990 values.

36. As shown in table 5, between 1990 and 2000 CH_4 emissions declined steadily by 12 per cent overall. This was largely attributed to the decline in emissions from waste management (–20 per cent), mainly stemming from an increased number of gas recovery/energy extraction units at landfill sites (following the EU landfill directive), and in transport (–39 per cent), owing to the increased market diffusion of vehicles equipped with catalytic converters. A reduction in cattle population, stemming from, inter alia, the gradual implementation of the EU Common Agricultural Policy, was the major driver for a 4 per cent reduction of emissions from enteric fermentation.

37. ***Nitrous oxide:*** Emissions of N_2O reached 8,600 Gg CO_2 equivalent in 2000. Major sources were emissions from agricultural soils (58 per cent), fuel combustion (24 per cent) and nitric acid production (8 per cent).

Table 6. Nitrous oxide emission trends

GHG gas source and sink categories	Gg CO_2 equivalent											Change (%)[a]
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	
Energy	1 784	1 814	1 796	1 817	1 980	1 880	2 105	1 938	2 134	2 124	2 105	18
Energy use in industry	*552*	*550*	*503*	*528*	*589*	*550*	*562*	*552*	*634*	*611*	*629*	14
Transport	*428*	*449*	*483*	*494*	*513*	*524*	*561*	*584*	*577*	*626*	*673*	57
Industrial processes	871	915	882	859	831	768	739	735	818	730	700	–20
Chemical Industry	*829*	*873*	*840*	*816*	*789*	*724*	*695*	*687*	*772*	*684*	*650*	*–22*
Agriculture	6 169	5 973	5 880	5 990	6 070	5 920	5 933	6 009	5 938	5 627	5 588	–9
Agricultural soils	*5 428*	*5 250*	*5 141*	*5 317*	*5 398*	*5 305*	*5 316*	*5 367*	*5 296*	*5 028*	*5 001*	–8
Manure management	*741*	*723*	*740*	*672*	*672*	*616*	*617*	*642*	*643*	*600*	*587*	–21
Total emissions	**9 109**	**8 986**	**8 823**	**8 926**	**9 133**	**8 825**	**9 031**	**8 938**	**9 120**	**8 705**	**8 600**	**–6**

[a] Change between 1990 and 2000, in per cent of 1990 values.

38. Table 6 shows that during the period from 1990 to 2000, total N_2O emissions decreased by 6 per cent, broadly following the trend of N_2O emissions from agriculture. The latter fell mainly because of reduced agricultural activity (the area under cultivation decreased by 30,000 ha between 1995 and 2000), lower manure production and reduced fertilizer use. The review team noted that the changeover from solid manure to slurry management in dairy and pork production could have increased N_2O emissions while reducing CH_4 emissions. Between 1990 and 2000, increases in N_2O emissions from fuel combustion, mainly due to increased biomass burning (see paragraph 8), were only partly compensated by decreases in emissions from nitric acid production. Emissions of N_2O from transport increased by 57 per cent as a result of the growing market diffusion of three-way catalytic converters in passenger cars.

39. ***Fluorinated gases:*** Emissions of fluorinated gases increased by 37 per cent between 1990 and 2000, although they still accounted for only about 1 per cent of total GHG emissions. Within the different groups of gases, a considerable variation can be observed (see table 7). Emissions of HFCs, mainly from refrigeration, air conditioning, use of aerosols and metered dose inhalers, increased notably, substituting for the substances phased out under the Montreal Protocol. Decreases in emissions of PFCs and SF_6, mainly originating from aluminium production and insulation in high-voltage electrical equipment respectively, only partly compensated for the increase in HFCs. The review team noted that estimates of PFC emissions might be uncertain as the aluminium production plant was not monitored. The estimates were derived from a mix of expert judgement, facility-level data and interpolation.

Table 7. Fluorinated gases emission trends

	Gg CO_2 equivalent											Change (%)[a]
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	
HFCs	4	7	10	31	72	127	178	271	302	351	373	9 580
PFCs	440	427	414	402	390	391	351	324	309	329	270	–39
SF_6	83	86	85	91	101	121	110	155	91	92	78	–6
Total	**527**	**520**	**509**	**525**	**563**	**640**	**639**	**750**	**701**	**772**	**721**	**37**

[a] Change between 1990 and 2000, in per cent of 1990 values.

III. POLICIES AND MEASURES

40. The NC3 chapter on policies and measures (PaMs) outlines the general context of Swedish climate policy, including the evolution of national GHG mitigation targets since 1988, and provides descriptions of the monitoring and evaluation processes in place, and of the related institutional arrangements. It also describes the most important PaMs implemented in the following sectors: energy

supply and energy use (including transport), trade and industry, agriculture, forestry and waste. It contains a summary table of PaMs aimed at mitigating GHG emissions. This table includes estimates for the mitigation effects of a limited number of PaMs for the years 1995, 2000 and 2005, but not for 2010. The chapter closes with a description of PaMs that have had a counterproductive effect (i.e. tax relief for commuters, and company subsidies for goods transport in sparsely populated areas) and of discontinued PaMs (environmental tax on domestic aviation). During the visit, the review team was provided with a wealth of additional information on recent developments and activities which are reflected in this report.

41. NC3 reporting on PaMs follows the UNFCCC guidelines to a large extent. Still, the review team identified potential for further improvement. The NC3 would have benefited from a more complete and more detailed reporting on mitigation effects of individual PaMs and on the underlying assessment methods. Except for activities implemented jointly (AIJ projects), no cost estimates are reported. Given the leading international role of Sweden in the implementation of economic and fiscal instruments relating to climate change, the review team noted that, in particular, reporting on cost-benefit analyses of the most important PaMs could have added value to the overall report. The team also felt that the complex system of monitoring and evaluation of PaMs in Sweden deserved a more detailed description in the NC3. Finally, the review team encouraged Sweden to follow more strictly the reporting structure laid down in the UNFCCC guidelines.

42. Protection of the global atmosphere has a long tradition in Sweden and benefits from a relatively high priority ranking in the overall policy agenda. The Swedish Government is continuously developing policies and measures to mitigate GHG emissions. Since 1999, emphasis has been given to the energy and transport sectors. In developing PaMs, Sweden often utilizes a so-called 'framework approach' with a phased introduction of PaMs. Sweden has also established PaMs controlling non-CO_2 GHG emissions, for example in requirements for flue gas cleaning in combustion plants, in control of discharge of landfill gas, and in the use of residuals from forestry and agriculture. However, these mitigation effects were co-benefits from PaMs that were mainly oriented towards objectives other than reduction of GHG emissions. The review team noted that work has been initiated in some new areas, e.g. industrial fluorinated gases. However, no efforts have been reported in wastewater handling nor in management of other liquid waste (sewage, manure, sludge, etc.).

43. The review team noted that the package of PaMs reported in the NC3 was well implemented. Many PaMs which were already in place before the NC3 was prepared (e.g. the CO_2 tax) have been strengthened. The implementation of additional PaMs in the context of a number of relevant laws and regulations also seemed to be in progress. The review team was impressed by some of the specific targets, e.g. the expansion of power capacity based on RES, which were acknowledged to be ambitious.

44. The reported PaMs were not only related to climate change. Some, such as those for waste management, have been introduced primarily to control local environmental problems arising from solid waste. Others, such as demand-side energy measures, addressed the reduction of GHG emissions in addition to other objectives, including economic competitiveness and energy security. In the transport sector, the 2001 Swedish Infrastructure Bill was designed to react to the increased demand for transport, particularly road freight transport, by maintaining, improving and expanding the road and rail infrastructure. Funding allocated to investments in rail infrastructure is more than twice as high as for investments in the road infrastructure. While local emissions of conventional air pollutants and noise in urban areas might be reduced, these activities are expected to lead to an increased use of energy for transport, that may have a counterproductive overall effect on the GHG emissions.

A. Cross-cutting policies and measures

45. A number of new policies and measures have been considered, such as the use of emissions trading, the expansion of electricity from RES and CHP, energy efficiency standards, and the extended use of taxes on emissions and energy (including subsidy elements for environmental reasons). Some of these policies and measures rely on the implementation of common EU policies.

46. Sweden is among the leading countries in environmental taxation. State revenues from energy and carbon taxes for the decade 2000–2010 add up to more than EUR 3 billion annually. These economic instruments are complemented by public information campaigns and direct subsidies to cost-effective mitigation activities. For example, EUR 10 million has been granted to fund a three-year information campaign on climate change starting in 2002, and about EUR 100 million is dedicated to a new climate investment programme granting funds to GHG mitigation projects at the municipal level during the period 2002–2004.

47. Swedish committees and enquiry commissions have played an important role in the consultative process on climate policy. For example, the Energy Commission was set up in 1994 to examine the ongoing energy policy programmes for adjustment and development of the energy system, and analysed the need for additional measures. The Green Tax Commission analysed the behavioural effect of implemented fiscal instruments from a socio-economic perspective, and examined the scope for integration of an environmental dimension into the national taxation system. In 1998, the Committee on Environmental Objectives, the Government Commission for Measures Against Climate Change, was established. Monitoring and evaluation of policies and measures in the field of GHG mitigation were core elements of its tasks and duties. It concluded its work in 2000. The Enquiry Commission on the Flexible Mechanisms of the Kyoto Protocol was set up in 1998 and is still working.

48. Sweden has been very active in international cooperation and has conducted several AIJ projects and promoted joint investments in small-scale projects. Between 1993 and 2000, the Swedish Energy Agency implemented an AIJ programme, primarily focused on fuel switching and energy efficiency improvements, with a focus on the Baltic states and the Russian Federation. Several studies and plans for regional emissions trading and mutual taxation schemes have been discussed over the years, most recently in the context of the Baltic Sea Region Joint Initiatives (JI) Testing Ground and the implementation of the EU emissions trading scheme. A multilateral agreement on how to facilitate JI in the Baltic Sea Region is expected to be concluded in 2004 and a Testing Ground Investment Facility has been capitalized to provide means for JI investments. Since 2000, the Energy Agency has developed a JI and clean development mechanism (CDM) programme (SICLIP, Swedish Climate Investment Programme) aiming at cost-effective emission reductions, the development of the flexible mechanisms as effective instruments, and the creation of a knowledge base.

B. Energy supply

49. In 2000, CO_2 emissions from fuel combustion in energy industries accounted for 13 per cent of total GHG emissions; a relatively low share, reflecting the large amount of hydropower and nuclear energy in electricity production. Between 1990 and 2000, emissions from energy industries fluctuated between a 55 per cent increase in 1996 and an 18 per cent decrease in 2000 (see paragraph 30). Emissions of CO_2 from electricity production are projected to decline by 14 per cent of the 1997 levels until 2010, while CO_2 emissions from oil refineries are projected to grow slightly (by 4 per cent). Thus, this energy subsector is expected to contribute substantially to the overall national GHG reduction target.

50. Sweden's complex and sophisticated energy taxation system comprises a number of taxes and charges, including the energy tax, CO_2 tax, sulphur tax, nuclear energy output tax, selective purchase tax,

value added tax and distribution charges. Tax rates are differentiated by, inter alia, different types of fuels (including seven fuels for stationary use and eight motor fuels) and different types of customers (i.e. one level for industry, agriculture and forestry, another for private households); for electricity consumption they are differentiated into two regions (the north of Sweden and the rest of the country). Tax rates are adjusted and modified at regular intervals. In 2001, tax rates ranged between SEK 0.015/kWh for peat and SEK 0.592 /kWh for petrol. The taxation system also includes a number of tax exemptions, for example a total exemption from the energy and CO_2 tax for fuel used for generating electricity, and tax reductions, such as a 50 per cent reduction of the energy, CO_2 and sulphur taxes for fossil fuel use in CHP.

51. As shown in table 8, the vast majority of the assessed mitigation effects of energy-related policies and measures result from the increase in energy taxes. The review team appreciated the detailed description of the method applied to estimate this mitigation effect in chapter 4.2 of the NC3. Still, the review team was unable to analyse the overall effect of policies and measures in the energy sector, mainly because of the complexity of the energy taxation system, but also because of incomplete reporting on estimates of mitigation effects.

Table 8. Policies and measures in the energy supply and demand sector

Measures within the energy sector	Activities affected	GHG	Year of implementation	Mitigation effect in 2005 Tg CO_2 equivalent
Energy taxes	Energy use	CO_2	1990s	8 [a]
Reform of electricity market	Electricity use/trade	CO_2	1996	NA
Conversion of electric heating	Building heating	CO_2	1998–2002	0.1–0.7
Grants for RES[b]	RES power capacity	CO_2	1998-2002	0.7–1.2
Information and public outreach	Heat and electricity use	CO_2	since–1998	0.3–0.5
Tax on electricity production	Electricity production	CO_2	2003	NA
New energy tax	Electricity use	CO_2	2003	NA
New climate investment programme	Local investments	all	2003	NA
Other	Energy use	CO_2	ongoing	NA
Total (of quantified effects)				**9.1–10.4 (excl. NA)**

Note: NA means "not available".

[a] Effect of economic instruments that were phased in or tightened after 1990 (see paragraph 108).

[b] Renewable energy sources.

52. ***Renewable energy sources:*** Because of the continuous increase in energy and carbon taxes, the use of fossil fuels is not expected to increase outside the transport sector. Instead, supported by subsidy programmes, RES are expected to expand considerably, turning Sweden into one of the fastest-growing biofuel markets in the world. Between 1997 and 2002, energy supply from biomass and wind power has considerably increased, supported by investment grants, operational subsidies and tax relief. In 2002, RES accounted for over 165 TWh of the TPES, of which more than 70 TWh were delivered as electricity. Electricity from RES is to be increased by 10 TWh in 2010, mainly through an expansion of biomass and wind power, stimulated by increased taxes on fossil fuels and by incentives such as a green certificate scheme that was introduced in May 2003.

53. Potential for expansion of large-scale hydropower is limited by a decision of the Parliament not to exploit the remaining large rivers that have not yet been utilized for hydropower. Only a small mitigation potential was reported to remain, by increasing the efficiency of existing hydropower stations and expanding small hydropower plants.

54. ***Electricity supply:*** Historically, nuclear power and hydropower have provided Sweden with electricity at generally low prices, for the benefit of energy-intensive industries as well as other electricity users. The formation of an open Nordic electricity market during the 1990s, with strong power interconnections throughout Norway, Finland, Denmark, Poland and Germany, allowed for substantial power exchange. Still, the Nordic electricity market showed considerable fluctuations in

electricity prices, with peaks in cold periods after dry summers. In the winter of 2002/2003, spot market price levels jumped to levels ten times higher than the estimated average marginal production costs. The review team noted that these fluctuations in electricity prices did not support a sustained rational use of electricity nor private investments in energy efficiency and cleaner power production.

55. Electricity imports are expected to play an increasing role in the energy supply of Sweden. During the 1990s, Sweden has been a net exporter of electricity, substituting fossil-fuelled power production for instance in Finland and Denmark. Sweden recently became a net importer of electricity and is expected to continue importing about 4 TWh electricity annually in the near future.

56. ***Nuclear phase-out plans:*** During the 1990s, nuclear energy accounted for about half of the total electricity supply (about 70 TWh electricity per year net delivery to the grid). Production grew until 2000, mainly due to operational improvements. In 1980, the government introduced a moratorium on nuclear power expansion, and since 1986 various phase-out policies for existing NPPs have been adopted. However, various considerations seem to continue also after the review took place. One of the two reactors at the Barsebäck NPP (located in the middle of the most densely populated region of Scandinavia) was taken out of operation in 1999. At the time of the review it was announced that the second unit would be taken out of operation in 2003, but in the meantime new negotiations between government and industry have started, creating uncertainty about the actual phase-out plans.

C. Energy demand

57. ***GHG emissions from energy use in industry and other sectors*** (excluding transport) accounted for 32 per cent of total GHG emissions. Within this share, CO_2 emissions from energy use in industry accounted for 18 per cent, CO_2 emissions from energy use in other sectors for 11 per cent, and emissions of non-CO_2 gases for the remaining 3 per cent. Between 1990 and 2000, GHG emissions from energy use dropped by 9 per cent.

58. ***Energy use outside the transport sector*** amounted to about 400 TWh annually, or 80 per cent of total energy use. Industry and the housing/tertiary sector held equal shares. Sweden has been successful in reducing its overall energy use; between 1990 and 2000 it fell by 27.2 per cent. Overall energy use is projected to remain at this level until 2010, since the growth in activity level (growth in building stock, industrial production, consumption, etc.) is expected to be compensated correspondingly by reduced energy intensity.

59. ***Electricity consumption:*** As a result of Sweden's electricity-oriented energy policy and consistently low electricity prices in the past, electricity accounts for about 40 per cent of the energy end use. The extensive use of electricity has resulted in relatively high shares for this energy form in building heating and industrial use. The review team was informed that there is a huge cost-effective potential for both improving energy efficiency in industry and reducing and substituting electric heating. Over the last decade the Swedish Government, utilities and local municipalities have implemented a number of policies and measures in this field, including public-awareness campaigns, local energy and environment plans and energy audits that have identified energy savings and opportunities and investment options.

60. In this context, direct subsidy schemes for electric heating were redirected towards district heating and RES. Procurement and investment programmes have been supporting energy efficiency development in residential, commercial and institutional energy use. The aim is to provide an incentive for development and accelerated market diffusion of new low-emission technologies, including low-energy appliances. The 1997 Energy Policy Decision revised and redefined the support to cover procurement of more energy-efficient technology. A 1999 ordinance lays down grants covering

50 per cent of the additional cost of the actual procurement of technology and 30 per cent of additional investment costs. According to information given to the review team, based on sales figures for new products, these grants had been estimated to have reduced both electricity consumption and oil use by about 0.4 TWh. These efficiency improvements were expected to reduce CO_2 emissions by 200–400 Gg per year.

61. ***Industry:*** Efforts to increase energy efficiency in industry have mainly been based on voluntary agreements in combination with energy audits. Technology procurement schemes and a planned scheme for environmental product policy are expected to reduce energy intensity in the long term. An important efficiency potential was identified in the energy end-use of Sweden's manufacturing industry. However, the release of this potential is considered to be complicated: considerable investments may be required, but the industry is increasingly operating in international markets where energy costs and subsidies are regarded as important competitive factors.

62. ***Building and housing sector:*** Sweden has a relatively well-insulated building stock, and around 40 per cent of houses are heated by electricity. Energy and carbon taxes now play the most important role for limiting CO_2 emissions from this sector, where the full tax is applied.[10] Further policies and measures in this field include investment grants for ecological buildings, building regulations, several incentives aimed at repair and maintenance of buildings, eco-labelling for white goods, energy declarations for apartment buildings and installation of individual meters for heating and hot water supply. The mitigation effects of policies and measures in this group were not quantified.

63. As a result of the policies and measures in place, emissions from the residential, commercial and institutional sectors are expected to drop by 20 per cent between 1997 and 2020, which represents 2 Tg CO_2 emissions annually. The review team noted that notwithstanding these achievements, considerable potential for energy efficiency and emission reduction remained untapped in the building sector. The Swedish Government is currently working on approaches to targeting a minor part of this potential through, inter alia, the implementation of the EU directive on energy performance of buildings and a continued shift towards green taxes.

D. Transport

64. In 2000, GHG emissions from fuel consumption in transport accounted for 30 per cent of total GHG emissions. Between 1990 and 2000, transport-related GHG emissions grew by 7 per cent. Sectoral projections indicate a further growth of 13.7 per cent for the period between 2000 and 2010.

65. Constantly increasing road transport, in line with GDP growth, is the main driver for this development. Between 1990 and 2000, passenger transport grew by 10 per cent, total freight transport by 12 per cent and road freight transport by 19 per cent. Increasing transport activity, particularly in the vast rural districts and across the long distances between the densely populated regions, accompanied economic growth during the 1990s. However, transportation grew at a much slower pace than the overall economy (see table 1).

66. The review team noted that "ensuring a socio-economically efficient and sustainable transport system for citizens and business throughout the country" is the overall objective of Swedish transport policy. A national interim objective requires transport-related CO_2 emissions to stabilize at their 1990 level by 2010. The review team noted that considerable additional efforts are necessary in order to meet this national sectoral objective.

[10] In industry the tax rate is reduced to 35 per cent of the full rate, to reduce the impact of the tax on the international competitiveness of Swedish industries.

67. Economic and fiscal instruments (e.g. energy tax, VAT on energy, CO_2 tax) were considered to have the largest sectoral GHG mitigation effect. However, because of their complex influences on all elements of transportation, including technological development, transport demand and choice of transport mode, these effects have not been quantified. The review team noted that only one of the package of transport-related policies and measures reported in the NC3 has been assessed for its mitigation effect (see table 9). The review team felt that, particularly in this most difficult sector, further efforts to quantify the mitigation effects of policies and measures could add substantially to the overall transparency of reporting on Swedish climate policy.

68. The portfolio of transport policies and measures complementing the economic instruments emphasized the promotion of public transport, more environmentally friendly driving behaviour, and the increased use of RES (e.g. ethanol–petrol mix for passenger cars, biodiesel for locomotives) (see table 9).

Table 9. Policies and measures in the transport sector

Measures inside transport sector	Activities affected	GHG	Year of implemention	Mitigation effect in 2005 Tg CO_2 equivalent.
R&D in telematics	Diverse	CO_2	1995 onwards	NA
Investment in railway infrastructure	Modal shift to rail	CO_2	ongoing	NA
Procurement of ethanol–petrol cars	Use of RES	CO_2	since 1999	NA
"Green car" agreement with Swedish car industry/joint programmes for more environmentally sound cars	Energy efficiency of passenger cars	CO_2	2000–2006	NA
Ecodriving, transport quality assurance	Driving behaviour, modal shift to public transport	CO_2	2000	0.1
Use of RES in railways	Use of RES	CO_2	ongoing	NA
Road pricing on highways and in urban areas	Transport demand	CO_2	under consideration	NA
Tax on aviation fuel	Energy use	CO_2	1989–96	abandoned

Note: NA means "not available".

69. In 2002, a new transportation bill was adopted. The document outlined some long-term development options for the Swedish transport sector, but did not include concrete GHG mitigation policies and measures, except for a research programme on biofuels. The bill announced a further development of economic instruments within the transport sector. The need for additional policies and measures in the transport sector will also be considered in the first interim evaluation of the Climate Bill in 2004 (see paragraph 20).

E. Industrial processes

70. Non-energy-related GHG emissions from industrial processes, mainly stemming from the production of metals and minerals, accounted for 9 per cent of total GHG emissions in 2000. Between 1990 and 2000, these emissions increased by 6 per cent. A further increase by 25.3 per cent was projected for the period from 2000 to 2010.

71. Two policies and measures were reported for this sector. Based on the EU Directive on Integrated Pollution Prevention and Control (IPPC), a "permit application procedure under various environmental laws" has been implemented. The regulation is intended to foster integrated consideration of environmental factors, with implications for process-related emissions, particularly in aluminium production.

72. The Refrigerants Order addresses the use of halocarbons and other refrigerants. Reporting requirements and regular compulsory inspections of new and existing refrigeration units containing HCFCs, HFCs or other refrigerants were implemented as the main instruments for reducing and

preventing emissions. The review team noted that the effectiveness of the Refrigerants Order has not been evaluated.

73. Starting in 2005, the EU emissions trading scheme will also cover activities in the production and processing of ferrous metals, mineral industry, and pulp and paper production. The review team noted that as yet there is no quantitative analysis of the impact of the EU-wide trading scheme on GHG emissions from Swedish industry.

74. The review team was informed that on the basis of dialogues with commerce and industry, long-term voluntary agreements between industries and government were seen as an appropriate instrument to formulate strategies towards the development of environmentally sustainable trade and industry in Sweden.

F. Waste management

75. In 2000, GHG emissions from solid waste management accounted for 3 per cent of total GHG emissions. Between 1990 and 2000, these emissions decreased by 21 per cent; a further decrease by 62 per cent between 2000 and 2010 was projected. The review team acknowledged this huge drop in emissions, which is mainly driven by the successful Swedish waste management policy.

76. Policies and measures in this sector included the use of solid waste for incineration in CHP and district heating, the centralization and increased control of landfills, and the collection of landfill gas. The cumulative GHG mitigation effect was estimated at 0.8 Tg CO_2 equivalent (see table 10).

Table 10. Policies and measures in the waste sector (solid waste)

Measures within solid waste	Activities affected	GHG	Year of implementation	Mitigation effect in 2005 Tg CO_2 equivalent
Waste management improvement	Waste management	CH_4	1991	NA
Collection of landfill gas	CH_4 evaporation	CH_4	1994	NA
Waste charges and landfill tax	Waste volume	CH_4	2000	NA
Landfill Ordinance	CH_4 collection	CH_4	2001	NA
Ban on landfill of combustible waste	Degradation of organic compounds	CH_4	2002	NA
Ban on landfill of organic waste	CH_4 fermentation	CH_4	2005	NA
Total				**0.8**

Note: NA means "not available".

77. The most important new measure for limiting waste going to landfills was reported to be the ban on landfill of combustible and organic waste in the Public Cleansing Ordinance. Effective in 2002 and 2005 respectively, these landfill bans were expected to further reduce CH_4 emissions by 2010. The EU Landfill Directive was adopted in April 1999 and has been incorporated into Swedish legislation by the Landfill Ordinance. Measures controlling wastewater were not reported.

G. Agriculture

78. In 2000, GHG emissions from agriculture, mainly stemming from agricultural soils and enteric fermentation, accounted for 13 per cent of total GHG emissions. Between 1990 and 2000, these emissions decreased by 7 per cent; a further decrease by 3 per cent between 2000 and 2010 was projected. Estimates of emissions from agriculture are reported to be highly uncertain, because of the need to refine the methods to estimate emissions in order to account for specific national conditions.

79. During the last five decades, agriculture in Sweden has undergone a radical change. One fifth of arable land cultivated in the 1950s (approximately 700,000 ha) is no longer farmed today; between 1995 and 2000 alone, the area under cultivation decreased by 30,000 ha. In 1999, there was approximately 2.7 million ha of arable land (corresponding to 6.5 per cent of the land area) and 0.5 million ha of

permanent pastures (grazing land). The number of dairy cattle fell by 22 per cent in the period from 1990 to 2000, implying a 20 per cent reduction in CH_4 emissions from enteric fermentation. However, the number of beef cattle almost doubled in the 1990s, leaving the total CH_4 emissions from this activity broadly unchanged.

80. The agriculture sector was only recently incorporated into the Climate Bill and little potential for the implementation of additional measures to reduce emissions from agriculture has been reported. An overall programme aimed at promoting a decrease of GHG emissions from agriculture is not planned. However, some environmental subsidies, such as nitrogen leaching and grazing land subsidies, certainly contributed to the reduction of emissions from the agriculture sector.

81. Among the more than 70 policies and measures reported in the NC3, only one is related directly to agriculture: start-up grants for energy forests. The substitution of fossil fuel use by fuelwood from energy forests was estimated to mitigate 0.15 Tg CO_2 emissions annually between 1995 and 2000. The review team noted that activity quotas as defined by the EU CAP might have the most important effect on future GHG emissions from agriculture in Sweden.

H. Forestry

82. Forests are considered to be among the most valuable natural resources in Sweden, and cover 62 per cent of the territory. Of these 27 million ha, 95 per cent can be classified as boreal forests, and 23 million ha are considered to be productive forests, or managed forest land.[11] Forests represent the largest carbon reservoir and have been a net carbon sink during recent decades. During the 1990s, the LUCF sector annually sequestered 20–26 Tg CO_2, representing 29–36 per cent of the total GHG emissions.

83. Every year, the Department of Forest Resources at the Swedish University of Agricultural Sciences generates regional statistics on stem volumes, growth, felling and natural dieback in the context of the National Forest Inventory (NFI). A large part of those forests, which are not covered in full detail by the NFI, grows in protected areas or in low-productive land (such as wetlands, or thin soil in rocky terrain and cold climate) where harvesting is generally not allowed. The land area covered by these forests is about 5.8 million ha.

84. The review team noted that forest increment has exceeded felling in the last 20 years, resulting in an annual growth in standing volume of 20–30 million m^3. During this period, annual forest increment has increased. Factors that contributed to this increase include intensified silviculture, changes in the tree species planted, fertilization by nitrogen deposition, forest management, nitrogen fertilizers, afforestation of former agriculture and grazing land, land drainage and prevention of forest fires. Annual fellings have also increased, but at a lower absolute level. The general trend towards increased timber removal in the 20th century has been more than counterbalanced by increased growth. As a result standing volume has steadily increased, which reflects an important long-term goal for Swedish forest policy.

85. Forest management activities have been implemented since about 1900. The review team noted that the use of nitrogen fertilizers had a minor effect on the carbon balance; since 1991, fertilized areas have been substantially reduced to 25,000 ha/year, or 0.1 per cent of the managed forest land. Afforestation is also a minor contributor; conversion of cropland into forest land totals 5,000 ha/year and there has been hardly any land drainage since 1993. The review team concluded that the factors with most influence on annual forest increment relate to the growth and management of established forests.

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[11] The NC3 defined managed forest land as land which is not protected, or primarily used for land-use activities other than forestry, which hosts a potential yield of stem-wood exceeding 1 m^3/ha per year.

86. Industrial use of biomass fuels totalled just over 54 TWh in 1999, which represents almost 60 per cent of total use of these fuels. Biomass use in district heating systems showed the largest increase, from 2 to 26 TWh during the period 1980 to 1999. Use of biomass fuels in the detached housing sector has remained at a fairly constant level of 10–12 TWh since 1980. Most of this is log burning, mainly by households with access to their own firewood. Logging residues from tree felling (tops and branches) used for heat production in district heating systems accounted for 7 TWh. The review team was informed that only a fraction of the theoretically available logging residues is currently used for energy purposes. New concepts for the harvest of logging residues were being developed. The potential of biomass fuels, as well as the ecological, economic and technical potential for forest fuel production, is being investigated. The review team noted that biofuel use was perceived as a sustainable solution, whereas the enhancement of sinks was seen as only a temporary solution.

87. The concept of sustainable forestry was reinforced in the 1993 Forestry Act. Since 1994, an increase in the share of broadleaved trees has been encouraged for the sake of nature conservation and biodiversity. The review team noted that this may reduce forest growth in the long term, if compared to a continued marked preponderance of coniferous trees.

IV. PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES

88. The NC3 provides a set of projections of future levels of GHG emissions, based on model calculations. It includes projections by gas and by sector, and also projections of overall emission levels. The review team noted that reporting on projections broadly conforms with the UNFCCC reporting guidelines. In particular, projections cover all sectors and GHGs (CO_2, CH_4, N_2O and fluorinated gases). Projections for the transport sector are included in the energy sector and are also reported separately. Projections of emissions from international bunkers are reported separately. The time horizon for projections is 2020 and emission levels are projected for the years 2005, 2010 and 2020. Removals of CO_2 from LUCF are not projected, but are assumed to remain unchanged until 2010.

89. The review team acknowledged that projections are broadly consistent with the inventory data submitted in 2001. The base year for these projections is 1997. Inventory and projection data are represented jointly in sectoral diagrams, as requested by the UNFCCC guidelines. The overall GHG emissions are presented as a total, and expressed in CO_2 equivalent, using the IPCC default global warming potential (GWP) factors.

90. The overall responsibility for the Swedish GHG emission projections lies with MoE. Projections of CO_2 emissions in the energy sector were prepared by STEM and SIKA with input from several institutions. Projections of non-CO_2 emissions for all sectors were prepared by the Swedish EPA, with input from SJV for the sectoral projections in agriculture. Some input assumptions (e.g. GDP growth) were prepared by the National Institute of Economic Research.

A. Scenarios, input assumptions and methodology

91. The NC3 presents two business-as-usual scenarios taking into account two potential courses the Swedish energy system could take after 2010: decommissioning of six existing NPPs starting in 2012 after a lifespan of 40 years (scenario 2) or continued operation of these NPPs on market terms (scenario 1). Electricity prices are assumed to rise only slightly until 2020 (by 5–13 per cent of their 1999 levels) in scenario 1, while scenario 2 assumes a more marked increase of 14–41 per cent. Both scenarios are based on the 2001 policy frameworks for energy, transport and environment, including the tax rates for energy, transport and CO_2 taxes. The implementation of policies and measures from the Climate Bill is not reflected, and RES subsidy programmes are assumed to be substituted by green certificate trading from 2003 onwards. A scenario with additional measures is not provided.

92. ***Assumptions on key parameters*** are reported transparently. In accordance with the NC2, the Swedish economy is assumed to grow by 1.9 per cent annually until 2010 (see table 11). As a result of demographic changes (the active working population is expected to decline from 2008), reduced economic growth is assumed after 2010. Assumptions on fuel prices in the NC3 are significantly lower than in the NC2. The development of crude oil prices is based on International Energy Agency (IEA) estimates of future world market prices. Based on forecasts in the EU Energy Outlook to 2020, import prices of natural gas are expected to rise slowly. The increasing demand after 2010 would necessitate additional imports from more distant regions, such as the Russian Federation or North Africa. The higher distribution costs would lead to considerably higher prices. The review team noted that the price assumptions for natural gas in 2020 would make offshore windpower competitive with new CHP plants fired by natural gas.

Table 11. Comparison of key assumptions in the NC2 and NC3

	NC2	NC3
GDP annual growth rate	1.9 per cent during 1995–2010	1.9 per cent during 1997–2010 1.1 per cent during 2010–2020
Exchange rate	SEK 7/USD in 2010	SEK7.5/USD in 2010 SEK8.26/USD in 2020
Crude oil price	USD 23/bbl[a] in 2010	USD 17/bbl in 2010 USD 22.5/bbl in 2020
Coal price	USD 53/tonne in 2010	USD 42/tonne in 2010 USD 42/tonne in 2020
Natural gas price		USD 2.6/Mbtu[b] in 2010 USD 3.5/Mbtu in 2020

[a] One barrel of oil.
[b] Millions of British thermal units, 1 Btu = 1,055.055 852 62 joules (J).

93. ***Methods used:*** The high share of the energy sector (about 80 per cent of the total GHG emissions) explains the comprehensive approach taken to prepare projections for this sector. In line with the NC2, the NC3 projections on CO_2 emissions from energy and transport were based on MARKAL, a widely used energy optimization model. Energy demand was modelled by several sectors and subsectors, including industry, housing and services, transport, and electricity and heat production. National models supplemented the calculations on economic conditions for a number of industries (EMEC), demand in passenger transport (SAMPER) and goods transport (SAMGODS). The projections for non-CO_2 gases and for the other sectors were built on trend analyses, spreadsheet models and expert assessments, based on sectoral plans and strategies (see table 12).

Table 12. Projection methods and models, by GHG and sector

	Energy	Transport	Industry	Agriculture	Forestry	Waste
CO_2	MARKAL EMEC	MARKAL SAMPERS SAMGODS EMEC	Trend analysis Expert assessment	Expert assessment Spreadsheet model	Expert assessment Spreadsheet model	NA
CH_4	Trend analysis Expert assessment	Trend analysis Expert assessment	Trend analysis Expert assessment	Expert assessment Spreadsheet model	NA	Expert assessment Spreadsheet model
N_2O	Trend analysis Expert assessment	Trend analysis Expert assessment	Trend analysis Expert assessment			NA
HFCs, PFCs, SF_6	NA	NA	Expert assessment Spreadsheet model	NA	NA	NA

Note: NA means "not applicable".

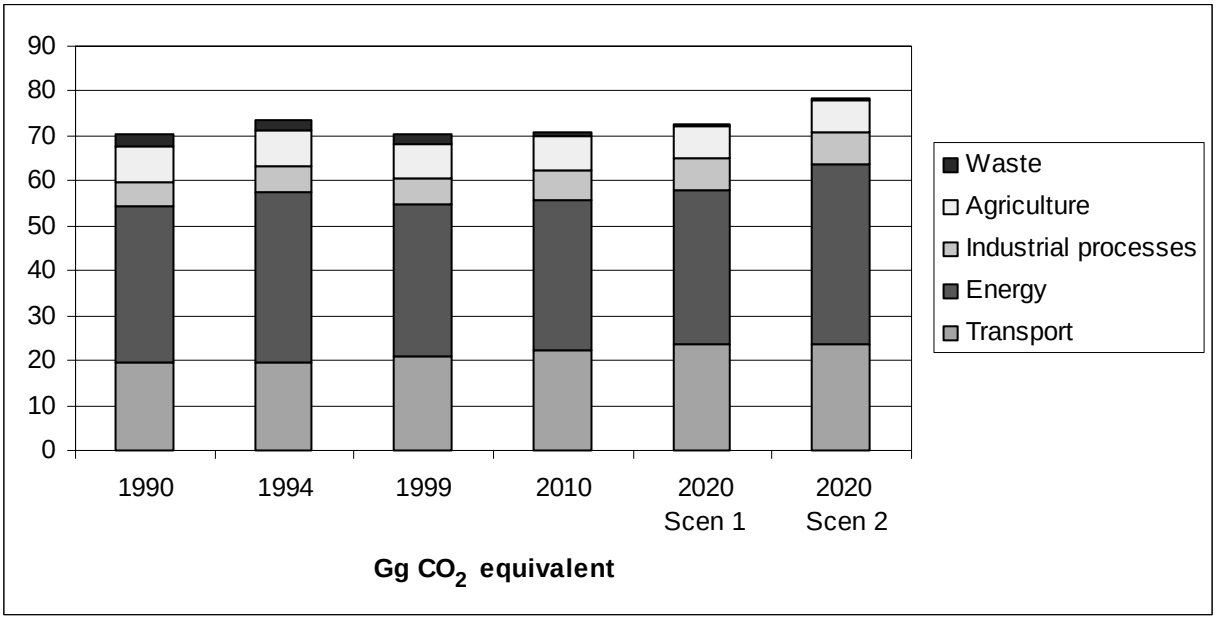
B. Results, uncertainties and projected emission trends by sector

94. ***Projection results*** show an increase in energy-related emissions substantiated by the growth in energy demand. Final energy consumption (FEC) is projected to increase by 0.6 per cent annually between 1997 and 2010. Relatively high growth rates of energy use in transport (by 1.0 per cent) in combination with the modest growth in energy use in industry (by 0.9 per cent), and in other energy use, e.g. housing, services (by 0.2 per cent) resulted in small changes to the overall FEC structure. The TPES was projected to grow by 0.4 per cent annually between 1997 and 2010, which is broadly consistent with historical trends.

95. A number of quantitative sensitivity analyses of uncertainties in the input assumptions were carried out. The uncertainty interval of the reference scenario ranges between a 2 per cent reduction and a 6 per cent increase in total GHG emissions in 2010 relative to the 1990 levels. The calculations were based on different sets of assumptions on the growth rate of industrial output, private consumption and construction of new buildings, as well as improvements in energy efficiency and in heating systems.

96. The review team noted that key uncertainties related to GDP growth, the status of nuclear units, fuel prices, electricity imports and changes in taxation rates and subsidy schemes. For example, changes in the support scheme for RES from SEK 150/MWh (EUR 16.5/MWh) to SEK 100/MWh would have relatively little effect on the Swedish electricity production system. A further reduction to SEK 50/MWh (EUR 5.5/MWh) would result in a reduction of 5–7 TWh electricity production from RES; instead of new windpower capacity, electricity imports and natural-gas-fired CHP would appear.

Figure 2. Total GHG emissions by sector in 1990, 1994 and 1999, and projected emissions in 2010 and 2020



97. Aggregate GHG emissions from the energy sector (including transport) are projected to remain at their 1990 levels until 2010 (see figure 2). Beyond 2010, an increase from 55.6 to 63.5 Tg CO_2 equivalent is projected, which means an increase of 14 per cent in 2010–2020. Continued operation of the existing NPPs on market terms (scenario 1) would result in 57.7 Tg CO_2 equivalent, which means a 4 per cent increase. It is assumed that the instruments of current energy and environmental policy will apply throughout the whole scenario period.

98. The projections for the transport sector were reported separately from the overall emissions of the energy sector. The assumption for the development in passenger and goods transport were transparently reported in NC3. The projection results indicate an increase of GHG emissions from fuel combustion in transport by 14 per cent during the period 1990–2010. The review team noted that the effect of the 2001 Infrastructure Bill (see paragraph 44) was not taken into account. This legislative act stipulates an investment of SEK 364 billion (EUR 40 billion) between 2004 and 2015, which represents the largest investment in Swedish transport infrastructure in modern times. The review team noted that additional transport demand induced by the construction of new road and rail capacity might result in GHG emissions being higher than projected.

99. The GHG emissions from industrial processes (excluding energy-related emissions) are expected to increase by 25 per cent from 1990 to 2010, mainly as a result of increases in metal and mineral production. Emission projections in the waste management sector for the same period reveal a 62 per cent decrease in aggregate emissions, resulting from the landfill ban for organic and combustible waste and regulations on landfill gas recovery. Emissions from the agriculture sector are projected to drop by 8 per cent, mainly as a result of reduced activity in this sector. Removals of CO_2 from LUCF were estimated to remain constant, although at a high degree of uncertainty.

C. Total effect of policies and measures

100. The total effect of adopted and implemented policies and measures for the period 1990–2010 was reported for the energy sector (including transport) and the waste sector. It was assessed by calculating the difference between the business-as-usual scenario described above and a "1990 instruments" scenario. The latter assumed a tax and subsidy level frozen as of January 1990 throughout the whole period 1990–2010, thus not taking into account the effect of changes during this period in CO_2 tax, VAT on energy use, sulphur tax, NO_X charge and subsidies for wind power, biomass and CHP.

101. Results from this analysis suggest that the energy-related policies and measures have a significant effect on total GHG emissions. The difference between the two scenarios amounts to 10 Tg CO_2 in 2010, or 14 per cent of the 1990 total GHG emissions. However, both 2010 scenarios assume 4 TWh of electricity imports, while in 1990, Sweden exported 3 TWh. In the NC3 chapter on projections, the total effect of policies and measures in the waste sector was estimated at 1.45 Tg CO_2 equivalent in 2010. The NC3 chapter on policies and measures reported an aggregated effect in the waste sector of 0.8 Tg CO_2 equivalent in 2005.

102. Mainly because of incomplete reporting on mitigation effects of individual measures, the review team was unable to compare the sum of individual effects of policies and measures with the total effect, as reported in the projections chapter. Some of the policies and measures reported (such as phasing out of NPPs) have an increasing effect on GHG emissions. The review team was informed that these effects were also taken into account when estimating the projections of GHG emissions in individual scenarios.

103. After projections for individual sectors were compiled, the totals were calculated for each gas, as well as aggregated into CO_2 equivalent emissions. Total emission trends are given in table 13. According to the NC3, CO_2 emissions should grow by 2 per cent, N_2O emissions by 4 per cent, and emissions of fluorinated gases by 33 per cent during the period 2000–2010, whereas CH_4 emissions should drop by 24 per cent. Aggregated GHG emissions are expected to remain stable (+0.6 per cent).

Table 13. Total GHG emissions: projections by gas (Gg CO_2 equivalent)

	1990	1999	2010	2020	
			Business as usual	Scenario 1	Scenario 2
CO_2	55 883	56 347	57 742	60 145	65 908
CH_4	6 811	6 172	4 664	4 048	4 048
N_2O	7 165	7 112	7 410	7 714	7 714
Fluorinated gases	523	800	1 061	891	891
Total (CO_2 equivalent)	**70 382**	**70 431**	**70 877**	**72 798**	**78 561**

V. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

104. The NC3 reporting on vulnerability assessment fully complies with the UNFCCC reporting guidelines and covers a wide range of vulnerable sectors, including water resources, land and soil, ecosystems, forestry, agriculture, fisheries, infrastructure of transport, energy and industry, as well as health, coastal zone and mountain areas. The assessments are based on SWECLIM, a national climate research network for state-of-the-art regional climate modelling, climate change scenarios and dialogue with impact research experts and stakeholders. The Rossby Centre at SMHI has developed a number of detailed regional climate scenarios for the potential situation by 2100. The review team was informed that new simulations with an improved model system and based on a set of the latest emission scenarios and global simulations reported by the IPCC in 2001 were in the planning stage.

105. Analysis of the results suggest that Sweden is vulnerable to a changing climate as the society is built today. A warmer and generally wetter climate may affect water resources, particularly in the southern part of the country, where water shortages may occur in dry years. It may lead to the cultivation of new crops and increased growth in agriculture. Also, forestry may have a positive impact in terms of wood and other forest products. Land and soils, ecosystems (mountain and Baltic ecosystems) and coastal zones are considered to be especially vulnerable. Infrastructure is expected to suffer from several impacts, including erosion and landslides, strong winds and heavy rainfalls.

106. Compared to the detailed vulnerability analysis, only a limited analysis of adaptation measures is reported in the NC3. The review team was informed that the hydrological safety of the most important dams of the hydropower system is currently being re-evaluated.

107. National experts expressed the need for the development of models and climate scenarios considering extremes (to reduce the uncertainties); climate impacts in all climate-sensitive sectors and the formulation of adaptation strategies also need more quantitative assessment studies.

VI. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

108. Sweden plays an important role in assisting developing countries by means of aid and development assistance (about 0.7 per cent of the gross national income is directed to development assistance). Two thirds of the bilateral development assistance is conducted through SIDA, while the remaining third is channelled via multilateral organizations, coordinated by the Ministry of Foreign Affairs. The multilateral support to UNFCCC is carried out by the MoE, whereas the Ministry of Finance provides support for the European Bank for Reconstruction and Development (EBRD).

109. The NC3 reported financial support using the appropriate tables, following the UNFCCC reporting guidelines. Bilateral and regional financial support was reported, as well as support to countries with economies in transition. The NC3 states that most new and additional Swedish support is provided via the Global Environment Facility (GEF) and reports a total contribution to the GEF of SEK 448 million (EUR 49.3 million) between 1998 and 2001. The review team gained the impression

that the financial support was not directly triggered by the UNFCCC requirements, and therefore might not be new and additional. Nonetheless, the review team noted that the results from the funded activities may, indirectly, relate to the objective of the UNFCCC.

110. Most of the financial support provided via bilateral cooperation in 1997–2000 was directed to energy-related projects (SEK 1,007 million), followed by agriculture (SEK 285 million), industry (SEK 161 million), forestry (SEK 137 million), coastal zone (SEK 126 million), transport (SEK 76 million) and waste (SEK 42 million). Substantive support was also provided for capacity-building, with funding in 2000 being 10 times larger than that in 1997 (SEK 23 million). A total of SEK 924 million was allocated to capacity-building from 1997 to 2000. Altogether, almost 50 per cent of the financial support for capacity-building was allocated to African countries (31 per cent) and Asian countries (15 per cent).

111. Sweden has indicated that it plans to increase the present financial support of SEK 10.6 billion by 42 per cent until 2006, a total of SEK 15 billion. In addition, SIDA is implementing an action programme to respond to the UNFCCC, which includes administrative capacity-building within SIDA; integration of climate aspects in country programmes; improved reporting; institutional development and capacity-building.

112. The NC3 provides descriptions of a number of projects in the field of technology transfer. The team noted that in most cases a direct link to the UNFCCC was not given. The projects may, however, indirectly result in technology transfer to developing countries that will also be relevant to the mitigation of GHG emissions.

VII. RESEARCH AND SYSTEMATIC OBSERVATION

113. ***Research:*** Reporting on research in the NC3 is comprehensive and in compliance with the revised guidelines. The high level of research related to climate change and its expected impacts impressed the review team. With its long tradition of research in the field of climate change, Sweden belongs to the group of leading research nations. Overall research funding totalled almost 4 per cent of GDP in 1999.

114. Research related to climate change is coordinated by the newly established Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS). The main organization providing funding for climate research is the Foundation for Strategic Environmental Research (MISTRA). Research is carried out by universities and colleges as well as some public authorities (e.g. the Swedish EPA) and some independent research institutes.

115. Research subjects include climate processes and systems, modelling and projections as well as impact assessments, socio-economic analyses and technologies capable of reducing emissions and increasing GHG removal.

116. ***Systematic observation:*** Sweden has a long tradition of meteorological and atmospheric observation. Its commitment to various aspects of GCOS is considerable. Continuous, long-term, engagement in these areas is in line with the Swedish Government's prioritization of research and development. There is much monitoring activity and systematic observation relevant to GCOS, mostly under the auspices of the World Meteorological Organization body World Weather Watch. Sweden is also involved in the development and operation of meteorological satellites (EUMETSAT). During the review, the review team was provided with a detailed Global Climate Observing System (GCOS) report and noted that it broadly followed the UNFCCC guidelines.

117. The Swedish EPA has overall responsibility for the coordination of all environmental monitoring. SMHI is responsible for supplying meteorological, hydrological and oceanographic data. The review team noted that, to a limited extent, Sweden supports developing countries in establishing and maintaining monitoring systems for reporting under the UNFCCC.

VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

118. Since the publication of the NC1 and NC2, environmental education has been expanded and specific projects (klimat.nu, SparKraft) have been undertaken to increase public awareness of climate change issues. In April 2000, the final report of the Government Commission for Measures against Climate Change identified public outreach as an important instrument. The commission emphasized the importance of information to raise public awareness of the risks associated with climate change. The review team was informed that funds amounting to EUR 10 million had been granted for a new three-year information campaign starting in December 2002.

119. The Swedish Government has highlighted the importance of consumer policies in a number of documents. The government's position is based, among other things, on studies showing that Swedish consumers are responsible for about half of all emissions of harmful substances to air and water. An active consumer policy in the environmental field has been developed to reduce household emissions, energy consumption and waste. The government places further importance on increasing public awareness through better information about the environmental impact of products, and by supporting efforts to change patterns in consumer behaviour.

120. There is public participation in addressing climate change, as several NGOs are very active in this field. Business NGOs regularly participate in the process of preparing the Swedish national communications.

IX. CONCLUSIONS

121. When reviewing the information reported in the third national communication of Sweden, the review team concluded that the document complied with the provisions of the UNFCCC guidelines. The team was of the opinion that, in combination with the annual GHG inventory submission and some additional documents, the NC3 provided a comprehensive overview of climate policy in Sweden. Some potential for increasing transparency of reporting was identified, especially in the assessment of costs and mitigation effects of policies and measures.

122. The review team noted that while the Ministry of Environment is responsible for the national climate change policy, other important ministries (e.g. Ministry of Industry, Employment and Communications) and agencies (e.g. the Swedish Energy Agency) are also actively integrating climate policy into their policy fields. Overall coordination of national climate change policy is established at the ministerial level. Climate policy benefits from a relatively high public awareness and a correspondingly high priority on Sweden's political agenda. Accordingly, the review team noted sufficient financial and administrative capacity in this field.

123. The review team acknowledged the submission of the GHG inventory using the CRF tables and encouraged Sweden to continue to improve the national system for the estimation of anthropogenic emissions by sources and removals by sinks, to harmonize the methodology for the different years, to recalculate the emission trends where necessary and to address the existing minor gaps.

124. Between 1990 and 2000, the overall GHG emissions declined by 5 per cent (excluding LUCF) and 21 per cent (including LUCF). Sweden is expected to meet its emissions target under the EC burden-sharing agreement (i.e. 104 per cent of the 1990 GHG levels) during the first commitment period.

Emissions of GHGs are projected to remain at their 2000 levels until 2010. For the period 2010–2020 GHG emissions are projected to increase by 4–14 per cent, depending on the further development of nuclear phase-out plans.

125. In 2002, within the context of the Climate Bill, Sweden set itself a stricter national GHG mitigation target to achieve 96 per cent instead of 104 per cent of the 1990 GHG levels during the first commitment period, and defined further policies and measures to contribute towards reaching this target. The elements of the Climate Bill are subject to evaluation, revision and extension at regular intervals, starting in 2004 and 2008.

126. The review team acknowledged that, relying on its long experience in the implementation of economic and fiscal instruments, Sweden managed to gain control over its overall GHG emission trends, in spite of considerable economic growth. The Swedish energy and CO_2 tax, supplemented by a sophisticated portfolio of incentives, support schemes, programmes, tools and standards, were identified as the main reason for the notable reductions in GHG emissions achieved in many sectors.

127. Sweden's success stories include a remarkable decoupling of GDP growth from GHG emissions, an increasing use of renewable energy sources (biomass use for heating and co-generation), energy efficiency improvements in industry, thermal building insulation, waste management, a long tradition of sustainable forestry and high activity in the field of international cooperation. Still, a number of areas with considerable potential for GHG reduction were identified, for example in the use of renewable energy sources, in the energy end-use of manufacturing industries and in the building sector. Exploring these could enable Sweden to continue its GHG reduction trend.

128. The review team noted that the increasing trend of emissions from transportation remained a challenge for the Swedish climate policy. A national objective to stabilize transport emissions at their 1990 level by 2010 is unlikely to be met unless considerable further efforts are taken. The review team noted that the Swedish Government is considering other measures to curb CO_2 emissions from the transport sector, and will introduce them if appropriate.

129. Sweden was commended on its ongoing work in the field of research and systematic observation, as well as public awareness and outreach. The review team felt that research on adaptation to a changing climate should be intensified.

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