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

Review team:

Héctor D. Ginzo (Argentina)
Inge Roos (Estonia)
Christoph Streissler (Austria)
Harald Diaz-Bone (UNFCCC secretariat, coordinator)

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

A. Introduction

1. The secretariat received Slovakia's third national communication under the United Nations Framework Convention on Climate Change, hereinafter referred to as the NC3, on 24 October 2001. An in-depth review was carried out between September 2002 and July 2003, including a visit to Bratislava from 9 to 13 September 2002. The review team consisted of Mr. Héctor D. Ginzo (Argentina), Ms. Inge Roos (Estonia), Mr. Christoph Streissler (Austria) and Mr. Harald Diaz-Bone (UNFCCC secretariat, coordinator).

2. The review team had a number of meetings and discussions on the most important aspects of the Slovak climate policy as outlined in the NC3. During these meetings with officials from the Ministry of Environment (MoE), academics and 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:*** Slovakia is a land-locked country in central Europe. It borders on the Czech Republic and Austria in the west, Hungary in the south, Ukraine in the east and Poland in the north. The total area of the territory is 49,036 km^2, dominated by agricultural areas (50 per cent) and forests (41 per cent). Slovakia is a mountainous country; 60 per cent of the total area lies more than 300 m above sea level. Almost the whole territory is drained by the river Danube into the Black Sea.

4. ***Demography:*** Slovakia's slight population growth from 5.30 million in 1990 to 5.40 million in 2000 is characterized by a decreasing birth rate and an ageing population. One quarter of the total population lives in 11 cities with more than 50,000 inhabitants, including the capital Bratislava (450,000 inhabitants) in the west and the city of Košice (242,000 inhabitants) in the east; 43.7 per cent of the total population lives in rural areas.

5. ***Economy:*** Slovakia has undergone a successful economic transformation since the beginning of the 1990s. After a recession in 1989–1992, the economy grew by 5.6 per cent per year on average between 1993 and 1998, mainly as a result of external demand for Slovak products on export markets. The economic transformation is reflected in the change of GDP structure. In 1990, half of the GDP was attributed to industry (49.9 per cent) and one third to services (33.5 per cent), but by 1993 these sectors had almost reversed their proportion of GDP (industry 29.2 per cent, services 54.4 per cent). The GDP share of agriculture and forestry decreased continuously from 7.4 per cent in 1990 to values below 5 per cent since 1995. Privatization, particularly in agriculture, trade and services, increased the share of the private sector in GDP from 37.3 per cent in 1993 to 82.6 per cent in 1997. The State, however, continued to hold a strategic majority share in the large energy industry companies.

6. In the view of the European Commission, Slovakia fulfils the economic preconditions for accession to the European Union (EU) in May 2004 (see para. 11). Notwithstanding its remarkable record of achievements over the past decade, Slovakia faces considerable economic challenges in the period ahead. Overall economic growth slowed to 2.1 per cent per year over the period 1999–2000, and unemployment rose rapidly to 18.3 per cent in 2000. Since 1996, the annual deficit in the balance of foreign trade amounted to between US$ 1.1 billion and 2.1 billion (i.e. about one tenth of total GDP), raising foreign indebtedness to US$ 9.1 billion in 2000.

Table 1. Main macro-economic indicators and GHG emissions for Slovakia[a]

	1990	2000	Change (%)[b] 1990–2000
Population (millions)	5.30	5.40	1.9
Gross domestic product – GDP (billions US$ of 1995)[c]	50.46	56.13	11.2
Industrial Production Index (1995 = 100)	125.30	115.70	–7.7
Total primary energy supply – TPES (Mtoe[d])	21.43	17.47	–19.5
Electricity consumption (TWh)	27.44	26.16	–4.6
Greenhouse gas (GHG) emissions[e] (Tg[f] CO_2 equivalent)	72.18	47.90	–33.6
GHG emissions per capita (Mg CO_2 equivalent)	13.62	8.87	–34.9
GHG emissions per GDP unit (kg CO_2 equivalent per US$ of 1995)	1.43	0.85	–40.3

[a] Data for population, GDP, TPES, and electricity are from "Energy balances of OECD countries, 2000–2001", OECD/IEA, Paris, 2003. GHG data are from the Slovak inventory submission in 2003.
[b] Difference of 2000 and 1990 values in per cent of 1990 values.
[c] Calculated using the method of purchasing power parities (PPP).
[d] Millions of tonnes of oil equivalent.
[e] Without accounting for land-use change and forestry (LUCF).
[f] One teragram (Tg) is equal to 1,000 gigagrams (Gg) or one million tonnes (Mt).

7. ***Energy:*** Since 1990, the Slovak energy profile has changed considerably. The total primary energy supply (TPES) decreased by almost 20 per cent between 1990 and 1994, and moderately increased thereafter. The consumption of solid fuels (mostly lignite) fell by 45 per cent between 1990 and 2000, while the consumption of natural gas increased by 14 per cent. The reduction in per capita GHG emissions by about one third reflects these changes in the energy profile (see table 1). In 2000, TPES comprised natural gas (33.1 per cent), coal (24.5 per cent), nuclear[1] (24.8 per cent) and oil products (16.4 per cent). Renewable energy sources (RES), including hydropower, biomass and geothermal energy, held a share of 2.8 per cent. The Slovak TPES depends to a large extent on imports; only 11 per cent stems from domestic energy sources (mainly lignite).

8. ***Political structure:*** As a result of the split of former Czechoslovakia, the Slovak Republic gained its independence in 1993. While the President represents the nation, the democratic constitution vests legislative power in the Parliament (National Council), which is composed of 150 deputies. The supreme executive authority is the Council of Ministers, chaired by the Prime Minister, which assumes responsibility for domestic and foreign policy. According to the new territorial system of administration (1999), Slovakia is divided into 8 regions, 79 districts and 2,904 communities. Since 2000, Slovakia has been a member of the Organisation for Economic Co-operation and Development (OECD). Slovakia is expected to join the European Union in May 2004 and is applying for membership in NATO.

9. ***Institutional arrangements:*** The Air Protection Department within the MoE is responsible for coordination of the national climate change policy. The Energy Department within the Ministry of Economy holds the main responsibility for energy policy. The ministries directly or indirectly involved in the implementation of climate policy include those of finance; transport, posts and telecommunications; agriculture; and construction and regional development. An interministerial coordination committee has not been established.

C. Key developments in climate change policies

10. Slovakia ratified the UNFCCC in August 1994 and submitted three national communications, in 1995, 1997 and 2001. During the visit to Bratislava in 2002, the review team analysed the information provided in the NC3 together with data from the most recent inventory submission of Slovakia to the Convention secretariat, which contained data on 1990–2000 emission trends. The results of this analysis suggest that Slovakia contributed to achieving the aim of the Convention, as its total GHG emissions

[1] The start of operation of Mochovce nuclear power plant (NPP) in July 1999 increased the share of nuclear energy on TPES from 17.1 per cent in 1998 to 24.6 per cent in 2000.

decreased by 34 per cent in the period from 1990 to 2000, without considering CO_2 from LUCF, and by 35 per cent if CO_2 from LUCF is considered.

11. Accession to the EU has been set as the highest political priority for Slovakia. The negotiation process towards full EU membership started in 1995. By October 2003, all chapters of the EU *acquis communautaire* had been closed. According to the 2002 progress report of the European Commission, Slovakia is considered to be able to assume the obligations of membership within the envisaged timeframe. However, in the period leading up to accession in May 2004, Slovakia needs to continue its preparations, in line with the commitments it has made in the accession negotiations.

12. Given the challenges both of the economic transformation process and of the EU accession process, at the beginning of the 21st century climate policy is not seen as a political priority in Slovakia. Correspondingly, the review team noted a low budget and very limited administrative capacity in this field. Nevertheless, Slovakia has joined the Kyoto Protocol, is firmly committed to its goals and expresses its intention to make use of its flexibility mechanisms. Slovakia has undertaken several activities to mitigate emissions of greenhouse gases (GHGs) that were implemented jointly (AIJ/JI projects) with other Annex I Parties, including Norway (fuel switch from fossil fuels to bio-energy), the Netherlands (replacement of brown-coal-fired boilers by a biomass-fired boiler; energy saving in the Slovak dairy industry) and Switzerland (Swiss Energy Efficiency Project). Slovakia was among the first countries to sell GHG emission credits in 2002 and intends to join the EU emissions trading market, starting in 2005.

13. In May 2002, Slovakia ratified the Kyoto Protocol, thus committing itself to reducing its aggregate emissions of GHGs such that average annual emissions in the period 2008–2012 are at least 8 per cent lower than 1990 levels. Slovakia experienced a reduction of 34 per cent in total GHG emissions (without LUCF) between 1990 and 2000, largely reflecting the restructuring of its economy and energy sector. The greatest emission reductions were achieved in energy supply (–36 per cent) and the agricultural sector (–49 per cent). Nonetheless, the review team gained the impression that major domestic GHG reduction potentials have not been fully exploited, as Slovakia's GHG emissions intensity (e.g. per unit GDP, per capita) is high compared to that of western European countries.

14. In conjunction with the ratification of the Kyoto Protocol, a number of preparatory arrangements were made. In November 2001, the *Strategy of the Slovak Republic for the Implementation of the Kyoto Protocol Commitments* (Kyoto Strategy) was adopted. Its long-term goals include control over national GHG emission trends, stabilization of GHG emission trends after 2015, and the development of an advanced strategy to reduce GHG emissions.

15. The review and the additional information provided during the visit allowed the review team to conclude that Slovakia's NC3 is a comprehensive document, reflecting all aspects of the Slovak climate change policy at the time it was prepared and published. It covers the GHG inventory, policies and measures, total and sectoral projections and other issues required by the UNFCCC guidelines.[2]

II. GREENHOUSE GAS INVENTORY INFORMATION

A. Inventory preparation and reporting

16. MoE, as the national focal point on climate change, is responsible for reporting on the Slovak national inventory and submits the relevant reports (common reporting format (CRF) and national inventory report to the UNFCCC secretariat. On behalf of MoE, the Slovak Hydrometeorological

[2] "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.

Institute (SHMU) compiles the inventory and coordinates the collection of all data. For this purpose, published data from several relevant institutions, such as the Slovak Statistical Office, are used, and unpublished data are also taken into account. Several institutions contribute to the annual preparation of the inventory, including the Technical University, the Agricultural University, the Forestry Research Institute, the Energy Research Institute, the private consultancy ProfIng, the Transport Research Institute, and the Statistical Office. The team was informed that emission estimates elaborated for individual sectors by external consultants and institutions are reviewed by SHMU's emissions unit.

17. The NC3 provides data on the Slovak GHG emission inventory for the period from 1990 to 1999, and includes emission data for the greenhouse gases 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). An estimate for the CO_2 removal from land-use change and forestry (LUCF) in Slovakia is also provided. CO_2 emissions from biomass are documented. CO_2 emissions from bunker fuels are reported to be zero, since international air transport is included in transport, and emissions from international maritime transport are reported not to occur. The review team noted that the NC3 chapter on inventory marked a significant improvement and extension of reporting on the Slovak GHG inventory, compared to the NC2. Still, it identified some potential for further increasing the transparency of inventory reporting, including (a) a more disaggregated split of the emissions from the energy sector (sectoral approach), (b) a description of the factors underlying the emission trends as required by the UNFCCC guidelines,[3] and (c) a more detailed explanation of the methodologies used and the recalculations that were undertaken.

18. New inventories are produced every year, together with updated historical emissions, in order to obtain consistent time series. During the visit, the review team was provided with the most recent 2002 inventory containing data for the period 1990–2000. The inventory data for 1990–1999 in both the NC3 and the 2002 inventory were found to be consistent. The base year for the inventory was 1990. The small differences due to the 2002 recalculations were explained to some extent by (a) revisions of activity data in the agriculture, waste and industry sectors and (b) revisions of emission factors (according to the revised 1996 IPCC methodology) for N_2O from agricultural soils, CH_4 from manure management and CH_4 from enteric fermentation. Nonetheless, some emission trends still need to be recalculated, including the N_2O emissions from industrial processes.

19. The inventory presented in the NC3 broadly conforms to the UNFCCC and Intergovernmental Panel on Climate Change (IPCC) reporting guidelines. Emission levels were assessed using the 1996 revised IPCC methodology. Some quality assurance/quality control (QA/QC) procedures were in place, including a comparison of activity data for major sources with national statistics and with data for previous years, and a comparison of transport-related fuel consumption based on fuels sold with model results. The team was informed that external reviewers (from the Czech Republic) are regularly invited to comment on the inventory results. QA/QC procedures are continuously developed and integrated into the national emission inventory system (NEIS).

20. Both default IPCC emission factors (EF) and country-specific EF were used. To estimate CO_2 emissions from the energy sector, mainly IPCC default values were applied, except for natural gas combustion. National EF were also used for the estimation of fugitive emissions from transport of crude oil and natural gas, for CO_2 emissions in clinker and lime production, for N_2O from nitric acid production and for CH_4 from manure management. Some national EF for industrial processes were supplied by the relevant industrial partners; others were derived from a number of different national studies. The review team was informed of plans to improve the EF for fugitive emissions.

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[3] Some of these factors were reported in the NC3 chapter on policies and measures.

21. The inventory for the year 2000 was generally assessed to be transparent. Uncertainties were not quantified. Nonetheless, national experts estimated uncertainty levels of less than 2 per cent for CO_2 from fossil fuel combustion; 30 per cent for the CO_2 balance from forests and soils; 30 per cent for CH_4 emissions; and the highest degree of uncertainty for N_2O emissions. The team noted that some emission sources in Slovakia were studied with the aim of reducing uncertainty in the estimation of GHG emissions and removals.[4]

22. The review team acknowledged the submission of the GHG inventory in the CRF and encouraged Slovakia to continue to improve the NEIS, to harmonize the methodology for the different years, to recalculate the emission trends where necessary and to address the existing gaps.

B. Emission profile and trends

23. ***Overall GHG emissions:*** The Slovak GHG emissions profile is dominated by the energy sector, with CO_2 as the main GHG. Overall emission trends in Slovakia show a clear downward tendency, mainly due to the economic transition process. Table 2 shows the emission trends by gas in the period from 1990 to 2000, as reported in the 2003 inventory submission.

Table 2. GHG emission trends by gas

	Gg CO_2 equivalent											Change
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**(%)[a]**
CO_2[b]	59 078	51 984	48 254	45 340	42 447	43 750	44 201	44 479	43 470	42 345	40 061	–32
CH_4	6 724	6 123	5 576	5 199	5 079	5 249	5 329	5 040	4 675	4 643	4 513	–33
N_2O	6 108	5 231	4 445	3 898	4 085	4 239	3 620	3 607	3 397	3 250	3 222	–47
Fluorinated gases	272	267	249	156	144	148	91	114	80	103	103	–62
Net GHG[c]	69 754	60 129	54 397	50 327	48 469	50 703	50 813	51 829	49 686	48 690	45 457	–35
Total GHG[d]	**72 181**	**63 605**	**58 524**	**54 593**	**51 757**	**53 386**	**53 240**	**53 240**	**51 622**	**50 341**	**47 900**	**–34**

[a] 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).

24. In 1990, CO_2 accounted for 82 per cent of the total GHG emissions (without LUCF), followed by CH_4 (9 per cent) and N_2O (8 per cent). A similar pattern can be seen for the year 2000, when the proportion of CO_2 was 84 per cent, followed by CH_4 (9 per cent) and N_2O (7 per cent). Emissions of fluorinated gases accounted for less than 0.5 per cent over the entire period.

25. Total GHG emissions (excluding CO_2 from LUCF) decreased by 34 per cent between 1990 and 2000, while total GHG emissions including net removals from LUCF decreased by 35 per cent. The decrease was mainly attributed to the decline in CO_2 emissions, which fell by 32 per cent, and to the decrease in CH_4 emissions by 33 per cent. The estimates for N_2O emissions decreased by 47 per cent up to 2000, but are reported to be highly uncertain. A major portion of these decreases were achieved during the first four years (trends for 1990–1994 were as follows: CO_2 –28 per cent; CH_4 –24 per cent; N_2O –33 per cent; total GHG –28 per cent).

26. ***Carbon dioxide.*** Total emissions of CO_2 in Slovakia were 40,061 Gg in 2000. Emissions from fossil fuel combustion accounted for more than 90 per cent of total anthropogenic CO_2. The major emitters were stationary fuel combustion (including energy industries, energy use in industry and energy use in other sectors, 81 per cent of total CO_2 emissions), followed by fuel combustion in transport

[4] The review team did not review the consistency of the Slovak 2002 inventory submission with the UNFCCC reporting guidelines on annual inventories and the IPCC guidelines since, according to decisions 18/CP.8 (inventory reporting) and 19/CP.8 (inventory review) from December 2002, this task was handed over to the separate expert review of the national GHG inventory.

(11 per cent) and industrial processes (only mineral products, 7 per cent). Some industrial CO_2 emissions sources, including coke and aluminium production, crude oil processing and metallurgy, were included in the energy sector. For this reason, the share of the industrial sector remained unclear. Emissions from energy industries, energy use in industry and energy use in other sectors were not reported individually. The review team noted a considerable lack of transparency in the reporting on CO_2 emissions from energy and industry, and was partly unable to analyse the emission trends in depth.

27. As shown in table 3 and figure 1, the decline of 32 per cent between 1990 and 2000 was driven mainly by the decrease in emissions in the energy sector, and to some lesser extent by the decreases in transport and industrial processes. The drop in energy-related emissions until 1994 was followed by a slight increase until 1997 and another drop thereafter. Emissions from mobile sources showed a similar trend, but at a higher growth rate than stationary energy sources during the mid 1990s. Emissions from industrial processes (mainly related to the production of cement, lime and magnesite and to the use of limestone and dolomite) dropped sharply (by 26 per cent) in 1991 and broadly remained stable until 1997. In 1998, a sharp increase returned these values to their 1990 levels, before they dropped once again in 2000.

Table 3. Carbon dioxide emission trends

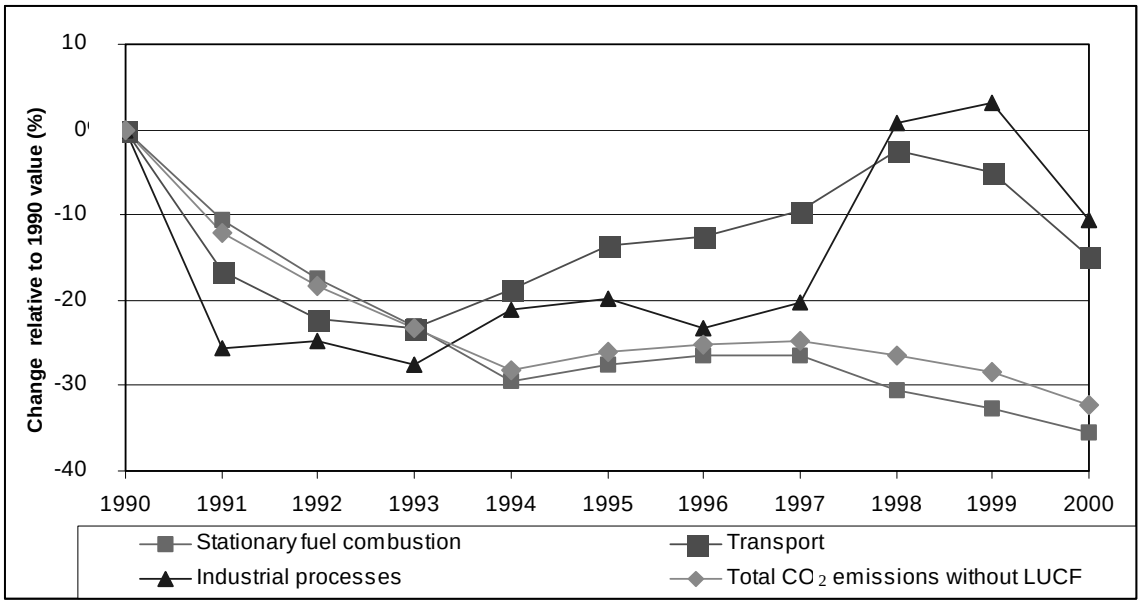
GHG gas source and sink categories	Gg CO_2 equivalent											Change (%)[a]
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	
Energy	55 724	49 487	45 731	42 907	39 802	41 062	41 628	41 803	40 089	38 886	36 965	–34
Stationary fuel combustion	50 654	45 257	41 784	39 016	35 684	36 685	37 194	37 212	35 139	34 066	32 647	–36
Transport	5 070	4 229	3 947	3 892	4 118	4 378	4 434	4 591	4 950	4 821	4 319	–15
Industrial processes	3 354	2 498	2 523	2 433	2 646	2 688	2 572	2 676	3 382	3 459	2 998	–11
Land-use change and forestry	–2 427	–3 475	–4 128	–4 266	–3 287	–2 683	–2 427	–1 411	–1 936	–1 651	–2 443	1
Total CO_2 emissions/ removals with LUCF	56 651	48 509	44 126	41 074	39 160	41 067	41 773	43 068	41 534	40 694	37 618	–34
Total CO_2 emissions without LUCF	**59 078**	**51 984**	**48 254**	**45 340**	**42 447**	**43 750**	**44 201**	**44 479**	**43 470**	**42 345**	**40 061**	**–32**

[a] In per cent of 1990 values.

28. The marked decline in energy-related CO_2 emissions can be partly explained by structural changes in the economy (see paragraphs 5–6), energy efficiency improvements, an overall decline in energy consumption, a shift from coal to natural gas and nuclear energy (see paragraph 7), and a reduction of energy-intensive production. Changes in the statistical system (modernization and harmonization with the EU system) and in applied accounting methodologies might also have contributed to these significant changes.

29. For the period 1990–2000, the estimated CO_2 removals in LUCF ranged from 1,411 to 4,266 Gg per year. In 2000, CO_2 removals were 2.443 Gg CO_2, which represented 6 per cent of total CO_2 emissions (without LUCF). The estimate included parts of the forest above ground (trees, plant cover, overlying humus) and below ground (roots, humus in soil). It also included estimates for wood harvests and forest fires. Land-use changes in forests, pastures, arable land, urbanized areas, etc. were evaluated. The considerable annual variations can be partly explained by climatic variations and changes in fuelwood production.

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



30. ***Methane:*** Emissions of CH_4 amounted to 4,513 Gg CO_2 equivalent in 2000. Waste management accounted for the largest share (39 per cent), followed by the energy sector (32 per cent) and agriculture (29 per cent). The proportion of households using cesspools and septic tanks for waste-water handling was relatively high, resulting in a considerable contribution to total CH_4 emissions (18 per cent in 1999).

Table 4. Methane emission trends

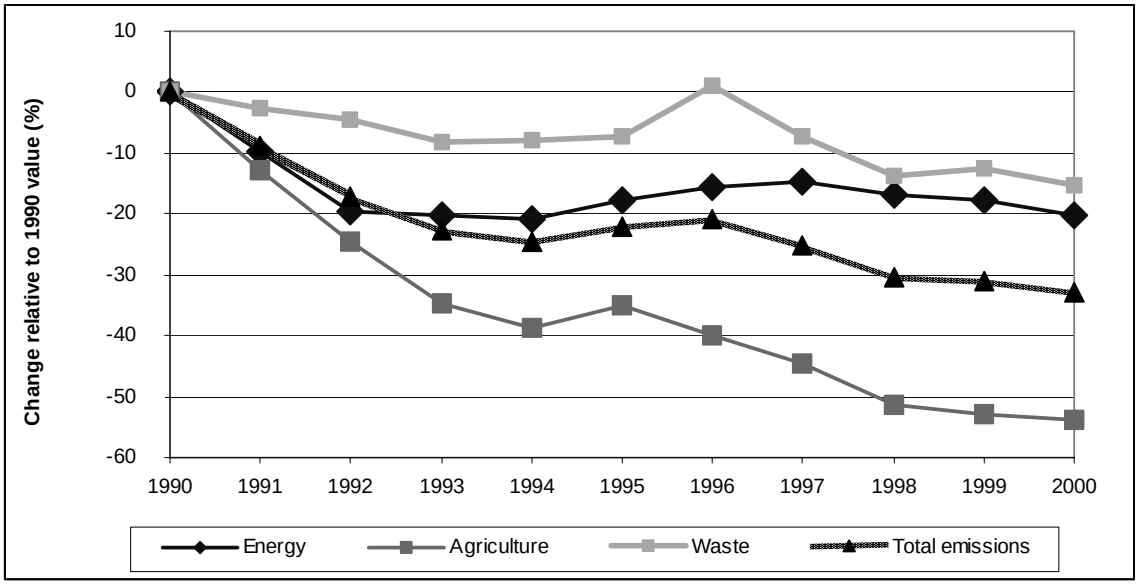
GHG gas source and sink categories	Gg CO_2 equivalent											Change (%)[a]
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	
Energy	1 805	1 626	1 449	1 440	1 431	1 481	1 524	1 540	1 498	1 482	1 439	-20
Fuel combustion	366	313	282	245	228	204	203	199	186	179	169	-54
Fugitive emissions	1 439	1 313	1 166	1 195	1 203	1 277	1 322	1 341	1 312	1 303	1 270	-12
Agriculture	2 837	2 473	2 145	1 852	1 737	1 841	1 702	1 571	1 382	1 338	1 310	-54
Enteric fermentation	2 441	2 105	1 813	1 547	1 449	1 546	1 421	1 313	1 155	1 119	1 098	-55
Waste	2 068	2 012	1 973	1 897	1 903	1 917	2 092	1 917	1 783	1 810	1 751	-15
Solid waste disposal on land	1 056	1 056	1 056	1 056	1 056	1 069	1 252	1 071	962	977	1 013	-4
Waste-water handling	1 012	956	917	841	848	848	841	847	821	832	737	-27
Total emissions	**6 724**	**6 123**	**5 576**	**5 199**	**5 079**	**5 249**	**5 329**	**5 040**	**4 675**	**4 643**	**4 513**	**-33**

[a] In per cent of 1990 values.

31. As shown in figure 2 and table 4, CH_4 emissions declined steadily between 1990 and 2000 by 33 per cent overall, which was largely attributed to the decline in emissions from enteric fermentation (–55 per cent), the largest source within the agriculture sector. A significant reduction in livestock farming, stemming (inter alia) from the transition to a market economy and the implementation of the rules for the EU common agricultural market, was the major driver of this decline. Emissions from energy decreased by 20 per cent due to declines in fugitive emissions (mainly crude oil and natural gas distribution, –12 per cent) and emissions from fuel combustion (–54 per cent). Emissions from waste management decreased by 15 per cent, mainly because of improvements in waste-water handling (–27 per cent) and solid waste disposal on land (–4 per cent). Following some recommendations by national experts, some EF and parameters were recalculated, including the CH_4 conversion factor for

waste-water and sludge handling systems, the fraction of sludge treated by the handling system and CH_4 recovery rates.[5]

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



32. ***Nitrous oxide:*** Estimates for N_2O emissions reached 3,222 Gg CO_2 equivalent in 2000. Most of these emissions were attributed to the use of mineral fertilizers on agricultural soils (71 per cent), followed by manure management (16 per cent), transport and chemical industry (both 5 per cent).

Table 5. 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	258	220	196	187	220	235	246	258	273	270	252	–2
Stationary fuel combustion	187	162	144	134	123	122	121	118	109	103	98	–47
Transport	71	58	53	52	97	113	125	140	164	167	154	117
Industrial processes	577	543	491	413	652	715	158	164	154	161	149	–74
Chemical Industry	577	543	491	413	652	715	158	164	154	161	149	–74
Agriculture	5 250	4 445	3 740	3 284	3 200	3 275	3 200	3 170	2 956	2 805	2 806	–47
Agricultural soils	4 156	3 452	2 883	2 541	2 504	2 544	2 523	2 550	2 411	2 289	2 303	–45
Manure management	1 095	993	857	743	696	731	676	620	545	516	503	–54
Total emissions	**6 108**	**5 231**	**4 445**	**3 898**	**4 085**	**4 239**	**3 620**	**3 607**	**3 397**	**3 250**	**3 222**	**–47**

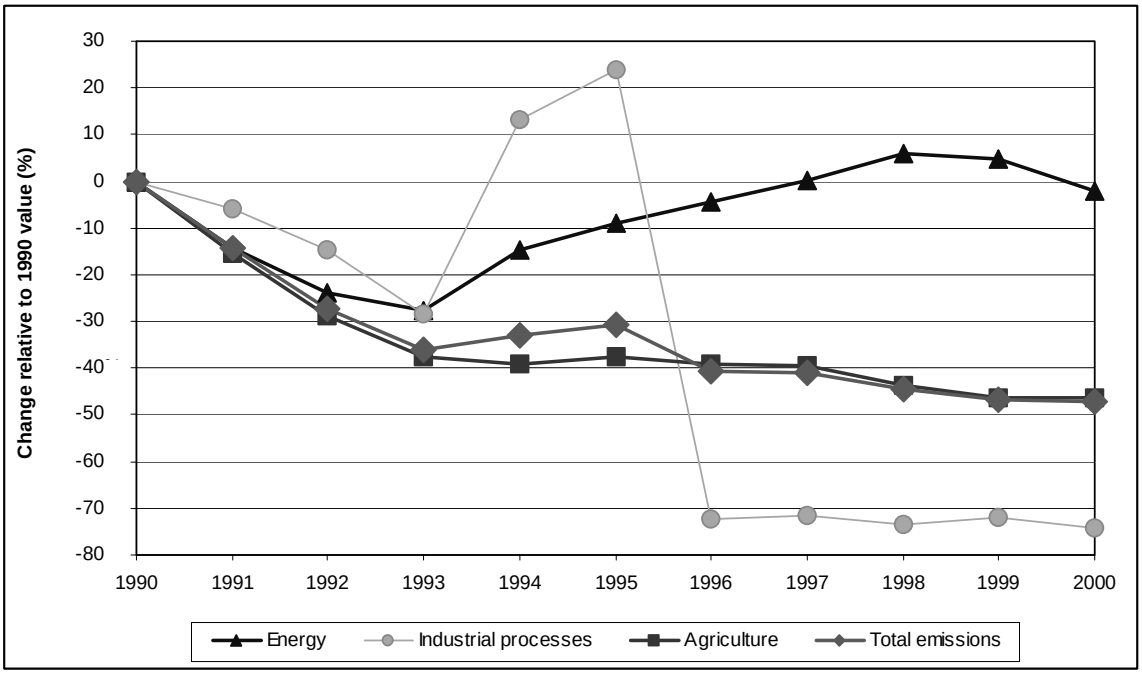
[a] In per cent of 1990 values.

33. As shown in table 5 and figure 3, the period 1990–2000 saw a steadily declining trend in N_2O emissions from agriculture (agricultural soils –45 per cent, manure management –54 per cent). The energy-related N_2O emissions dropped until 1993, broadly following the declining energy demand in this period, but have been rising since 1994, mainly due to the increasing use of three-way catalytic converters in passenger cars. Emissions from the chemical industry (mainly stemming from nitric acid production) dropped to one quarter of the 1990 level in 1996 and broadly remained stable thereafter. Inconsistencies in the estimates for N_2O emissions from industrial processes for the years 1994 and 1995

[5] According to the Good Practice Guidance and Uncertainty Management in National GHG Inventories, the default value for CH_4 emissions (maximum CH_4 predicting capacity) from domestic/commercial waste water was applied (0.6 instead 0.25 kg CH_4/kg).

result from different assumptions on the efficiency of NO_x absorbers in nitric acid production and need to be recalculated.

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



34. ***Fluorinated gases:*** Emissions of fluorinated gases decreased by 62 per cent between 1990 and 2000, when they accounted for less than 0.5 per cent of total GHG emissions. Within the different groups of gases, a considerable variation can be observed (see table 6). Decreases in PFC emissions (mainly originating from aluminium production) more than compensated for the increases in HFC emissions (mainly from the use of these substances in refrigeration, foam production, aerosols and metred dose inhalers, substituting the substances phased out under the Montreal Protocol) and in SF_6 emissions (from insulation in electrical equipment). Actual as well as potential emissions were estimated on the basis of questionnaires developed by the Slovak Association for Cooling and Air-Conditioning Technology in 1998. The base year for fluorinated gases was chosen to be 1990.

Table 6. Fluorinated gases emission trends

	Gg CO_2 equivalent											Change (%)[a]
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	
HFCs	0	0	0	0	3	25	45	70	44	78	78	
PFCs	272	267	249	156	132	114	35	33	24	12	12	–96
SF_6	0	0	0	0	9	10	11	11	12	13	13	
Total	**272**	**267**	**249**	**156**	**144**	**148**	**91**	**114**	**80**	**103**	**103**	**–62**

[a] In per cent of 1990 values.

35. ***Other gases:*** Emissions of NO_X, CO and SO_2 presented in the NC3 were calculated in the national inventory REZZO. The categories of emission sources in REZZO were based on the Clean Air Act and did not fully correspond to the structure of sources as defined by the IPCC CRF requirements. Emissions of NMVOC have been regularly estimated within the framework of the National Programme of NMVOC Emission Reduction. The major sources of emissions were the use of solvents and the transport, refining and storage of crude oil and petrol.

III. POLICIES AND MEASURES

A. Overview

36. The NC3 outlines the general context of climate policy in Slovakia and describes the most important policies and measures (PaMs) implemented for the relevant GHGs and sectors. It contains summary tables of exemplary PaMs aimed at mitigation of GHG emissions in the different sectors.[6] During the visit, the review team was provided with much additional information on recent developments and activities.

37. The review team acknowledged the level of comprehensiveness and transparency achieved in NC3 reporting on PaMs, in particular its clarity regarding the development of PaMs described in the NC2. It identified some further potential for improving the comprehensiveness, transparency and accuracy of reporting, including more accurate descriptions of the implementation status of PaMs, and harmonization of the descriptions of PaMs in the text with those in the accompanying sectoral tables. Information on costs and cost-efficiency of individual PaMs were reported for the energy sector only (see paragraph 52).

38. The team was informed that governmental documents are generally developed in the relevant ministry, in a more or less intensive process of coordination with other ministries involved. The resulting documents are then passed to the government, which officially takes note of them in many cases, but rarely approves or otherwise takes decisions on them. The review team gained the impression that these national circumstances, in combination with the lack of an overall coordination of climate policy and its low priority ranking in Slovakia, might be the reason for the minor involvement of ministries other than the MoE in the field of climate change.

39. The most important strategic documents related to climate change policy are: the *Strategy, Principles and Priorities of Governmental Environmental Policy*, which was approved by the government and by the National Council; the *New Energy Policy;* and the *Waste Management Programme of the SR 2000–2005*, all of which are based on government resolutions. Among the documents the government took note of is the *Strategy of the Slovak Republic for Implementation of the Kyoto Protocol Commitments*[7] (cited in the NC3 as "Strategy of the SR in relation to global climate change"). The Kyoto Strategy was under preparation while the NC3 was being drafted; it was published in November 2001, and the review team was provided with an English version before its visit to Bratislava.

40. The Kyoto Strategy is designed as guidance for the development of climate policies in all relevant ministries. Among other things, it lays down short-, medium- and long-term overall emission targets, priorities for capacity-building and objectives for individual sectors, and also outlines the CO_2 emissions trading scheme. The Kyoto Strategy is to be followed by an *Action Plan of Fulfilment of the Kyoto Protocol Commitments* specifically naming the concrete PaMs for attaining the objectives of the Kyoto Strategy. At the time of the country visit, this Action Plan was about to be finalized. The review team regarded the Kyoto Strategy and the Action Plan as clear progress when compared to the NC2; in particular, the proposed emissions trading (ET) scheme for CO_2 (see below) was noted as a particularly promising and innovative project. The review team felt that a framework was missing for regular monitoring and reviewing of the successful implementation of climate policy, in particular the effect of GHG mitigation PaMs.

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[6] For transport, industry and the residential, commercial and institutional sector, no summary tables of individual PaMs were provided. However, the total effect of sectoral PaMs is reported in the NC3 chapter on projections.

[7] Hereafter referred to as Kyoto Strategy.

41. In general, there had been no major changes in the policy-making process or in the general outline of the PaMs since the NC2. The main changes in the national circumstances affecting PaMs – preparation for EU accession, scheduled decommissioning of two units of the Jaslovské Bohunice NPP and the decision in 2000 not to build units 3 and 4 of the Mochovce NPP – are described above.

42. When comparing the NC2 and the NC3, the team learnt that Slovakia has successively discontinued state energy subsidies and shifted to a more market-based approach, partly by using tax exemptions as incentives. The State Environment Fund, installed in 1991 and still listed as a measure in the NC3, was abolished in January 2002 because of budget restrictions. The review team identified the lack of funding as a major risk factor for not achieving the ambitious national environmental objectives.

B. Energy

43. Between 1990 and 2000, emissions from stationary fuel combustion declined by 35 per cent as a result of a significant reduction in energy demand and the restructuring of Slovak energy industries. In 2000, they accounted for 71 per cent of total GHG emissions.

44. A new *Energy Policy* was formulated in a governmental resolution in 2000. The overall objectives of the policy are threefold: integration into the EU internal market, security of the energy supply, and sustainable development. The document mentions three policy goals: (a) the adaptation of cleaner technologies, including desulphurization and denitrification units; (b) fuel switching from coal to gas and RES; and (c) energy savings. In the light of these goals, the two most important PaMs currently concerning the energy system are (a) the liberalization of the energy market and (b) the commitment to reducing the emissions of conventional air pollutants. These are implemented by several specific acts which also influence GHG emissions, directly or indirectly.

45. The most important PaMs for the energy sector include the *Act on Energy* (No. 70/1998), which is the legal basis for the liberalization of the energy market, and the *Clean Air Act* (No. 478/2002), which aims at reducing the emission of conventional air pollutants. The latter also builds the framework for the existing ET scheme for SO_2 and the proposed scheme for CO_2 (see below). Regulation will be necessary in those areas of the energy system that constitute a natural monopoly. The proposed *Act on Regulation in Network Branches* is expected to stipulate the relevant economic and organizational conditions.

46. In September 2000, the Slovak Government approved the *Draft Model of the Slovak Power Industry Transformation and Privatization of Energy Companies Stakes*. The resolution elaborates on the transformation and restructuring of energy distribution companies into separate joint-stock distribution companies and joint-stock heating companies, and on restructuring of the dominant electricity producer and transmission grid operator (Slovenské elektrárne, a.s.) and its division into two joint-stock electricity companies, responsible for transmission grid operation and production respectively. In the context of this policy document, former plans to extend the capacity of Mochovce NPP were dropped. Instead, some phase-out plans for two units of the Jaslovské Bohunice NPP are currently under discussion.

47. Household energy consumption has been subsidized considerably in the past. A recent Energy Charter report revealed that in 1998 private consumers paid about 50 per cent of the costs for electricity whereas industry paid 105 per cent, and commercial consumers about 110 per cent. A maximum price was set for heat. These subsidies and cross-subsidies were going to be removed by 2002, according to a *Schedule of Adjustments of Regulated Prices, Including Energy*.

48. The *Act on Energy* obliges electricity buyers and heat distributors to buy electricity and heat from RES and from CHP plants when it is (a) environmentally justified or (b) technically feasible. The review team was informed that these indistinct preconditions reduced the effectiveness of this obligation

significantly. The founding of the Cogeneration Centre in the Slovak Energy Agency is expected to promote combined cycle technology. A further measure to promote small hydropower plants, small cogeneration units (both up to 1 MW installed power), and other RES units is the 1992 *Income Taxes Act*, which stipulates an income tax allowance for the first five years of operation. However, national experts estimate the effect to be low. Hence, the review team doubted that PaMs to promote CHP and RES were sufficient to meet the targets envisaged in the NC3.

49. The review team learnt that the draft *Act on Energy Efficiency* had been withdrawn in 2001. It contained several regulatory elements on efficient energy use, including building regulations, obligatory energy audits for large consumers, energy labelling of appliances, minimum energy efficiency requirements for heat production, and an obligation for operators of heat sources to preferentially install CHP units. Instead of this comprehensive act, the *Act on Energy Labelling for Household Appliances* came into force in 2002, implementing the relevant EU directives.

50. Energy-related CH_4 emissions result mainly from fugitive emissions from the natural gas distribution system. PaMs in this field include an inspection of the national gas distribution system (effects were not estimated) and planned technical measures to cut losses in international transit pipelines, aiming at a reduction of 3,000 Mg CH_4 per annum. The legal basis for both PaMs is still to be established. No PaMs to reduce energy-related N_2O emissions are reported in the NC3.

51. Although its primary goal is the abatement of conventional air pollutants, the *Clean Air Act* indirectly also affects energy-related CO_2 emissions from medium- and large-scale stationary sources. The most important effect is the switch from fuels with high sulphur content (coal, heavy heating oil) to those with low sulphur content (natural gas, biomass). The complementary *Act on Charges for Air Pollution* introduces differentiated emission charges for conventional pollutants. Existing installations that do not yet comply with the emission limits set by the *Clean Air Act* are charged successively higher specific emission fees. By 2006, existing installations will have to comply with the emission limits as well. The overall aim of these acts is compliance with the national emission limits laid down in the *Convention on Long Range Transboundary Air Pollution* and the *Protocol on Reduction of Acidification, Eutrophication and Ground Ozone*. National experts assume that these acts and the increasingly competitive market situation will lead to an increase in the installation of combined cycle technology, thermal insulation of buildings and utilization of RES.

52. ***Cost and cost efficiency***. Valuable information on abatement costs is given in table 4.8 of the NC3. During the review team's visit, the method of arriving at these data (ENPEP) was explained. The resulting table lists mitigation costs and reduction potentials for a number of energy-efficiency and renewable-energy technologies. In several cases, estimates for the necessary investments vary widely, so up to four different calculations were reported. Specific mitigation costs (or cost ranges) are calculated on the basis of these input data, the given lifetime of the installation and an assumed fuel price development.

Table 7. Investment costs, mitigation costs and total emission reduction potential for different technologies[a]

Technology	Investment cost (US$ million)	Mitigation cost (US$/t CO_2)	Total emission reduction potential (Gg CO_2/[a])
CC[b] in industrial PP[c]	469	+23.1	230
CC in public PP	242	+27.0	585
CC in public PP plus thermal insulation	242	+26.9	541
Biomass in industrial PP with parallel implementation of CC	55–258	–42.3 to –27.2	328
Biomass in DHS[d]	98–458	–41.2 to –26.5	386
Biomass in DHS plus thermal insulation[e]	74–343	–45.7 to –25.0	307
Biomass in individual heating of houses	14–77	–22.7 to –20.0	685
Geothermal energy in DHS	160–889	–39.3 to +20.5	217
Geothermal energy in DHS plus thermal insulation	112–622	–39.3 to +19.2	165
Solar heating in individual heating of houses	459–702	+8.6 to +34.4	174
Biomass in industrial heat monoproduction	57–266	–11.1 to +4.7	267
Biomass in industrial cogeneration	16	–41.1	77

[a] Results of ENPEP model; after table 4.8 of the NC3.
[b] CC = combined cycles.
[c] PP = power plant.
[d] DHS = district heating system.
[e] "plus thermal insulation" designates additional thermal insulation of building stock.

53. The review team noted with interest that almost all biomass technologies (in industry, district heating, and individual heating) showed negative mitigation costs, and were therefore reasonable even from a microeconomic perspective. This was also true for geothermal energy technologies (except for the most expensive ones), but not for the implementation of combined cycle technologies or solar heating.

54. During the visit, the review team was provided with cost curves for the implementation of these technical measures, showing the amount of GHG mitigation that could be reached up to a certain cost level. PaMs with negative abatement costs showed an emission reduction potential of about 1,500 Gg CO_2 per year, while PaMs up to around 30 US$/t CO_2 showed a further 1,000 Gg CO_2 mitigation potential. Given the high potential of no-cost measures, the review team concluded that the main obstacle for GHG mitigation in Slovakia was not technological but financial constraints.

55. ***CO_2 emissions trading:*** The Kyoto Strategy distinguishes between GHG reductions as a result of economic decline during the transformation process and GHG reductions from the implementation of concrete mitigation PaMs. The results of this analysis suggest that Slovakia will be in the position of a net supplier of emission rights in an international emissions trading market. Slovakia would prefer to participate in international ET at two different levels – intergovernmental and individual enterprises – according to well-defined international and domestic rules, and has therefore begun to draft the *Act on Establishing an ET System for CO_2*. This system builds on the experience gained with the national system of ET for SO_2.[8]

56. In contrast to the existing SO_2 ET system, which is national in scope, ET for CO_2 has to be aligned with the requirements of the Kyoto Protocol. Furthermore, in order to achieve benefits by coupling it to other systems, it should be aligned with the ET system which is currently under discussion in the EU. Participation will be obligatory for those installations listed in annex 1 of the draft EU directive; this will cover approximately 60–70 per cent of total CO_2 emissions. Slovakia intends to open the system also to single installations not listed in annex 1, mainly in order to enable participation of

[8] Since 1998, Slovakia has been the only European country with an ET system for SO_2. Large stationary sources are assigned a certain amount of yearly emissions rights by the district administration, in the form of a licence limited to the year of issue.

energy transformation installations with less than 20 MW installed power. The draft allocation plan favours grandfathering over auctioning and limits the total amount of emission rights sold on the international market to 10,000 Gg CO_2, effectively creating a limiting gateway between the national and the international ET systems.

C. Industry

57. Slovakia is a country with a high proportion of heavy industry; large enterprises dominate the manufacturing sector. Public ownership of large enterprises has been seen as one reason for low energy efficiency in the past. Privatization of public enterprises proceeded in 1999, although in some of them (gas utility and pipeline, electricity generation and distribution companies) the state continued to hold a strategic majority of 51 per cent.

58. All PaMs listed in this sector are technical measures implemented or planned in specific large-scale industrial installations. During recent years most of these plants have introduced technical innovations in order to comply with new environmental legislation. All these plants are subject to the EU directive on integrated pollution prevention and control (IPPC); transition periods for introducing the IPPC were a critical issue during accession negotiations until 2003, when the *Act on IPPC* (No. 245/2003) was adopted. Installations where improvements have been made include: US Steel, an iron and steel plant, where primarily SO_2 emissions have been reduced; ZSNP (Žiar nad Hronom), an aluminium plant, where different technical improvements were made, including a reduction of PFC formation; and a number of cement installations, where innovations in the fields of production technology and combustion process are expected to increase energy efficiency. In steel and cement plants, a large proportion of the emissions is process-related and therefore depends directly on production volume.

59. The legislation on air quality is the only national regulation to reduce industrial emissions. The choice of mitigation measures concerning fluorinated gases (PFCs, HFCs and SF_6) is thought to be very limited, so no PaMs have been developed in this field.

D. Transport

60. Between 1990 and 2000, emissions from fuel combustion in transport declined by 13 per cent, mainly as a result of a significant reduction in freight transport. In 2000, they accounted for 9 per cent of total GHG emissions. During the visit, the review team was provided with additional data on the development of transport and the modal split. Between 1993 and 2000, these data showed a decrease in passenger transport by rail from 4,569 to 2,870 million passenger kilometres (–39 per cent) and in freight transport by rail from 14,201 to 11,234 million tonne kilometres (–21 per cent). During the same period, motorized individual passenger transport increased from 18,248 to 23,812 million passenger kilometres (+30.5 per cent). The share of electric railways amounted to about 42 per cent by length of track and about 80 per cent by passenger transport volume. In October 2000, restructuring plans for Slovak Rail were adopted, aiming to create the conditions necessary for the liberalization and eventual privatization of its commercial activities.

61. PaMs addressing transport emissions included the *Act on Fuel Consumption Tax* (preferential treatment of biofuels)and the *Act on Road Tax* (restricted to commercial freight transport; tax reductions for combined transport). Both acts have been implemented and were estimated to have a minor effect because of low tax rates. Additionally, a *Support Programme for the Rationalization of Fuel and Energy Consumption in Transport* has been approved for the following fields of action: (a) acceleration of public transport, (b) reduction of the average specific energy consumption in individual transport, (c) integration of energy efficiency considerations in other acts, (d) technical improvement of

infrastructure and vehicle fleet in public transport, (e) support of walking and cycling, and (f) raising public awareness.

62. Quantitative estimates of the mitigation effects of these PaMs were not reported in the NC3, except for the modal shift from individual to public transport, with a listed mitigation potential of 290 Gg CO_2 equivalent per year by 2010. National officials considered this estimate as very optimistic.

E. Energy use in residential, commercial and institutional sectors

63. In 2000, the residential sector accounted for about 19 per cent of total final energy consumption. The potential for certifiable energy savings in building heating was estimated at about 40 per cent of total heat consumption. Nearly half of the apartments were connected to district heating systems (1996: 84 per cent of all flats in apartment buildings, corresponding to 42 per cent of all flats), most of which were in a technically poor condition. Maintenance of the district heating systems would need considerable investment, but consumers have already struggled with price increases due to the phasing out of cross-subsidies for household energy consumption.

64. In the period 1992–1997, almost 11,000 flats were insulated, facilitated by a subsidy programme for thermal insulation of buildings. The state subsidies for this measure amounted to 540.8 million SKK (approximately US$ 12.3 million), resulting in overall yearly energy savings of about 197 TJ. This specific programme was terminated in 1997, and energy-saving investments are now supported by the general State Fund of Housing Development which in 1999 had a total volume of 3 billion SKK (approximately US$ 68 million). Furthermore, an action plan on building reconstruction ("Proposed conception of building reconstruction with special accent upon housing fund") is currently under consideration.

65. Progress has been made in terms of the regulatory and technical framework for the residential sector. The target set in the NC2 was a reduction in specific heat consumption of new buildings by 16 per cent in 2005 and by 24 per cent in 2010, compared to 1993 levels. Technical standards for thermal insulation in new and existing buildings (Slovak Technical Norm 730540) were tightened. The current values for heat consumption are 85 kWh/m^2 per year for new residential buildings and 130 kWh/m^2 per year for reconstruction of residential buildings. The review team felt that a monitoring and evaluation programme accompanying these activities would be necessary to ensure their successful implementation.

F. Agriculture

66. GHG emissions from the agricultural sector declined by 49 per cent in the period 1990–2000 and accounted for 9 per cent of total GHG emissions in 2000. The main driver behind this trend was the decline in agricultural production and livestock population since 1990. A further reduction in livestock numbers is reported as a measure to harmonize the Slovak agricultural policy with the EU *acquis communautaire*. On the other hand, intensified agricultural production of meat and milk to meet domestic demand is envisaged. The measures arising under the EU Common Agricultural Policy are expected to reduce CH_4 emissions by 22 Gg CO_2 equivalent per year, while formation of N_2O from manure management is expected to increase by 546 Gg CO_2 equivalent per year, mainly due to a change in animal stock composition.

67. The planned production of biogas from animal excrement is estimated to reduce CH_4 emissions by 32Gg CO_2 equivalent per year by 2005 (i.e. five years after it is fully implemented), and by 167 Gg

CO_2 equivalent per year by 2015.[9] This measure would also reduce N_2O emissions from manure management by 398 Gg CO_2 equivalent per year in 2005, and 1,373 Gg CO_2 equivalent per year in 2015.

G. Land-use change and forestry

68. Forests cover 41 per cent of the national territory, and their timber-growing stock is estimated at more than 396 million m^3. Estimated CO_2 removals in LUCF have increased slightly since 1993 and were equal to 6 per cent of total GHG emissions (excluding LUCF) in 2000. Traditional firewood usage represents an energetic value of 3,800 TJ per year, but the overall potential for biomass produced in forestry is estimated at 9,380 TJ per year. LUCF is not seen as a priority for climate policy, although a number of PaMs were reported, including:

(a) ***Soil stock protection***. By the avoidance of deforestation the physical condition of forest soils is conserved (i.e. erosion is prevented) as well as their carbon stock. This PaM is currently implemented. Soil carbon stocks will be monitored through the GHG national inventories.

(b) ***Change in tree species composition***. The objective of this PaM is to increase the carbon stock in forests through the progressive substitution of conifers by broad-leafed species. This measure was reported implemented in the NC2, and it is still in force. The change in accumulation of biomass carbon will be monitored by the State Forestry Institute.

(c) ***Afforestation of non-forest areas***. The objective is to increase the country's forested area by the conversion of non-arable lands. Originally formulated as *Programme of Afforestation of Non-Forest Areas Unfit for Agricultural Use for the period 1994–2000* (Decree No. 550/1994 of the Slovak Government), this measure was discontinued because of disputed property rights, and because unclear financial and subsidy policies for landowners could not be clarified. The programme was later restarted on state-owned lands.

(d) ***Protection of carbon stocks in forests affected by emissions***. The *Implementation Programme for Elimination of Damage Caused by Anthropogenic Activity* (Resolution No. 594/1994 of the Slovak Government) was conceived to protect forests from acid rain produced by industrial activities. Thirty-three per cent of the Slovak forests are affected by air pollution and acid rain. This PaM was discontinued for lack of financial support.

H. Waste management

69. Methane emissions from waste management (including waste-water handling) decreased by 11 per cent in the period from 1990 to 2000. In 2000, it accounted for 4 per cent of total GHG emissions.

70. Waste management is a comparatively recent policy area in Slovakia. In 1991, a separate framework for waste management was created by the *Waste Act* (No. 238/1991 Coll.). This act was fundamentally revised in 2001 to incorporate the relevant EU legislation. In 1993, the first Waste Management Programme (WMP) already included specific and ambitious objectives for waste minimization, recovery and disposal, as well as cleaning of old, uncontrolled landfills and other contaminated sites. All uncontrolled dumping sites and landfills were closed down, and a network of landfills meeting regulatory conditions was created.

71. The most recent WMP, published after the NC3, takes into account new waste legislation and covers the period until 2005. With the revision of the *Waste Act*, the classification of wastes was also changed, in order to be consistent with EU legislation. The amount of municipal waste has remained

[9] These estimates are based on corrected data for table 4.2 in the NC3.

approximately constant during recent years; in 1999 it was 1,706 million tonnes (dry matter), corresponding to 315.9 kg per person per year. About 75 per cent of the municipal waste comes from private households. The NC3 is not very clear regarding the waste streams; notably, the amount of biodegradable waste that is disposed of in landfills – an important figure in terms of CH_4 formation – could not be deduced. About two thirds of municipal waste (62 per cent) is disposed of in landfills and only a small fraction (12 per cent) is incinerated; the remaining portion is disposed of in dump sites.

72. Only about 60 per cent of Slovak households are connected to a system of collection and treatment of waste water (see paragraph 31). The adoption of the relevant EU legislation is expected to increase this fraction, but considerable investments will be needed.

73. An important measure in the field of waste management is the collection and utilization of CH_4 emitted from landfills. The review team was informed that in 1995 there were approximately 2,300 landfills officially in operation; the unofficial number was estimated to be up to 7,000. Landfills that are now in operation will either have to be retrofitted with gas collection systems by 2008, or be shut down. Landfill gas either has to be used for energy or, if this is not possible, flared. The team was informed that eight retrofittings of landfills had been carried out within the framework of the Dutch JI programme ERUPT.

IV. PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES

74. Projections of GHG emissions reported in the NC3 covered all key sources and sinks in the following sectors and for the following gases: energy (fossil fuel combustion and fuel use in transport – CO_2, CH_4 and N_2O; industrial processes – CO_2, CH_4, N_2O as well as HFCs, PFCs and SF_6; agriculture – CH_4 and N_2O; forestry – CO_2; and waste – CH_4 and N_2O. Projections of emissions from international bunkers were not reported separately. The period covered by the projections was 2000–2015. The projected trends were consistent with the inventory data until 1998, which was chosen as the base year for all scenarios. The inventory data were represented in diagrams together with the projections, starting from 1990, the base year for calculating emission reduction targets.

75. The review team commended Slovakia for its high quality of modelling and reporting on GHG projections, with a greater degree of transparency and consistency than in the NC2. The structure of the projections presented in the NC3 was in compliance with UNFCCC reporting guidelines. Sectoral representation of projections was consistent with the sectoral reporting on PaMs. For projection estimates, all energy-related emissions (resulting from combustion) in energy, transport, industry and agriculture were represented as emissions in the energy sector. Separate figures for the transport sector (as a subsector of energy) were given, while the projections for the industry and agriculture sectors included only non-energy emissions. The overall GHG emissions were presented as a total, and expressed in CO_2 equivalent, using the standard global warming potential factors. This provided an insight into the possibilities of meeting the Kyoto targets.

76. Institutional arrangements concerning the preparation of projections were not specified in the NC3, but were clarified in the course of discussions during the country visit. The overall responsibility for the Slovak GHG emissions projections lay with MoE. All projections reported in the NC3 were compiled by the consulting company PROFING Ltd in Bratislava. Some input assumptions (e.g. GDP growth) were taken from other sources referenced in the NC3. During the country visit, a set of updated projections for total CO_2 and total GHG emissions was presented (see figures 4 and 5). These projections were compiled by PROFING in 2002, and showed only minor changes compared to those presented in the NC3.

A. Scenarios, assumptions and methodology

77. The scenarios described in the projections chapter are consistent with the requirements of the UNFCCC reporting guidelines. Three different scenarios for aggregated GHG emissions were used to examine the effect of different policy options. These included a "baseline" or "without measures" scenario, a "with measures" scenario and a "with additional measures" scenario. Additionally, a "maximum" scenario was developed for CO_2 emissions from combustion and transformation of fossil fuels.

78. The **"with measures" scenario** represented the actual situation when adopted PaMs were taken into account. The "**without measures"** or "baseline" (BAU) scenario represented an extrapolation of the actual situation, without any changes in the energy supply structure. Its construction allowed evaluation of the effects of decreases in fuel consumption and of increases in emissions fees. The **"with additional measures**" **scenario** was based on an evaluation of the aggregated impact of all PaMs reported in chapter 4 of the NC3, including the planned measures.

79. During the visit, the review team was informed that no sensitivity analyses to account for uncertainties in the assumptions were carried out. This was partly a consequence of limited funding and the number of staff involved in compiling the NC3. Key uncertainties related to GDP growth, use of nuclear energy, and domestic energy demand forecast. No future work in the area of projection of total effects of PaMs was mentioned in the NC3, and the discussions during the country visit indicated that this would depend very much on funding.

80. The **key assumptions** for all modelling scenarios of CO_2 emissions from fossil fuel combustion and transformation related to (a) the development of final energy consumption in end-use sectors; (b) the structure of total primary energy sources (TPES); (c) the conversion, transport and distribution of fuels and energies; and (d) restructuring in industry, transport and services. The expected development of final energy consumption for individual sectors was determined based on input data from different documents (i.e. *Forecast of the dynamics of GDP development*; *Forecast of electricity consumption*, etc.). Key assumptions and basic input data for a number of key indicators, including GDP growth, heat and electricity consumption, volumes of crude oil and oil products, were provided in appendix P3 of the NC3. The review team commended Slovakia for the level of comprehensiveness and transparency in this regard.

81. During its visit to Bratislava, the review team learnt that the assumptions for **GDP growth** in the NC3 were 2.8 per cent for the period 2000–2005, 3.86 per cent for 2005–2010 and 3.64 per cent for 2010–2015. The NC2 projections had been based on a 4.25 per cent growth rate for 2000–2005, which was one of the main reasons for lower NC3 projection results compared to NC2 projections.

82. The analysis of effects of different PaMs focused on the **energy sector**, because of its dominant role for the total GHG emissions and its large mitigation potential. The following **assumptions**[10] were applied to all scenarios for CO_2 emissions from fossil fuel combustion: (a) electricity consumption increase rates of 1.5-2.0 per cent per year; (b) phase-out of two units of the Jaslovské Bohunice NPP in the years 2006 and 2008; (c) heat consumption in residential and industrial sectors will increase by 1.5 per cent per year until 2005 and drop by 1.8 per cent per year thereafter; (d) decline in the GDP share of the industrial sector from 22 per cent in 2000 to 15.9 per cent in 2010;[11] (e) constant development of economic activities in iron production; (f) steady growth of volumes of crude oil processing and oil

[10] Expected growth rates are listed in the tables P3.1–P3.5 of the NC3, appendix P.3.

[11] Additionally, the internal energy efficiency improvement (IEEI) in industry was assumed to be 3 per cent.

products output; (g) moderate growth rates for motor fuel consumption in road transport, as well as in railway, air and water transport activities.

83. ***Methods used.*** Energy supply, distribution and consumption was modelled using the BALANCE and IMPACT module of the ENPEP software. Depending on sectoral data availability, both top-down and bottom-up approaches were used. BALANCE is a non-linear equilibrium model that matches supply and demand in the energy sector and all of its subsectors using a market-based simulation approach, and can also model different preferences of energy users and suppliers. The purpose of the IMPACT module is to determine the impacts (pollutant emissions, waste generation, land use, etc.) from the activities in the energy sector, by using the results of the BALANCE model. The modelling of the energy sector by the BALANCE model also included the energy-related emissions in transport, industry and agriculture. Projections in non-energy sectors were made by expert judgement, on the basis of sectoral plans and strategies.

B. Results from projection of emissions from the energy sector

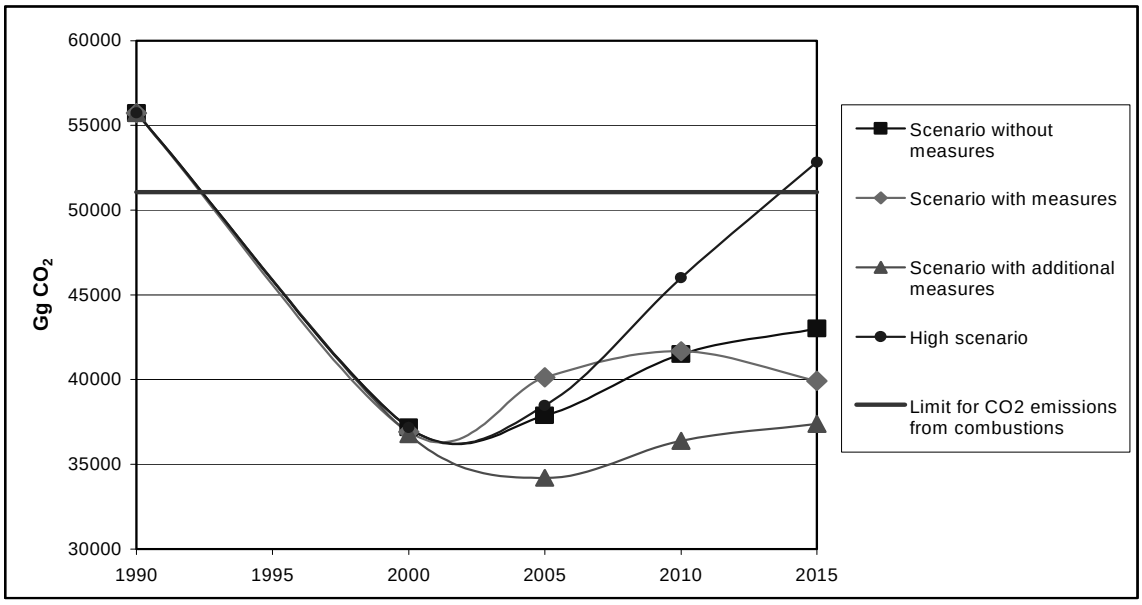
84. Emissions projected in the energy sector include CO_2, CH_4 and N_2O from fuel combustion, as well as fugitive CH_4 emissions from production, transport and distribution of coal, natural gas and crude oil. Aggregate emissions in the "with measures" scenario are projected to grow from 38 Tg CO_2 equivalent in 2000 to 44 Tg CO_2 equivalent in 2015, which means a 14 per cent increase in the period 2000–2015.

85. Projections indicate that the energy sector will keep its dominant role in total aggregated GHG emissions; its share of the total GHG emissions in the "with measures" scenario is expected to increase slightly from 81 per cent (2000) to 83 per cent (2020). If additional measures in the power sector are implemented ("with additional measures" scenario), a further reduction in aggregate GHG emissions of 11 per cent of the "with measures" scenario level can be achieved. During the discussions with local experts, the review team gained the impression that the projection of energy demand could be slightly overestimated, which results in higher projected emissions.

86. Projections for the transport sector are presented separately from the overall emissions of the energy sector. The results indicate that GHG emissions from fuel combustion in transport should increase by 27 per cent during the period 2000–2015. Annual growth would be 1.6 per cent, which is quite moderate considering the trends in transport sectors in other European countries. The transport share in aggregate GHG emissions would remain stable at 10–11 per cent by 2015. Taking into account the high growth rates in the transport sector in countries with comparable circumstances, the review team felt that future national communications would benefit from a more detailed consideration of the projection of emissions from the transport sector.

87. Projections of CO_2 emissions from fossil fuel combustion are represented in figure 4. The graphs show that during the first commitment period (2008–2012) the attainment of the national CO_2 limit is realistic even under the high scenario assumptions.

Figure 4. Projections of carbon dioxide from combustion and transformation of fossil fuels



88. The effect of the *Clean Air Act* on both new and existing sources was assessed in the "with measures" and "with additional measures" scenarios. In both scenarios, the effect from this act was estimated to lead to a reduction of 1,372 Gg CO_2 equivalent in 2010. The "with additional measures" scenario included the following estimated GHG mitigation effects for 2010: CHP: 814 Gg CO_2 equivalent, RES: 1,857 Gg CO_2 equivalent, thermal insulation of buildings: 803 Gg CO_2 equivalent, and modal shift from individual to public transport: 269 Gg CO_2 equivalent.

89. Projections of energy-related CH_4 and N_2O emissions were calculated on the basis of fuel consumption for individual scenarios using the IPCC methodology and default aggregated emission factors. For CH_4 emissions in transport, emission factors from the COPERT programme were used. Projections of fugitive CH_4 emissions were based on different forecasts (coal mining and storage, oil production and natural gas consumption).

C. Projection of emissions from other sectors

90. GHG emissions from **industrial processes** (excluding energy-related emissions) were expected to increase by 14 per cent from 2000 to 2005 ("with measures" scenario). As a result of the intensive ongoing restructuring processes in the industrial sector, a further decrease in industry's share of Slovakia's GDP was projected, from 22 per cent to 18 per cent in the period 2000–2005.

91. Projections for process-related CO_2 emissions from industry were based on the expected activities of the relevant sectors, not on a modelling approach. The level of total emissions for non-energy-related CO_2 emissions was estimated at 3,935 Gg CO_2 in 2005, mainly from cement production and utilization of cement, lime and magnesite in industry. As changes in industrial activities were not estimated beyond 2005, projections of emissions until 2015 remain constant. Similarly, no specific measures other than technical development were assumed in N_2O emissions from nitric acid production; the N_2O emissions were assumed to remain constant at 62 Gg CO_2 equivalent.

92. Projections of the emissions of fluorinated gases (HFC, PFC and SF_6) were based on several assumptions concerning their use and substitution, especially as cooling substances. The total projected emissions showed a slightly increasing trend, reaching about 230 Gg CO_2 equivalent in 2010. Factors

influencing the use of fluorinated gases were identified, among them the earlier availability of alternatives on the market. One measure considered in this context was the tightening of technical standards for cooling systems. Only semiquantitative projections were presented for the case that this measure would not be taken, namely that emissions might be 10–30 per cent higher.

93. Emission projections in the **waste management** sector for the period 2000–2015 in the "with measures" scenario revealed a reduction in aggregate emissions of 33 per cent. The "with additional measures" scenario showed an additional reduction potential of 31 per cent, based on expert judgements. Projections of CH_4 emissions from this sector were analysed in four different scenarios: along with the "without measures" scenario, low-, medium- and high-impact scenarios were developed. These scenarios differed in the degree of reduction of biodegradable waste and biogas combustion, and in the degree of households connected to waste-water treatment systems. The relation between these different scenarios and the specific PaMs listed in chapter 4 of the NC3 remained largely unclear to the review team. Projections of N_2O emissions from this sector were analysed in a "without measures" scenario (constant emissions) and a "with measures" scenario, reflecting a gradual increase in nitrogen elimination from communal waste-waters.

94. Emissions from the **agriculture sector** were projected to grow by 49 per cent between 2000 and 2015 ("with measures" scenario). The "with additional measures" scenario showed a reduction potential of 27 per cent. An important source of uncertainty in this sector was the EU accession process, which was expected to have a major influence on trends in agricultural production.

95. When considering **CO_2 removals from LUCF**, the review team noted that projections included only forestry sinks of CO_2; land-use change was not considered. The "with measures" scenario forecasted an increase in CO_2 removals of 1.1 Tg CO_2, while additional measures were estimated to increase the CO_2 removals by 0.4 Tg CO_2 in 2015. This would account for 4 per cent ("with measures") or 6 per cent ("with additional measures") of aggregated GHG emissions in 2015.

D. Total effect of policies and measures

96. The total effect of adopted and implemented PaMs, assessed by the difference between the "with measures" and the "without measures" scenarios, ranged from 5 to 17 per cent of total aggregated emissions. The total effect of planned PaMs is obtained by calculating the difference between the "with measures" and the "with additional measures" scenarios. It accounted for 13 per cent of total aggregated emissions.

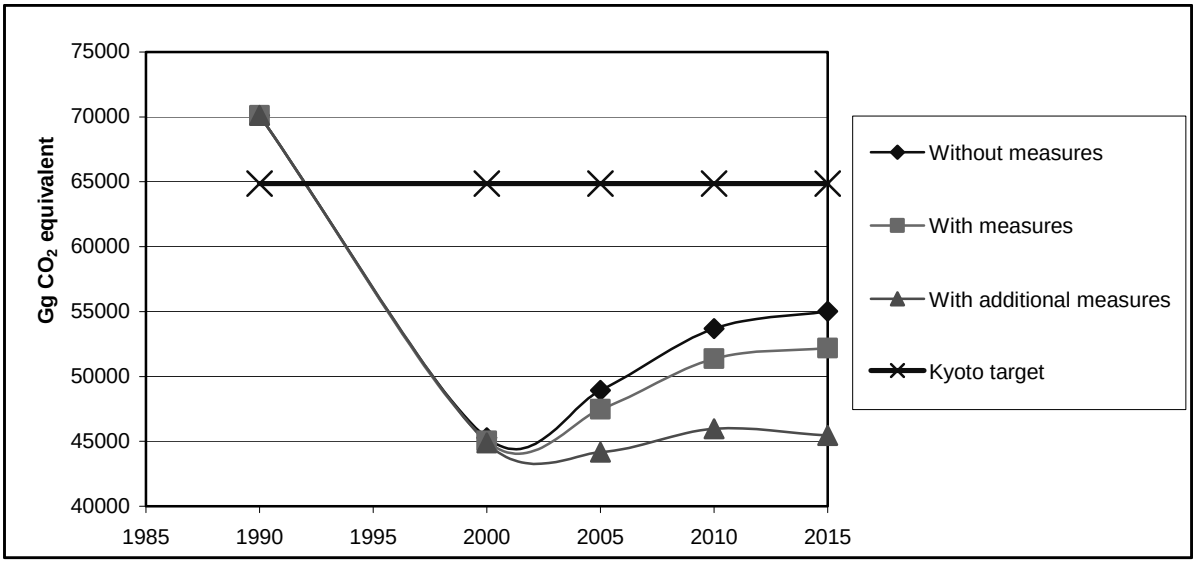
97. No specific methods for estimating the effects of individual PaMs were described. The review team was informed that, for several reasons, a consistent comparison between the sum of individual effects of PaMs and the total effect given in the projections chapter was not possible. The main reasons were the inconsistencies in sectoral representation between the PaMs and the projections chapter, as well as uncertain or even unknown effects of individual PaMs.

98. The inventory data used in the NC3 indicated that the target for reduction in GHG emissions (8 per cent decrease from 1990 level) was 64.5 Tg CO_2 equivalent. The projected average annual aggregate emissions in 2010 were 52.2 Tg ("with measures" scenarios) and 45.5 Tg ("with additional measures" scenario). Figure 5 presents the aggregated GHG emission trends for all three scenarios as reported in the NC3.

99. The review team concluded that Slovakia is not expected to face any challenges in achieving its Kyoto target. Moreover, a significant reduction reserve (offset) is projected, ranging from 12 to 19 Tg CO_2 equivalent, which enables Slovakia to make use of the flexibility mechanisms – international emission trading and joint implementation. The review team learnt that owing to the uncertainties

accompanying the economic transition process, the Slovak GHG emission projections have to be interpreted with caution and need to be revised at regular intervals.

Figure 5. Total aggregate emission projections (CO_2 equivalent) and Kyoto targets



V. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

100. The vulnerability assessments, as reported in the NC3, addressed three vulnerable sectors in Slovakia: agriculture, forest ecosystems and water resources. The assessments were based on two interconnected atmospheric general circulation models from the Goddard Institute for Space Studies and the Canadian Centre for Climate Modelling. The published data resulted from a research project of the Slovak National Climate Programme and projects in the framework of grants by the national research funding agency VEGA.

101. Vulnerability assessments for the agriculture sector found potential benefits from an extended growth period which may increase the production potential of biomass by 10 per cent in southern Slovakia and by 25 per cent in northern Slovakia in 2075. Adverse impacts were expected from the intensification of plant pests, increased frequency of extreme events and water deficits. Discussed adaptation options included changes in cultivation techniques, the structure of crop cultivation, the revitalization of existing irrigation systems and the construction of new ones.

102. The high vulnerability of the forestry sector towards changes in bioclimatic conditions (precipitation and higher evaporation) was emphasized in the NC3. Individual vegetation communities (particularly spruce and fir) were not adapted to long-term deviations of mean temperatures exceeding 1 °C. Negative impacts on forests in Slovakia were expected to increase in future in view of a changing climate, calling for consideration of adaptation policies and measures. A number of adaptation options were reported, including afforestation of unused land, enhanced protection of forest stands and change of tree species composition (substitution of conifers by hard broad-leaved species, and strengthening the genetic and species diversity of forests).

103. Slovakia's water resources were also expected to suffer from the impacts of climate change, including reduction of water outflow and increased pollution, decreased soil moisture, water retention

within the river basin and evapotranspiration. On the basis of long time-series of climatological data, models predicted an overall decrease in the sizes of both surface and groundwater resources as a result of climate change (NC2). This, coupled with a rise in economic activity, a growing population, and stricter environmental rules regarding the use of water resources, was likely to result in the diminution of water availability for human consumption and productive activities (particularly agriculture and livestock production). The review team noted that inadequate water resources may thus become a socio-economic liability. Adaptation options reported in NC3 included water consumption management, improvement of existing water management systems and indirect measures addressing the water consumption patterns of consumers.

104. Vulnerability assessments of other sectors such as industry, livestock, fisheries and tourism were not reported. The relationship between climate change and the severe summer rainfalls that led to devastating local floods of the river Danube were only partially investigated.[12] The review team noted that no socio-economic impacts were addressed, although the cost of the long-term impact of loss of habitats may far exceed short-term economic losses.

105. The team noted that prioritization of adaptation options, suggested mechanisms for implementation and financial support have not yet been worked out. The adaptation strategies are yet to be approved and are not seen as a priority by the Slovak government.

VI. RESEARCH AND SYSTEMATIC OBSERVATION

106. ***Research:*** The NC3 reported briefly on activities in this field. The institutional framework for research and systematic observation was set by the *National Climate Programme of the Slovak Republic*. Several ministries, as well as research and educational institutions, participated in this programme with diverse and relevant projects. The programme was under the aegis of MoE, and SHMU coordinated the implementation of projects addressing climate change.

107. The subprogramme WATER focused on monitoring hydrological and climatic elements by means of the network of monitoring stations. This sub-programme was carried out jointly by SHMU (MoE), the Research Institute for Water Management (Ministry of Agriculture), the Research Institute for Melioration and Landscape Engineering (Ministry of Agriculture), the Department of Land and Water Resources Management (Ministry of Education), and the Institute of Hydrology (Slovak Academy of Sciences).

108. The review team noted that the *National programme of greenhouse gases emission reduction*, the *National programme to reduce the emission of volatile organic compounds*, and the *Hydrological regime changes as the result of global changes* were described in the NC2, but were not referred to in the NC3.

109. The NC3 listed a number of diverse projects related to climate research in the fields of potential impacts of climate change, the variability and changes of climate, and the impact of climate change on the hydrological cycle, and water resources. Many of these projects were financed by VEGA (official) grants.

110. The Slovak Government has neither participated in international research projects, nor has it received international financial support to carry out its own research programmes. The review team noted that active international involvement could greatly improve both the quality and extent of climate change research. It would also open up the real possibility of taking advantage of the perceived interest

[12] See Christensen and Christensen: Severe summertime flooding in Europe. *Nature*, Vol. 421. 20 February 2002.

shown by university students and young professionals eager to join the national research effort on climate change.

111. Summary information on Global Climate Observing System (GCOS) activities, as required by the UNFCCC reporting guidelines, was neither reported in the NC3 nor in earlier national communications. A GCOS report has not been submitted to the UNFCCC secretariat, either.

VII. EDUCATION, TRAINING AND PUBLIC AWARENESS

112. The NC3 reported few activities in this field. The team was informed that public perception of climate change had changed in recent years, from a topic for a small group of experts to an issue of public concern. This change has been enhanced by the floods occurring in August 2002 in the Czech Republic, Austria and Germany, which were a cause of concern in Slovakia also.

113. Some information materials concerning climate change were widely distributed by the Slovak authorities: the NC2 and the NC3, the United States country study of 1997 and the periodical *Air Quality Reports*. Beyond these documents, several periodicals of general environmental interest were published, and discussion of environmental questions in the media was documented. Furthermore, two film festivals on environmental topics regularly took place. The internet was increasingly important in the dissemination of information, and some materials were also published in English.

114. There were three institutions dedicated to energy questions: the Cogeneration Centre and the Energy Institute, both part of the Slovak Energy Agency, and the Energy Consulting and Information Centres, which dealt with energy saving in the housing area.

115. The NC3 did not contain information on how environmental issues in general and climate change issues in particular were integrated into the curricula of schools and universities. Educational materials were listed as part of the information materials, but no details about their nature were provided. Furthermore, no information was given on participation in international educational efforts concerning climate change issues.

116. The new *Act on Free Access to Information* also facilitated the increased public interest in environmental issues. The NC3 reported a significant improvement in the area of cooperation between governmental and non-governmental organizations; during the country visit, however, the review team saw no evidence that environmental NGOs were actively involved in the policy-forming process concerning climate change. In general , the review team formed the impression that environmental information is actively promoted by MoE, but climate change issues do not have predominant importance. The information in the NC3 was less focused on climate-change than it was in the NC2.

VIII. CONCLUSIONS

117. When reviewing the information reported in the third national communication of Slovakia, the review team concluded that the document broadly 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 updated information on GHG projections, the NC3 provided a comprehensive overview of the current status of climate policy in Slovakia. Some potential for increasing the transparency of reporting was identified, especially in the chapters on inventory and policies and measures.

118. Given the challenges of the economic transformation process and the EU accession process, climate policy does not rank very high on Slovakia's political agenda at the beginning of the 21st century. Correspondingly, the review team noted a low budget and limited administrative capacity in this field. Nevertheless, Slovakia has joined the Kyoto Protocol, is firmly committed to its goals and

expresses its intention to make use of its flexibility mechanisms. Slovakia has implemented several AIJ/JI projects and intends to join the EU emissions trading market, starting in 2005. A precondition for this is the successful implementation of the new UNFCCC reporting requirements that were decided at the eighth session of the Conference of the Parties in New Delhi.

119. Slovakia contributed to achieving the aim of the Convention, as its overall GHG emissions declined by 34 per cent (excluding LUCF) and 35 per cent (including LUCF) in the period from 1990 to 2000, mainly as a result of economic restructuring, reduced energy demand, improvements in energy efficiency and agricultural reforms. Furthermore, Slovakia is expected to meet its emissions target under the Kyoto Protocol, as GHG emissions are projected to increase only slightly between 2000 and 2010, resulting in an overall GHG emission reduction of about 25 per cent, compared to the 1990 levels. If all planned policies and measures are implemented, emissions are projected to drop by 35 per cent of the 1990 levels ("with additional measures" scenario).

120. The review team noted that while the Ministry of Environment is responsible for the national climate change policy, other important ministries (e.g. the Ministry of Transport, Posts and Telecommunications) are yet to actively integrate climate policy into their policy fields. The Energy Department within the Ministry of Economy has the main responsibility for energy policy. Overall coordination of the national climate change policy is still to be established. The setting up of a new advisory committee is currently under discussion. The review team concurred with the views expressed by several host-country representatives on the need to strengthen the existing institutional arrangements.

121. The review team acknowledged the submission of the GHG inventory in the common reporting format (CRF) and encouraged Slovakia to continue to improve the national emission inventory system, to harmonize the methodology for the different years, to recalculate the emission trend lines where necessary and to address the existing gaps.

122. Slovakia's success stories related to climate change include a remarkable decoupling of GDP growth from GHG emissions and successful transformations in the energy and agriculture sectors. Strict environmental policies led to significant improvements in air quality and waste management. A long tradition of sustainable forestry helped to preserve and protect the large Slovak forests. Ancillary benefits from these different policies also helped to mitigate the national GHG emissions after 1994, when the Slovak economy partly regained its strength. The CO_2 emissions trading system, as the core element of Slovakia's Kyoto Strategy, is expected to ensure that mitigation efforts by private companies will be rewarded efficiently and with minimal transaction costs in the near future.

123. The team felt that while the long tradition of climate science by research institutions is commendable, new funding efforts for these activities are needed to maintain the activities at this level. Activities in the field of global climate observing should be reported. In addition, the research on vulnerability and adaptation should be intensified, in view of the possible link between climate change and an increased frequency of extreme events, like the severe rainfalls that led to devastating floods of the river Danube in 2002.

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