The Fourth National Communication of the Slovak Republic on Climate Change 2005

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Ministry of the Environment of the Slovak Republic
Slovak Hydrometeorological Institute

Bratislava

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Contens

Abbreviations

a. s. l.	Above sea level
APVT	Agency of Science and Technique
CEN	European Committee for Standardisation
CFCs	Chloroflourocarbons
CHP	Cold half-year
CNG	Compressed natural gas
ČOV	Wastewater Treatment Plant
CRF	Common Reporting Format
EFRA	Ecological and Forestry Agency
ENO	Electricity Power Plant Novaky
EO	Population equivalent
EU	Europe Union
EVO 2	Electricity Power Plant Vojany 2
FMFI	Faculty of Mathematics, Physics and Informatics
GCMs	General circulation of atmosphere
GCOS	Global climate observing system
GDP	Gross domestic product
GHG	Greenhouse gas
GIS	Geographic Information System
GWP	Global Warming Potential
HCs	Hydrocarbons
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
IEEI	Internal energy efficiency improvement
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Prevention and Pollution Control
JE	Nuclear Power Plant
KP	Kyoto Protocol
KVB	Climate water balance
LPG	Liquid natural gas
LULUCF	Land use, land use change and forestry
LVÚ	Forestry Research Institute
MDPT	Ministry of Transport, Post and Telecommunications
MH	Ministry of Economy
MP	Ministry of Agriculture
MŠ	Ministry of Education
MVE	Small hydropower plants
MVRR	Ministry of Construction and Regional Development
MŽP	Ministry of Environment
MZV	Ministry of Foreign Affairs
NA	Not applicable
NBS	National Bank of Slovakia
NCV	Net calorific value
NE	Not estimated
NEAP	National Environmental Action Plan
NEIS	National Emission Information System
NIR	National Inventory Report
NIS	National Inventory System
NKP	National Climatic Program
NMVOC	Non Methane Voluntary Organic Compounds
OECD	Organization for Economic Cooperation and Development
OZE	Renewable Energy Resources
PES	Primary energy sources
PFCs	Perfluorocarbons
ppm	Pars per million
REP	Regional energy enterprises
REZZO	Register of Emissions and Air Pollution Sources
SAV	Slovak Academy of Science
SAŽP	Slovak Environmental Agency
SE	Slovak Electricity Company
SEA	Slovak Energy Agency
SEPS	Slovak Electricity Transmission Network
SHMU	Slovak Hydrometeorological Institute
SIŽP	Slovak Environmental Inspection
SK	Slovak
SPP, a.s.	Slovak Gas Industry, company
SPU	Slovak Agriculture University
STU	Slovak Technical University
ŠÚ SR	Statistic Office of the Slovak Republic
SZCHKT	Slovak Association of Refrigeration and Air Conditioning Engineers (RACE)
TP	Warm half-year
TTP	Permanent grass cover
UN FCCC	United Nations Framework Convention on Climate Change
URSO	Regulatory Office for Network Industries
USD	U.S. Dollar
VA	Value added
VEGA	Scientific Grant Agency of the Ministry of Education SR
VUD	Transport Research Institute
VUEPP	Research Institute of Agriculture and Food Economy
VÚVH	Water Research Institute
ZP	Natural gas
ZSE, SSE, VSE, a.s.	West, Middle and East Slovakia Power Plants
ŽSR	Railways of the Slovak Republic
ZZL	Basic air pollutants

Executive Summary

This chapter includes a brief summary of the Fourth National Communication of the Slovak Republic on Climate Change.

ES.1 Introduction

Climate change is one of the most serious global environmental problems. The international community and the general public have already realized the urgent need to tackle this problem. The instrument to tackle the problem of climate change is the UN Framework Convention on Climate Change (Convention) adopted in 1992. The aim of the Convention is to stabilize atmospheric concentrations of greenhouse gases to a safe level. Currently, there are 185 countries or international communities, including Slovakia and the EU that are parties to the Convention. The Convention requires the adoption of measures that aim to reduce the GHG emission to the level of the year 1990.

The unfavorable development and balance of GHG emission generation since 1992 have created a demand to adopt an additional and effective instrument that would involve the participation of developing countries. In 1997, the parties of the Convention agreed to endorse the Kyoto Protocol (KP) that defines reduction objectives and instruments to achieve them for countries of the Annex 1 to the Convention. Developed countries defined in Annex B of the KP should individually or together reduce emissions of six GHGs on average by 5.2 % from the level of the year 1990 during the first commitment period 2008 - 2012. Slovakia, as a member states of the EU (the EU commitment was adopted in the form of so-called burden sharing agreement) committed to an 8 % reduction of emissions compared to the base year 1990.

According to the emission inventory updated in April 15, 2005 (8), Slovakia has achieved a reduction of total anthropogenic emissions of greenhouse gasses, stated as CO_2 equivalent, of approximately 30 % compared the year 1990. This achievement is the result of several processes and factors, mainly:

- higher share of services in the generation of the GDP,
- higher share of gas fuels in the final consumption of energy resources,
- restructuring of industries,
- gradual decrease in energy demands in certain heavy energy demanding sectors (except for metallurgy),
- and the impact of legislative measures influencing directly or indirectly the generation of greenhouse gas emissions.

The Fourth National Communication on Climate Change is developed in consistent with the requirements of the guidelines of the FCCC/CP/1997/7, part II (Guidelines for the Preparation of the National Communications by Parties Included in Annex I to the Convention). The report describes the actual framework and shows the results of the activities undertaken to meet the commitments of the Convention and the Protocol in the period from 2001.

Slovakia publishes the Report on Demonstrable Progress for the first time as an individual chapter. The report which was developed based upon the Art. 7.2. and 3.2. of the Kyoto Protocol and Decision 25/CP.8 provides for a brief analysis of the steps and measures that are critical preconditions to meet the commitments of the country.

ES.2 National circumstances

The Slovak Ministry of the Environment is responsible for national environmental policy including climate change and air protection issues. It has the responsibility to develop acts, and amendments to existing legislation. Legislation proposals are commented by all ministries and other relevant bodies. Following the commenting process, proposed acts are negotiated in the Legislative Council of the Government, approved by the Government, and finally by the Parliament.

Supporting institutions founded by the Ministry of Environment play an important role. These include the Slovak Hydrometeorological Institute, the Water Research Institute, and the Slovak Environmental Agency. Academic and research institutions (i.e. the Forestry Research Institute Zvolen, the Transportation Research Institute Zilina, the Slovak Agricultural University Nitra, the Slovak Technical University Bratislava, FMFI Bratislava, and the Slovak Academy of Science), non-governmental organizations, and associations of interested groups (the Slovak Energy Agency, PROFING, EFRA Zvolen, SZCHKT, Detox, SPIRIT, Ecosys) are involved in the process of development and implementation of policy and measures aimed to mitigate climate change impacts.

The Slovak Republic lies in Central Europe with a total area of 49 036 km^2. Agricultural soil covers 50 %, forest soil 41 %, water 2 %, and 3 % is covered by built-up areas. Slovakia is a mountainous country, 60 % of its surface is over 300 m, 15 % over 800 m and 1 % over 1 500 m. The highest point is Gerlach peak (2 655 m a. s. l.), and the lowest point is at the discharge of the Bodrog River out of Slovakia (94 m a. s. l.). More than 95 % of the territory is drained by the Danube River to the Black Sea; only a small part at the north of the country drains into the basin of the Baltic Sea. Slovakia is a highly biologically diverse country; the west and north are covered by the Western Carpathian Mountains, and large lowlands cover the south.

In Slovakia, there are a high proportion of areas of nature protection. At the end of 2003, 9 natural parks and 14 protected areas were designated. The total acreage of protected nature areas represents 1 144 807 ha, 23.3 % of the total territory. As part of the activities related to Slovak membership in the EU, the network of protected areas (NATURA 2000) is being established.

According to the global climatologic classification, Slovakia is in the mild climate zone category with precipitation uniformly distributed over the whole year. The Atlantic Ocean impacts the west part of Slovakia, a continental influence is typical for east part. A regular rotation of four seasons and variable weather throughout the year are typical for this country.

Slovakia has 5.38 mil. inhabitants (as of 31. 12. 2003). The average population density is 110 inhabitants/km^2. The population is concentrated in the cities in the lowlands and the main basins. Mountains areas are randomly populated. In Slovakia, there are 47.8 % of inhabitants are economically active. The largest city is Bratislava with 425 533 inhabitants (as 31. 12. 2003). It is the capital of the Slovak Republic.

Since 2000, macroeconomic development of the Slovak Republic has been influenced by implementation of measures with respect to the preparation of the country for EU membership. Among the most important measures were the removal of price distortions, changes in indirect taxes, and reconciliation of public financing mechanisms. In 2001, the growth in GDP reached 3.3 %. In 2003, the Slovak economy continued its positive development, when the growth of gross domestic product (GDP) at constant prices reached 4.2 %, which is a comparable to the growth of the most developed economies in transition and a double that of the EU25 countries.

In 2003, the energy sector reached a 2.5 % share on the total GDP. Energy intensity calculated on purchasing power is gradually decreasing, and was 1.9 times higher than the average recorded in the EU. The reason is a high proportion of heavy-energy-demanded industry contributing to the GDP. The energy sector is a dominant sector contributing by a 80 % share on total GHG emissions generation. Consumption of primary energy sources per capita slightly increased and reached approximately 90 % of the EU25 average.

The internal structure of the Slovak industry prior to EU membership recorded significant changes. The share of mining, distribution of electricity, gas and water in the industrial sector input decreased and are close to those in developed countries. On the other hand, the share of industrial production on the GDP generation slightly increased. The overall share of industry in the formation of GDP reached 26.9 % in 2003.

Industrial production experienced a slight slowdown of growth dynamics (from 6.8 % to 5.7 %) in 2003 against the previous year, caused by the production decline in the sectors of extraction of minerals and production and distribution of electricity, gas and water. On the other hand, the development of industrial production was positively influenced by ongoing growth of industrial production targeted to foreign markets (production of automobiles, rubber and plastic goods, electric and optic equipments).

In 2003, the transport network included 17 772 km of roads and motorways. Motorways represented 313 km of the network. The length of railways was 3 657 km, with 1 558 km of electrified lines. The length of navigable watercourses remained unchanged at 172 km, with channel length of 38.45 km. Road transport is typical for the food industry, production of machinery and electronic equipment, as well as for production requiring supply logistics in just-in-time operations. Rail transport services are mainly focused on the transport of bulk goods (mineral resources, substrates, agricultural commodities, etc.). These industries have recorded a decline in production (e.g. a 9 % decline in mining of mineral resources in 2002 alone), and a resultant decline in the transport of these types of goods. By contrast, the development of small and medium-sized enterprises resulted in higher road transport. Water transport is operated on the navigable rivers Danube, Vah, Morava and Bodrog.

In the past 10 years, the number of automobiles increased by 17 %. This increase was recorded mainly in the individual automobile sector. Compared to 1990 the intensity of transport in 2003 has increased by 160 % for motorways, by 139 % for class I roads, by 123 % for class II roads and by 7 % for class III roads. Consumption of liquid fuels represents the largest share on the final energy consumption in transport sector. The share of solid and gaseous fuels and electricity is small.

At the end of 2003, soil represented 4 903 389 ha. Agricultural soil covers 2 436 878 ha (49.7 %), forestry soil 2 004 100 ha (40.9 %) and other non-agricultural and non-forestry soils represent 462 410 ha (9.4 %).

Agriculture production shows a long lasting decrease in the share of GDP and employment. Share of GDP (in constant prices) was 4.55 % in 2003. Over the last 10 years, only a slight decrease in acreage of utilized agriculture soil was recorded. The percentage of tilled areas reached 6.17 % in 2003.

The structure of vegetable production was changed. On arable soil, the share of cereals, oil plants and vegetable increased, while on areas of annual and multi-year forage, potatoes, corn and leguminous plants were reduced. In the total structure of agricultural soil, the areas of permanent grass cover have increased and the share of hop-gardens, vineyards and orchards has decreased.

In animal production, the problems persist with the nutrition, fodder techniques and care of animals that result in ineffective production. A long lasting decrease in the number of cattle is accompanied with changes in breed structure. This brings a higher share of milk production with a lower number of milk cows. In addition, technological changes in stabling are applied. Production of pigs is stagnant, however, and does not cover domestic consumption. Poultry has experienced a positive growth trend. The share of total GDP generated by the forestry management is decreasing and is below 1 % (1990 - 0.97 %, 2001 - 0.54 %).

Assessment of waste generation and handling pursuant to the new Waste catalogue was conducted for the first time in 2002 (the Act 223/2001 on Waste and implementing Regulation 284/2001 on the Waste Catalogue). This legislation transposed the European Waste Catalogue and has brought about fundamentals changes in waste balance and waste recording. The overall trend in waste management is towards an increase of material and energy recovery and a decrease in the disposal by incineration and land filling.

The household sector contributed to total energy consumption by 28 % in 2002. More than 70 % of total energy consumption is used for heating; approximately 20 % to heating of water, and the rest about 10 % is for other activities such as lighting, cooking and use of electrical devises. The most important energy source is fossil fuels.

ES.3 Greenhouse gas emission inventory

The most important greenhouse gas (GHG) in the atmosphere is a water vapor (H_2O) that contributes by two third to the total greenhouse effect. Its concentration in the atmosphere is not directly affected by human activities. In general, it is determined by a natural water cycle or deference between evaporation and precipitation. Carbon dioxide (CO_2) contributes to the greenhouse effect by more than 30 %, methane (CH_4), nitrous oxide (N_2O), and ozone (O_3) totally by 3 %. Group of synthetic substances HFCs (partially fluorinated hydrocarbons), PFCs (perflourocarbons) and SF_6 are other greenhouse gases that are released into the atmosphere exclusively by human activities. Photochemical active gases such as carbon monoxide (CO), nitrogen oxides (NO_X) and non-methane volatile organic carbons (NMVOC) are not greenhouse gases, but they contribute indirectly to the greenhouse effect in the atmosphere. They are generally referred to as ozone precursors because they affect the creation and destruction of ozone in the atmosphere.

The Chapter 3 presents national emissions of CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NO_X, CO, NMVOC, SO_2 and its aggregated equivalents from 1990 - 2003 as determined by April 15, 2005 (the 2003 Emission Inventory was published in 2005).

All emissions are represented in the units of molecular weight (e.g. Gg CO_2, not Gg C). Values of global warming potential (GWP100) are used according to the IPCC recommendations (1) (Climate Change 1995, The Science of Climate Change CO_2=1, CH_4=21, N_2O=310, F-gases =140-23 900).

ES.3.1 Introduction

The GHG emissions presented in the Third National Communication were updated and converted using the newest available methods, national conditions and data published by the Slovak Statistical Office. Total GHG emission represented 46 758.8 Gg in 2003 (without sinks from land use and land use change and forestry (LULUCF)). This represents a reduction by 33 % in comparison with the reference year 1990. In comparison with 2002, the emissions increased by 1.5 %. Total GHG emissions in Slovakia are stable or slightly increasing (in 2003) due to recovery of economic activities, increase in transport, and expected increase in actual emissions of F-gases (mainly HFCs and SF_6). Total GHG emissions including sinks from LULUCF sector are peaked and exceeded 1998. Significant changes are expected in the next year (2004 inventory) as the EU legislation came into effect in Slovakia. Also, revisions of the NEIS database and changes in balance methodology in sector Agriculture and LULUCF were applied. The table ES.1 shows the aggregated GHG emissions.

Table ES.1 Aggregate anthropogenic GHG emissions in Slovakia in 1990-2003

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	CO_2 eqvivalent [Tg]													
Net CO_2	57.0	48.6	44.3	41.2	39.2	41.2	42.0	43.3	41.7	41,0	37.7	37.3	37.0	37.9
CO_2*	59.4	52.1	48.4	45.4	42.4	43.8	44.4	44.7	43.6	42.6	40.1	42.6	42.3	42.8
CH_4	6.3	5.9	5.5	5.1	5.0	5.2	5.2	5.0	4.7	4.6	4.6	4.5	4.7	4.7
N_2O	6.0	5.2	4.4	3.9	4.1	4.2	4.2	4.3	4.0	3.8	3.8	4.0	3.9	3.9
HFCs, PFCs, SF_6	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total (with net CO_2)	69.7	60.0	54.4	50.3	48.4	50.7	51.5	52.6	50.5	49.5	46.2	46.0	45.6	46.8
Total*	72.1	63.5	58.6	54.6	51.7	53.4	54.0	54.0	52.4	51.2	48.6	51.3	50.9	51.6

Emissions determined by April 15, 2005

* CO_2 emissions without sinks in LULUCF sector (Land use-Land use change and forestry)

ES.3.2 CO_2 emissions

The most important anthropogenic source of CO_2 is combustion and transformation of fossil fuels that represent more than 95 % of total emissions of CO_2 in Slovakia. CO_2 also occurs in technological processes such as production of cement, lime, and magnesite, and use of limestone. The balance includes also the production of coke, iron, and steel. CO_2 emissions also occur at the aluminium and ammonium productions. Emission factors, determined based upon the content of carbon in fuels were used to calculate the CO_2 emissions. CO_2 is emitted also in the process of conversion of grassland and forest areas into agricultural soil, during forest fire and solid waste incineration.

Total net CO_2 emissions increased in 2003 by more than 1 % compared with the previous year, totally decreased by more than 33 % compared with the reference year 1990. The most important changes occurred in the energy sector; a significant increase by 1 000 Gg of CO_2 emissions compared to 2002 was caused by stationary sources. Among the most important reasons appears

the recovery of the Slovak economy, followed by new sources of pollution, and a shift to solid fuels due to the increased prices of natural gas. Similarly, increased trend in CO_2 emissions is also at the transport sector. It is anticipated a gradual increase of CO_2 emissions in this sector.

ES.3.3 CH_4 emissions

The most significant source of methane in Slovakia is agriculture, cattle farms and pig breeding. Methane is a direct product of metabolism of herbivorous animals and as a product of organic degradation of animal excrements. The calculations of emissions are based on annual data of the Slovak Statistical Office and the Green Report of the Ministry of Agriculture. The default IPCC emission factors were modified based upon specific national conditions with respect of an increased efficiency of breeding. A decreasing trend in number of cattle has started since 1993 and has resulted in the decrease of methane emissions. After 2001, this trend is not considerable.

Total methane emissions reached in 2003 an increase compared to the previous year by 1 %. However, emissions decreased by 26 % compared to the reference year 1990. The most important changes were recorded in the sector of fugitive emissions from mining of brown coal, mining and transport of oil and natural gas. The revision of emission factors and selection of appropriate parameters were carried out. The revision dealt with the data from 1990. The most significant increase in methane emissions was in the case of landfill waste. This was caused by a higher percentage of landfilling mainly by waste of industrial character. This trend is anticipated in the future as well.

ES.3.4 N_2O emissions

The mechanism of emissions and removals of N_2O is not clearly described. Values obtained are biased by a high degree of uncertainty. The main cause of direct and indirect N_2O emissions is surplus of mineral nitrogen in the soil (intensive fertilization) and unfavorable aerial regime in soils (use of heavy machinery). Emissions in the Energy sector and transport were determined on the basis of total fossil fuel consumption by application of default emission factors according to the IPCC. Wastewater treatment plants are also the source of N_2O emissions.

In 2003, the total N_2O emissions slightly increased compared with the year 2002. However, the drop compared to the reference year 1990 is almost 35 %. The most substantial increase was recorded in transport sector and Industrial Processes sector (chemical industry). The later regards to increase in chemical production (nitric acid). After the surprising increase of N_2O in 2002 in wastewater, in 2003, a slight decrease is recorded. This relates to the amount of industrial wastewater treatment.

ES.3.5 Emissions of HFCs, PFCs a SF_6

The IPCC method is used to assess sources and emissions of fluorinated gases. The real and potential emissions in the period of 1995 - 2003 are determined. In Slovakia, these gases are not produced. Source of emissions are the gases, which are used as coolants, slacks, puffers, in solvent products, SF_6 as insulating gas in transformers and metallurgy industry. CF_4 and C_2F_6 occur by aluminium production. From 1995, the use of HFCs, PFCs a SF_6 has increased and it is anticipated the increasing trend in the future.

In 2003, total F-gases emissions considerable increased. This trend was expected due to a special feature of the emissions. They have a long lifespan and both actual and potential emissions are taken into account. Compared with 2002, the emissions increased by 24 %. However, compared to the reference year 1990, the decease is more than 37 %. The most significant increase of emissions was recorded in the case of HFCs that substituted use of the PFCs. Emissions of CF_4 a C_2F_6 together with emissions of SF_6 are released in the production of aluminium. Their concentrations increased due to an increased production capacity.

ES.3.6 Aggregated emissions

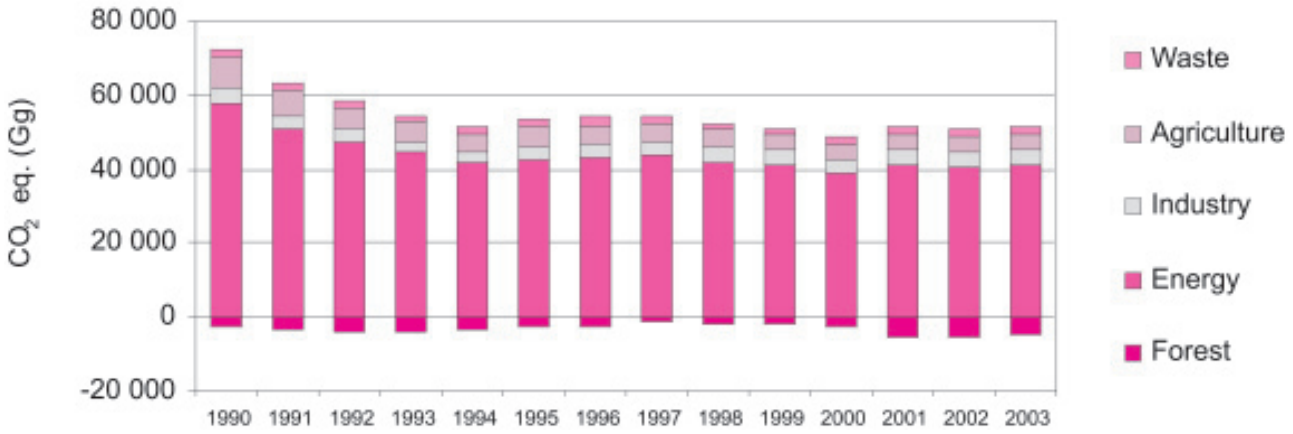
In 2003, the aggregated emissions compared to 2002 slightly increase by 1.5 % representing more than 700 Gg (without sinks from LULUCF). However, compared with the reference year 1990, the emissions of greenhouse gases showed a significant decrease by 20 465 Gg, or 28 % respectively (without removals from LULUCF). The Energy sector has the most significant impact on the GHG emissions, representing almost 80 % share in 2003. Other sectors (industrial processes, agriculture) contribute together by 8 % each on the total emissions. Waste sector contributes by 4 %. These shares are determined as emissions in CO_2 of aggregated equivalents (figure ES.1)

ES.4 Policy and measures to mitigate greenhouse gas emissions

Overview of strategy documents, programs, and action plans that define direct or indirect instruments to meet commitments to mitigate negative impacts of climate change and to reduce GHG emissions are summarized in chapter 4. Basic strategy documents are as follows:

- Strategy, Principles and Priorities of the State Environmental Policy,
- National environmental action program II,
- National strategy for sustainable development,

Figure ES.1 Share of individual sectors on aggregated emissions (CO_2 *eq.* Gg) in period of 1990-2003



- Slovak Strategy to achieve the Kyoto Protocol - comprehensive strategy document that was adopted in 2002. It defines three time horizons aimed to stabilize and reduce the GHG emissions,
- Proposal of the Energy Policy of the Slovak Republic,
- National Strategy of the Industrial Policy Development,
- Concept of utilization of renewable energy sources,
- Sectoral operation program Transport and Telecommunications and the Transport Policy of the Slovak Republic until 2015,
- Program to enhance rational consumption of fuels and energy in transport,
- Waste Management Program,
- Concept of GHG emission reduction in construction and public works sectors till 2005,
- Concept of cattle breeding in 2000 - 2005,
- National plan of regional development,
- Adaptation of agriculture of Slovakia to climate change,
- Concept of forestry policy,
- Action plan for transport and the environment.

Table ES.2 Effect and characteristics of measures in Energy sector (including transport)

Measure	Type of measure	Status	Applied in scenario	IPCC sector	Year	2010	2015	2020	2025
					gas	GHG CO_2 eq.			
Act 572/2004	Regulatory economic	I	with measures	1.A*	CO_2	838	920	1 029	1 156
					CH4	-6	-7	-8	-9
					N_2O	-12	-15	-18	-21
					sum	820	898	1 003	1 125
Directive 2001/77/ES	Regulatory	I	with additional measures	1.A.1.a	CO_2	476	476	476	476
					CH_4	0	0	0	0
					N_2O	1	1	1	1
					Sum	477	477	477	477
Directive 2001/91/ES	Regulatory	I	with additional measures	1.A.4.b	CO_2	0	74	118	168
					CH_4	0	5	8	11
					N_2O	0	0	0	0
					sum	0	79	126	179
Directive 2003/30/ES	Regulatory	S	with additional measures	1.A.3.b	CO_2	324	350	361	361
					CH_4	0	0	0	0
					N_2O	0	0	0	0
					sum	324	350	361	361

(*except 1.A.4.b and 1.A.3)

Table ES.3 Impact and characteristics of measures in sector Industrial Processes

Measure	Type of measure	Status	Applied in scenario	Sector	Year	2010	2015	2020	2025
					Gas	GHG CO_2 eq.			
Modernization of production ofHNO_3	regulatory, technical	S	With measures	2.B.2	N2O	4	6	5	6
New technology of emission sinks	regulatory, technical	S	With additional measures	2.B.2	N2O	128	997	997	997
Modernization of production of aluminium	regulatory, technical	S	With measures	2.F	PFCs	0.009	0.009	0.009	0.009
Installment of inert anodes	regulatory, technical	S	With additional measures	2.F	PFCs	0	0	0	0.012
Reduction of releases in compliance with the EU legislation	regulatory	I	With additional measures	2.F	HFCs	0.123	0.145	0.129	0.129
	regulatory	I	With additional measures	2.F	SF_6	0.004	0.004	0.006	0.006

Table ES.4 Impact of measures to reduce GHG emissions in the Agriculture

Measure	Type of measure	Status	Applied in scenario	Sector	Year	2010	2015	2020	2025
					Gas	GHG CO_2 eq.			
Disposal of animal waste	Regulatory	I	With additional measures	4.B	CH_4	47	78	105	108
			With measures		N_2O	77	107	138	169
			With additional measures			0	65	44	39
New manures	Regulatory	I	With measures	4.C	N_2O	307	430	552	675

Indicated positive emission trend in recent years is the result of several changes in economic sector and other heavy pollution sectors, restructuring of the industry and adoption of environmental legislation. The chapter 4 deals with the assessment of policies and measures declared in the Third National Communication, and provide for the overview of newly adopted measures in the area of GHG emission reduction. The measures are evaluated with respect to current stage of implementation and, where relevant, the impact of measures (and supporting programs) is quantified.

Research

In 1991, the National Climate Program (NKP) was established. Since 1993 the national program has been funded by the MZP SR. Research results of the period 1993 - 2001 are summarized in 11 collections. Since 2001 NKP has stagnated due to the lack of finances from MŽP SR. Monitoring of climate change and the participation at the GCOS program is carried out by the SHMU. The research projects with respect to renewable sources are carried out by the research institutes, universities and specialized organizations. The Ministry of Education is a central authority in the area of research and development. It is also responsible for the coordination of the projects of the 6th Framework Program and grants (VEGA, APVT). In the Agriculture sector, there are four projects oriented towards climate change research:

- Research of stocks and the balance changes of carbon in highlands,
- Impact of global climate change on forests of Slovakia,
- Progressive climate change and its impacts on the development of society,
- Measures taking into account the adaptation of meadows and pastures on climate change.

Table ES.5 Impact of measure to increase sinks and reduce GHG emissions in Land Use, Land Use Change and Forestry

Measure	Type of measure	Status	Applied in scenario	Sector	Year	2010	2015	2020	2025
					Gas	GHG CO_2 eq.			
Afforestation and increased protection against fires	Regulatory economic	I	With additional measures	5.A	CO_2	39,19	62,16	120,62	149,76
					CH_4	0,84	1,05	1,05	1,05
					N_2O	0.,62	0,62	0,62	0,62
				5.B	CO_2	9,45	13,23	24,57	26,46
				5.C	CO_2	12,60	17,64	32,76	35,28
				5.C	CO_2	3,15	4,41	8,19	8,82

Table ES.6 Impact of measures to reduce GHG emissions in the sector Waste

Measure	Type of measure	Status	Applied in scenario	Sector	Year	2010	2015	2020	2025
					Gas	GHG CO_2 eq.			
Measures in waste disposal	regulatory	I	With measures	6.A	CH_4	186.06	304.08	409.50	516.81
			With additional measures		CH_4	6.66	7.43	8.14	8.79
Municipal waste waters	regulatory	S	With measures	6.B.2	CH_4	32.76	44.52	77.70	147.00
					N_2O	-5.98	-7.98	-8.64	-9.31
Industrial waste waters	regulatory	S	With measures	6.B.1	CH_4	6.51	13.44	21.00	28.98
					N_2O	-3.61	-4.81	-5.21	-5.61

I - policy and measures have been already implemented
S - adopted, approved policy or measures
P - planned, prepared policy/measures

ES.5 Projections and assessment of measures effects

Fossil fuel combustion and transformation is the most important source of energy related GHG emissions in Slovakia. Fugitive methane emissions occur from fuel extraction, transport and processing. The following sub-sectors of the IPCC categories are relevant and have been followed in actual projections:

1.A.1	**Energy industry**
1.A.1.a	Public Electricity and Heat Production
1.A.1.b	Petroleum Refining
1.A.1.c	Manufacture of Solid Fuels and Other Energy Industries
1.A.2	**Manufacturing Industries and Construction**
1.A.2.a	Iron and Steel
1.A.2.b	Non-Ferrous Metals
1.A.2.c	Chemicals
1.A.2.d	Pulp, Paper and Print
1.A.2.e	Food Processing, Beverages and Tobacco
1.A.2.f	Other
1.A.3	**Transport**
1.A.3.a	Civil Aviation
1.A.3.b	Road Transportation
1.A.3.c	Railways
1.A.3.d	Navigation
1.A.3.e	Other Transportation
1.A.4	**Other Sectors**
1.A.4.a	Commercial/Institutional
1.A.4.b	Residential
1.A.4.c	Agriculture/Forestry/Fisheries
1.A.5.a	**Other**
1.A.1	**Energy industry**
1.A.1.a	Electricity and heat generation
1.A.1.b	Oil refineries
1.A.1.c	Coal processing and others
1.A.2	**Processing industry and production**
1.A.2.a	Iron and steel production
1.A.2.b	Production of non-ferrous metals
1.A.2.c	Chemical production
1.A.2.d	Production of cellulose, paper and printing houses
1.A.2.e	Food production
1.A.2.f	Other
1.A.3	**Transport**
1.A.3.a	Aviation transport
1.A.3.b	Road transport
1.A.3.c	Rail transport
1.A.3.d	Water transport
1.A.3.e	Other transport
1.A.4	**Other sectors**
1.A.4.a	Offices and institutions
1.A.4.b	Households
1.A.4.c	Agriculture, forestry
1.A.5.a	**Other**

The following scenarios have been developed based upon the UNFCCC method (FCCC/CP/1999/7):

Scenario without measures

- This represents the status that does not take into account policies and measures implemented, adopted or
- anticipated to be implemented after the reference year 2003.

Scenario with measures

- It models effect of adopted and implemented policies and measures. Legal measures adopted after the reference year 2003 are specifically considered.

Scenario with additional measures

- It models GHG emission projections considering effects of anticipated policies and measures. The effect of the transposition of the EU Directive 2001/77/EC on the Support of Renewable Energy Sources was modeled. The Proposal of the Energy Policy of the Slovak Republic served as a basic framework for the scenario proposals.

ES.5.1 Projections of energy related CO_2 emissions

Results of the modeling of CO_2 emissions development according to the scenarios are shown at Figure ES.2.

Scenario results are compared to the level of 92 % of CO_2 emission generation from combustion and transformation of fossil fuels for the default year 1990. It is obvious that the Kyoto reduction objective will be met for all scenarios, even in the scenario without measures. However, the dynamic of economic growth will lead to an increase in CO_2 emissions and further decrease of emissions for the post Kyoto period seems not to be realistic without additional measures or activities.

ES.5.2 Projections of CH_4 emissions in the Energy sector

The energy related CH_4 emissions occur in fossil fuel combustion and transformation, while fugitive methane emissions occur in fuel extraction, transport and processing. The projections of CH_4 emissions were calculated based upon the fuel consumption according to the IPCC method and recommended IPCC aggregate emission factors. In the case of transport, emission factors of the COPERT III program were applied. All three scenarios were modeled in order to assess the effect of measures. The annual fugitive emissions of CH_4 were calculated for the following activities:

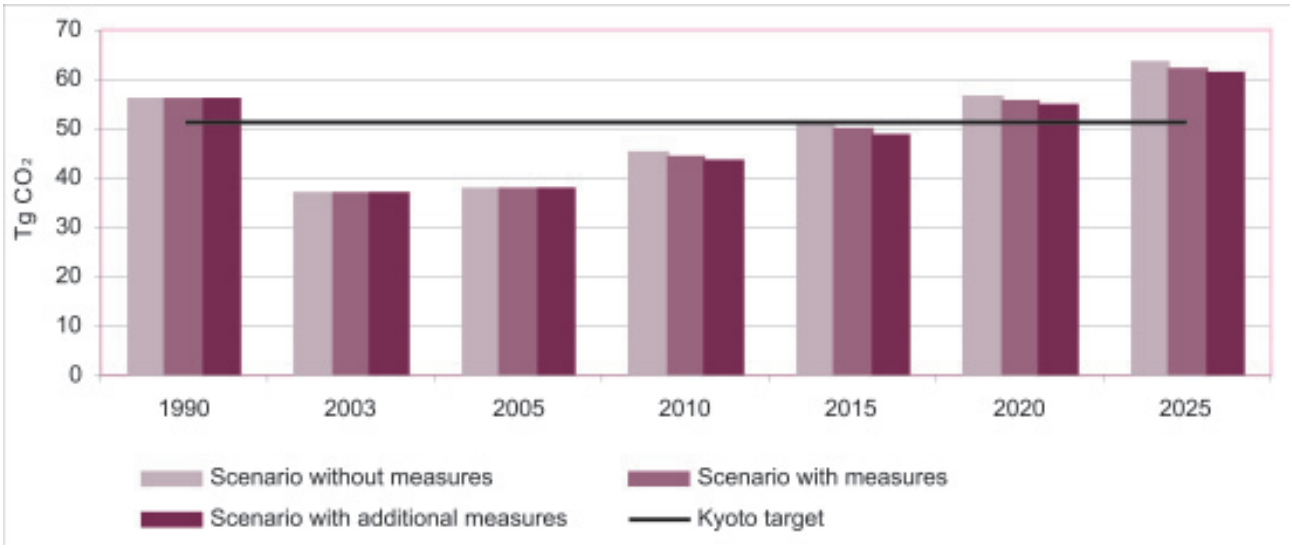
- underground coal mining,
- processing and storage of oil and oil products,
- storage, transport and distribution of natural gas.

Table ES.7 Projections of aggregated emissions (Gg CO_2 equivalent)

Scenario	1990*	2003	2005	2010	2015	2020	2025
Without measures	69 553	44 013	50 956	56 458	63 270	70 172	77 707
Energy	57 676	38 651	39 637	46 670	52 405	58 402	65 023
- of which transport	5 169	5 371	5 649	6 350	6 821	7 017	6 991
Industrial processes	4 264	3 938	4 188	5 178	6 350	7 649	9 048
Agriculture	7 860	4 015	2 772	2 763	2 744	2 828	2 941
LULUCF	-2 345	-4 815	2 116	-424	-536	-1 040	-1 669
Waste management	2 098	2 223	2 243	2 271	2 307	2 334	2 365
With measures	69 553	44 013	50 870	55 336	61 902	68 522	75 721
Energy	57 676	38 651	39 637	45 850	51 507	57 399	63 898
- of which transport	5 169	5371	5649	6 350	6 821	7 017	6 991
Industrial processes	4 264	3 938	4 178	5 169	6 336	7 634	9 033
Agriculture	7 860	4 015	2 772	2 687	2 637	2 690	2 772
LULUCF	-2 345	-4 815	2 116	-424	-536	-1 040	-1 669
Waste management	2 098	2 223	2 166	2 056	1 958	1 839	1 687
With additional measures	69 553	44 013	50 505	53 634	59 682	65 102	72 071
Energy	57 676	38 651	39 637	45 050	50 602	56 435	62 882
- of which transport	5 169	5 371	5 649	6 027	6 471	6 655	6 631
Industrial processes	4 264	3 938	4 151	5 042	6 059	6 502	7 889
Agriculture	7 860	4 015	2754	2 333	2 129	2 032	1 989
LULUCF	-2 345	-4 815	2 107	-490	-635	-1 228	-1 891
Waste management	2 098	2 223	1 856	1 700	1 527	1 360	1 202

* Emissions in base year for the KP

Figure ES.2 Scenarios of CO_2 generation without LULUCF



ES.5.3 Projections of N_2O emissions in the Energy sector

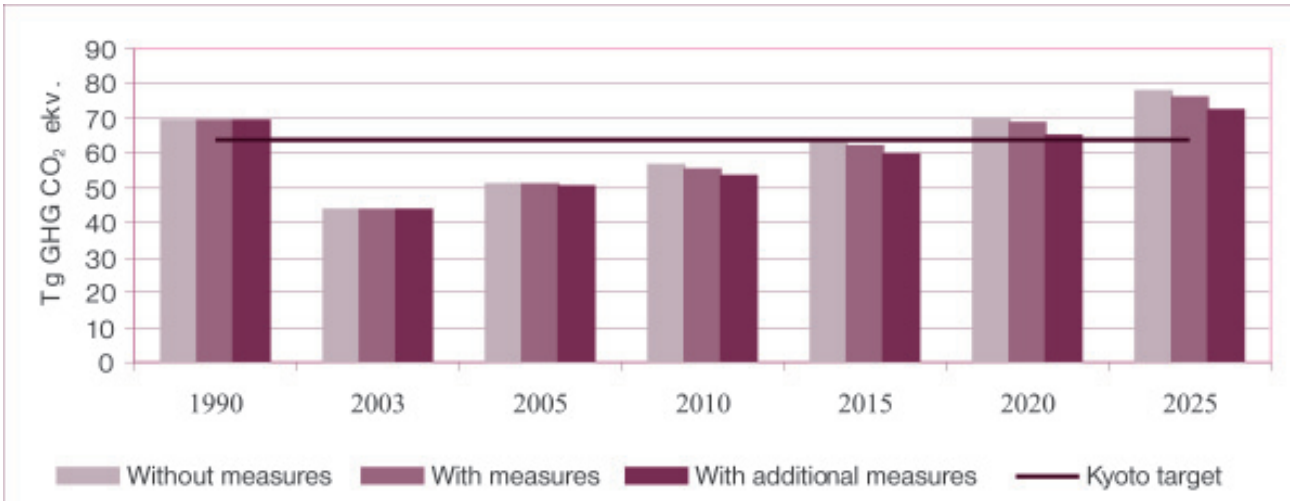
The energy related N_2O emissions occur in fossil fuel combustion and transformation. The production of N_2O emissions in transportation were the subject to balancing. The IPCC method and recommended emission factors were applied. Also, emission factors of the COPERT III in the case of vehicle stock were used. The emissions from combustion and transformation of fuels were calculated for the same scenarios as for CO_2 and CH_4. This allowed analyzing the impact of measures aimed to reduction CO_2 emissions and N_2O generation.

ES.5.4 Projections of total aggregated GHG emissions

Projections of total aggregated emissions (calculated to equivalent of CO_2 according to the GWP) were calculated for three scenarios: without, with and with additional measures (shown in table ES.7).

Projections of aggregated GHG emissions in 2000 – 2015 are shown in figure ES.3. Observed trends clearly indicate that the Kyoto Protocol reduction objective will be achieved for the time horizon by 2010 even for the reference without measure scenario. According to currently developed trajectories achieving of further decrease in emissions during the post-Kyoto period seems to be unrealistic even for the scenario with additional measures. Specific strategy and programmes need to be developed and implemented to keep trend of GHG emission growth decoupled from the GDP increase due to anticipated growth of the GDP and recovery of economic activities.

Figure ES.3 Projections of aggregated GHG emissions



ES.6 Expected impacts of climate change, vulnerability assessment and adaptation measures

ES.6.1 Climate change in the Slovakia in recent years

In Slovakia, the average annual temperature of the air increased by about 1.1 °C and annual atmospheric precipitation decreased by about 5.6 % in the 20th century. In southern Slovakia, the decrease was more than 10 % of total precipitation; in the north and northeast of Slovakia, an increase of up to 3 % over the century was documented. A significant decrease in the relative humidity of the air of up to 5 % and a decrease in snow coverage over the whole territory were recorded. In addition, potential and actual evaporation, soil humidity, global radiation balance confirm a gradual desertification of Slovakia. However, characteristics of sun radiation did not change significantly (except for a decrease in 1965-1985). Similar development continues after 2000 as shown in figures ES.4 and ES.5

Figure ES.4 Development of average air temperature (T) in Hurbanovo and areal atmospheric precipitation (R) in Slovakia (from 203 stations) during warm half-years (IV-IX) in 1900 -2004

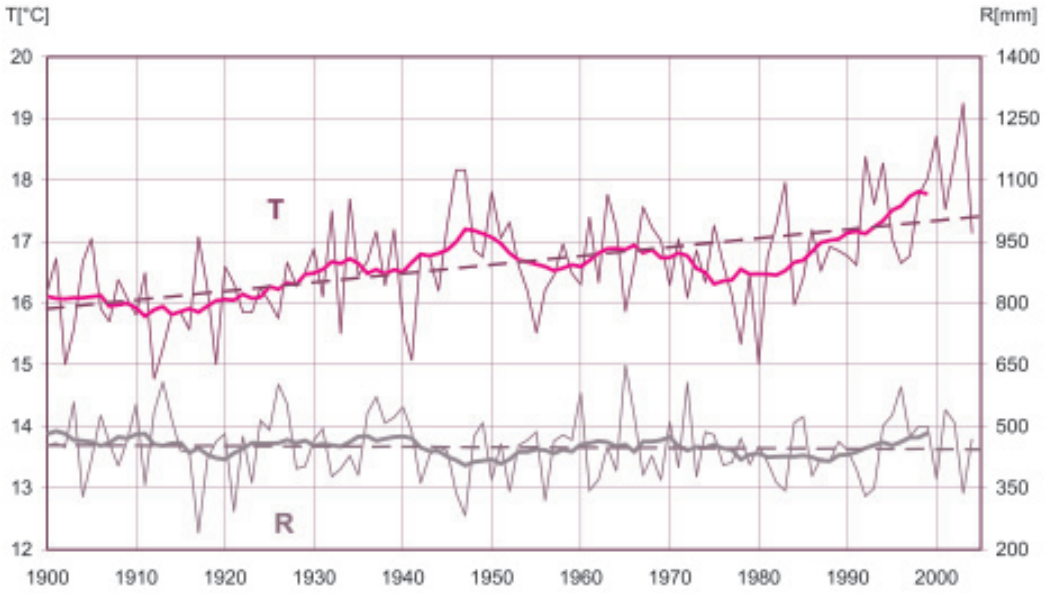
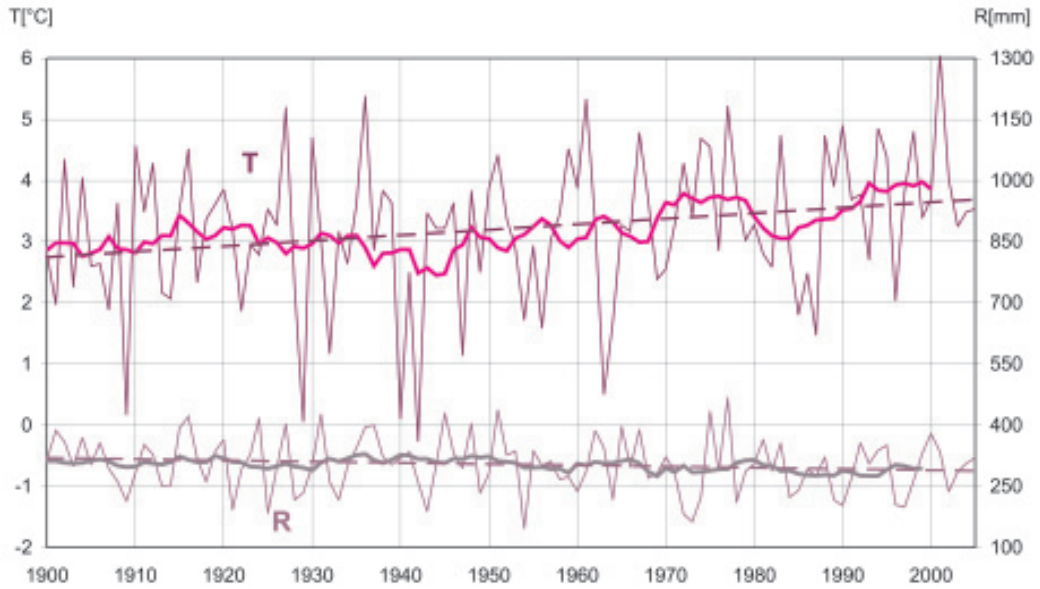


Figure ES.5 Development of average air temperature (T) in Hurbanovo and areal atmospheric precipitation (R) in Slovakia (from 203 stations) during cold half-years (X-III) in 1900-2004



ES.6.2 Climate change scenarios in Slovakia

A total of 9 models of general circulation of atmosphere (GCMs) in four world climate centers have been developed. The most important are models CCCM 2000 and GISS 1998. The method of statistical downscaling is used in regional outputs of the GCMs. This means that modification of outputs from global climate models are statistically interpolated to individual selected points in Slovakia. The sets of measured data are also applied. Climate change scenarios are provided with regard to annual development of individual climate elements for certain time horizons. The scenarios also include time scales of selected elements up to 2100. Climate change scenarios are developed for several climate elements, such as air temperature, atmospheric precipitation, global radiation, and air humidity.

ES.6.3 Hydrological cycle, water resources and water management

The assessment of climate change impact on the hydrological cycle is carried out based upon mathematic modeling of potential changes of the hydrological regime. Climatic characteristics (air temperature and precipitation) served as the input values. The changes of the hydrological regime were assessed based upon hydrological balance models. A spatial model using GIS methods was developed to construct anticipated changes of long time average runoff. The relationship between average annual runoff, average annual precipitation and air temperature was assessed. The maps of changes in a long-time average annual precipitation were developed compared to the reference period (1951-1980). The maps including assessment of future average air temperature were used as input maps for the Turcov model. The methods of map algebra were applied to calculate areal averages of percentage changes of runoff for selected basins of Slovakia.

ES.6.4 Agricultural production in Slovakia

Increased temperatures allow for accelerating physiological processes of plants, start of phenophases, phenophases intervals, and vegetation periods. Extension of vegetation periods is forecast up to 43 days in the southern part of Slovakia in 2075, and up to 84 days in northern parts.

Evapotranspiration deficit is one of the most important characteristics. It is expressed as the difference between potential and actual evapotranspirations (dE = Eo - E in mm). By the end of 2075, it is estimated that there will be an increase in dE by 126 mm in southern Slovakia, and seven times the current state in the northern part. This is an important phenomenon. It is estimated that periods of drought will start in the early months of the year and there will be a shortage of water in the soil at levels up to 400 m a. s. l.

Measures aimed to utilize positive and mitigate negative impacts of climate change are directed mainly to:

- Changes in crop growing technologies. It is emphasized to apply an approach of sustainable management, without extremes and natural recovery of soil fertility,
- Changes in agro-climatic division and structure of grown crops and varieties. The aim is to use natural sources of radiation and water regimes,
- Changes in cultivation programs. The effort should be given to cultivation of hybrids that are adaptable to biotic and abiotic stresses. Special attention should be paid to the division of seeds.

ES.6.5 Forest ecosystems and forest management

Changes in bioclimatic areas were investigated by the support of two indices (IT, IQ). These represent the most important climatic factors with respect to forest communities. The index of average annual air temperature (IT) was defined as one of the most important ecological factors. The assessment was carried out for the total surface of Slovak forests for three selected woods: spruce, fir, and beech. Based upon the results, spruce and fir are not in compliance with the bioclimatic demands. IT index of 3-5 is forecast (conditions of climate change) at 71 % of spruce surface, 82 % of fir surface and 32 % of beech surface. The IQ index signals the biggest changes for beech at its lower bound.

ES.7 Review of climate change research

Research and scientific projects in the last 10 years were implemented mainly in following institutions: SHMU, the Department of Metrology and Climatology of the Faculty of Mathematics, Physics and Informatics of the University Komenskeho, the Geophysical Institute and the Institute of Hydrology of Slovak Academy of Science, Department of Water Management and Landscape of the Slovak Technical University, Slovak Agricultural University in Nitra, Technical University in Zvolen, The Forest Research Institute in Zvolen, Hydro-melioration, Bratislava, the Water Research Institute, the Faculty of Natural Sciences and other institutions.

ES.8 Education and enhacement of public awareness

Education and public awareness activities with respect to climate change are not legally and institutionally supported; however, there are many examples of projects and programs of several institutions dealing with the issue of climate change. The main institution governed by the Ministry of Environment is the Slovak Environmental Agency - SEA (www.sazp.sk). It is a partner institution to the European Environmental Agency (www.eea.eu.int) and includes centers of environmental education.

The National Action Plan for Health and the Environment for 2006 - 2010 (NEHAP) governed by the Ministry of Health also deals with the climate change issues. The recommendations of the WHO are available at the web page of the Institute of Public Health (www.uzvsr.sk)

An increase of public awareness was significantly improved by new information technologies and Internet although the extent of use does not reach the EU average. The SEA operates web portals on environmental monitoring - Information System of Monitoring (www.iszp.sk) and Enviroportal - information system on environmental impact assessment (www.enviroportal.sk). These systems are built based on the Act 261/1995 Coll. on the State Information System and establish the condition to provide actual and full information on the environment to each individuals. Based upon the Information System of Environmental Departments, environmental impact assessment belongs to one of nine sub-systems. There is information generated by the Ministry of Environment, district and regional environmental offices and the Slovak Environmental Agency. The system requires the automation of related activities.

1. Introduction

Climate change is one of the most serious global environmental problems. The international community and the general public have already understood the urgent need to tackle this problem. Moreover, the public is more and more witness and victim of the damage due to extreme heat, flooding and wind storms that Europe, North America, China, India, and the Caribbean were exposed in this year.

The instrument to tackle the problem of climate change is the UN Framework Convention on Climate Change adopted in 1992. The aim of the Convention is to stabilize atmospheric concentrations of greenhouse gases to a safe level. Currently, there are 185 countries or international communities, including Slovakia, and the EU that are parties to the Convention. The Convention requires the adoption of measures that aim to reduce the GHG emission to the level of the year 1990.

The results of the research and practical experience confirm that stabilisation of GHG concentrations will require tremendous effort. Without emission limitation, the atmospheric concentrations of CO_2 would grow from 374 ppm in 2002 to 490 - 1 260 ppm in 2100. This would represent 75 - 350 % increase from the year 1750. In order to stabilize the concentrations at the level of 450 ppm, the GHG emissions should drop below the level of the reference year 1990 in the next decade. The CO_2 contributes to more than 60 % of anthropogenic emissions of GHG. Actual global emissions are 23 mil. m^3, which represents 1 % of the total volume of this gas in the atmosphere. Coal, oil and natural gas combustions release CO_2 from fossil fuel sources.

The concentration of methane in the atmosphere has increased two and half times in the period of the industrial era. Methane concentration contributes to 20 % of the anthropogenic emissions of GHGs. A rapid growth in methane concentration is caused by intensive farming, livestock production, coal mining, transport and utilization of natural gas and combustion of biomass. The life span of methane in the atmosphere is 10 - 12 years. Total annual emission is about 0.4 bill. tons of CH_4 and represents a stable annual increment.

Nitrous oxide has the life span in the atmosphere equal to 114 years. Together with, certain industrial gases and ozone, they contribute to total GHG emissions with 20 %. The concentration of N_2O has increased by 16 % compared to the 19th century, mainly as the result of intensive farming, over-fertilization and inappropriate agro-technical procedures. Other sources of emissions include fuel combustion, certain industrial technologies, livestock production, and wastewater treatment. The total emission level is about 3 - 7 mil. tons of nitrogen per year. The mechanism of emission generation and N_2O sinks is related to the natural cycle of nitrogen in the atmosphere. Therefore, quantification is difficult, and calculations are characterized by a high level of uncertainty.

The unfavorable development and balance of GHG emissions generation since 1992 have created a need to adopt an additional and effective instrument. In 1997, the parties of the Convention agreed to endorse the Kyoto Protocol (KP) that defines reduction targets for countries of the Annex I to the Convention. Developed countries defined in Annex B of the Kyoto Protocol should individually or together reduce emissions of six GHG on average by 5.2 % from the level of the year 1990 during the first commitment period 2008 - 2012. The reduction target of the Slovak Republic is 8 % reduction of emissions compared to the base year 1990. The Kyoto Protocol has generally extended the options of the countries to choose the way and the instruments that are most appropriate for achievement of their reduction targets, taking into account the specific circumstances of the country. The common feature of new mechanisms is the effort to achieve the maximum reduction potential in the most effective way.

In Slovakia, the UN FCCC came into effect on the 23rd November 1994. Slovakia ratified the Kyoto Protocol in May 2002. The quantified reduction commitment accepted by Slovakia for the period 2008 - 2012 in Annex B to the Kyoto Protocol is equivalent to 5 multiply of 92 % of total national emissions of greenhouse gasses in 1990.

According to the emission inventory of April, 2004, Slovakia has achieved a reduction of total anthropogenic emissions of greenhouse gasses expressed as CO_2 equivalent, of approximately 30 % compared the year 1990. This achievement is the result of several processes and factors, mainly:

- higher share of services in the generation of the GDP,
- higher share of gas fuels in the primary energy resources consumption,
- restructuring of industries,
- gradual decrease in energy demands in certain heavy energy demanding sectors (except for metallurgy),
- and the impact of air protection legislative measures influencing directly or indirectly the generation of greenhouse gas emissions.

A comparison of the GDP trend with the trend of aggregate emissions of greenhouse gasses shows that Slovakia is one of few countries where the trend of emissions is decoupled from the GDP increase. However, by international comparison, the generation of greenhouse gasses per capita still remains one of the highest in Europe.

Without introduction of effective measures Slovakia will contribute to further increase of GHG emissions due to anticipated growth of the GDP and recovery of economic activities. Therefore, the investment strategy to tackle GHG emissions is one of the most important objectives.

In May 2004, Slovakia joined the European Union. Relevant European legislation is expected to have additional positive direct and indirect effects to reduction of GHG emissions, mainly in the energy sector. The introduction of emission trading scheme will allow for the implementation of further reduction measures.

The Fourth National Communication on Climate Change is developed in consistency with the requirements of the guidelines of the FCCC/CP/1997/7, part II (Guidelines for the Preparation of the National Communications by Parties Included in Annex I to the Convention). The report describes the actual framework and shows the results of the activities undertaken to meet the commitments of the Convention and the Protocol in the period from 2001 when the Third National Communication was submitted.

Slovakia publishes the Report on Demonstrable Progress for the first time as an individual chapter. The report was prepared based upon the Art. 7.2 and 3.2 of the Kyoto Protocol and Decision 25/CP.8, and provides a brief analysis of the steps and measures that are critical preconditions to meet the commitments of the country.

2. National circumstances relevant to GHG emissions and removals

This chapter includes brief description natural and economic conditions relevant to the development and generation of greenhouse gas emissions and removals. In addition to basic geographical data, a climate profile of the country, population development, economic and environmental framework, this chapter outlines the relevant legislative processes, together with a definition of functions and responsibilities of the individual institutions involved in this process.

2.1 National framework for environmental policy making and legislative process

The Slovak Ministry of the Environment is responsible for national environmental policy including climate change and air protection issues. It has the responsibility to develop acts, and amendments to existing legislation. Legislation proposals are commented by all ministries and other relevant bodies. Following the commenting process, proposed acts are negotiated in the Legislative Council of the Government, approved by the Government, and finally by the Parliament. The Ministry of the Environment cooperates with other ministries, such as Ministry of Economy, the Ministry of Agriculture, the Ministry of Finance, the Ministry of Transport, Posts and Telecommunications, and the Ministry of Construction and Regional Development.

District and regional environmental offices are decision making bodies according to the Act 525/2003 Coll. These are located at 8 regional and 46 district administration offices. Inspection and enforcement activities are carried out by the 4 inspectorates of the Slovak Environmental Inspection. According to the Act 478/2002 Coll. on Air Protection, competencies and decision making process on large, medium and small pollution sources are given to regional, district levels and municipalities.

The Act 572/2004 Coll. on Trading with Emission Quotas is the first legal instrument directly oriented towards control of GHG emissions. According to this Act, competencies with respect to trading of emission quotas are given to the Ministry of the Environment, regional and district environmental offices.

Supporting institutions founded by the Ministry of Environment play an important role. These include the Slovak Hydrometeorological Institute, the Water Research Institute, and the Slovak Environmental Agency. Academic and research institutions (i.e. the Forestry Research Institute Zvolen, the Transportation Research Institute Zilina, the Slovak Agricultural University Nitra, the Slovak Technical University Bratislava, FMFI Bratislava, and the Slovak Academy of Science), non-governmental organizations, and associations of interested groups (the Slovak Energy Agency, PROFING, EFRA Zvolen, SZCHKT, Detox, SPIRIT, Ecosys) are involved in the process of development and implementation of policy and measures aimed to mitigate climate change impacts.

2.2 Geographical profile

The Slovak Republic lies in Central Europe with a total area of 49 036 km^2. Agricultural soil covers 50 %, forest soil 41 %, water 2 %, and 3 % is covered by built-up areas. Slovakia is a mountainous country, 60 % of its surface is over 300 m, 15 % over 800 m, and 1 % over 1 500 m. The highest point is Gerlach peak (2 655 m a. s. l.), and the lowest point is at the discharge of the Bodrog River out of Slovakia (94 m a. s. l.). More than 95 % of the territory is drained by the Danube River to the Black Sea; only a small part at the north of the country drains into the basin of the Baltic Sea. Slovakia is a highly biologically diverse country; the west and north are covered by the Western Carpathian Mountains, and large lowlands cover the south.

The long term average water flow in Slovak rivers is approximately 3 328 $m^3.s^{-1.}$ including inflow from neighbour countries. Of this amount, only 398 $m^3.s^{-1}$ (12 %) originates in Slovakia. There are 54 large water dams with a total operating volume of 1 890 mil. m^3. These dams are able to capture approximately 14 % of the water generated in the territory of Slovakia. The dams were constructed to provide electricity generation and regulate water volume. In addition, there are 198 small water reservoirs with a total volume of 65 mil. m^3 that were constructed for agricultural purposes. Currently only 60 of them are in operation as an additional source of irrigation water (1).

In Slovakia, there are a high proportion of areas of nature protection. At the end of 2003, 9 natural parks and 14 protected areas were designated. The total acreage of protected nature areas represents 1 144 807 ha, 23.3 % of the total territory. As part of the activities related to Slovak membership in the EU, the network of protected areas (NATURA 2000) is being established.

2.3 Climate profile

According to the global climatologic classification, Slovakia is in the mild climate zone category with precipitation uniformly distributed over the whole year. The Atlantic Ocean impacts the west part of Slovakia, a continental influence is typical for east part. A regular rotation of four seasons and variable weather throughout the year are typical for this country.

In Slovakia, during the period 1901 - 2000, increased average annual temperature of the air by about 1.1 °C and a decrease in annual atmospheric precipitation by about 5.6 % were recorded. In the south of Slovakia, the decrease was more than 10 % of total precipitation; in the north and northeast of Slovakia; an increase of up to 3 % over century was documented. A significant decrease

in the relative humidity of the air of up to 5 % and a decrease in snow coverage (2) were recorded. There is an evidence of a gradual desertification, particularly in south Slovakia, with regard to evaporation, global radiation balance, evapotranspiration, and soil humidity. Figures 2.1 and 2.2 show deviations in the ten-year average annual temperatures and the long term annual precipitation in the period of 1901–1990; the figure 2.3 illustrates the trend in areal annual precipitation in 1881–2005.

Figure 2.1 Decade average annual temperatures in Hurbanovo and annual deviations in the period of 1901-1990, TP (warm half-year (IV.-IX.) and CHP [cold half-year (X.-III.)] in the period of 1881–2005 (2005 data are estimate)

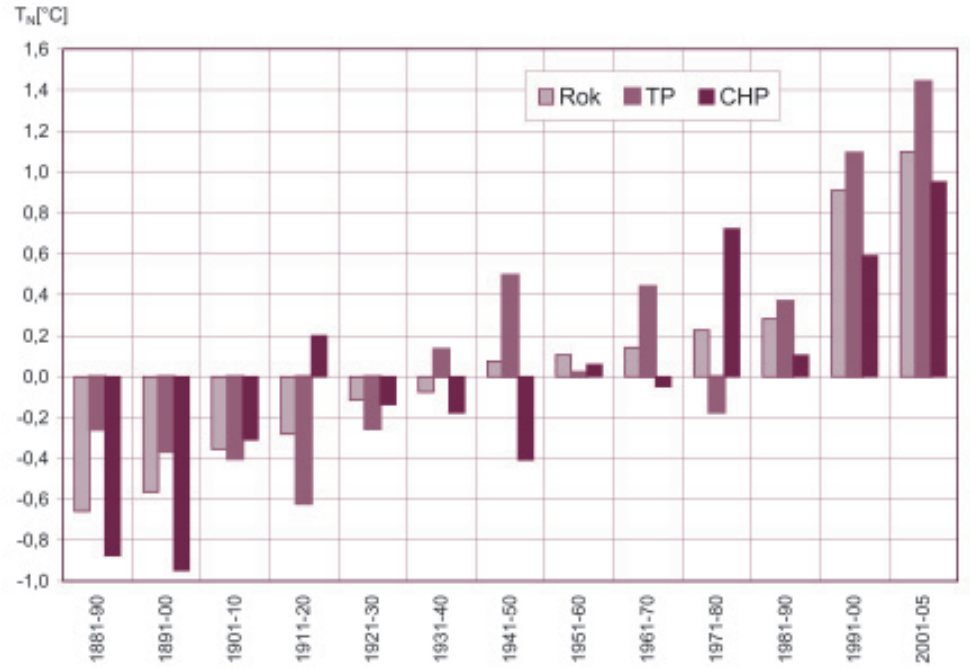


Figure 2.2 Decade average annual areal precipitation calculated from 203 stations as % of normal in 1901-1990 (TP = (IV.-IX.), CHP = (X.-III.), in 1881-2005 (2005 data are estimate)

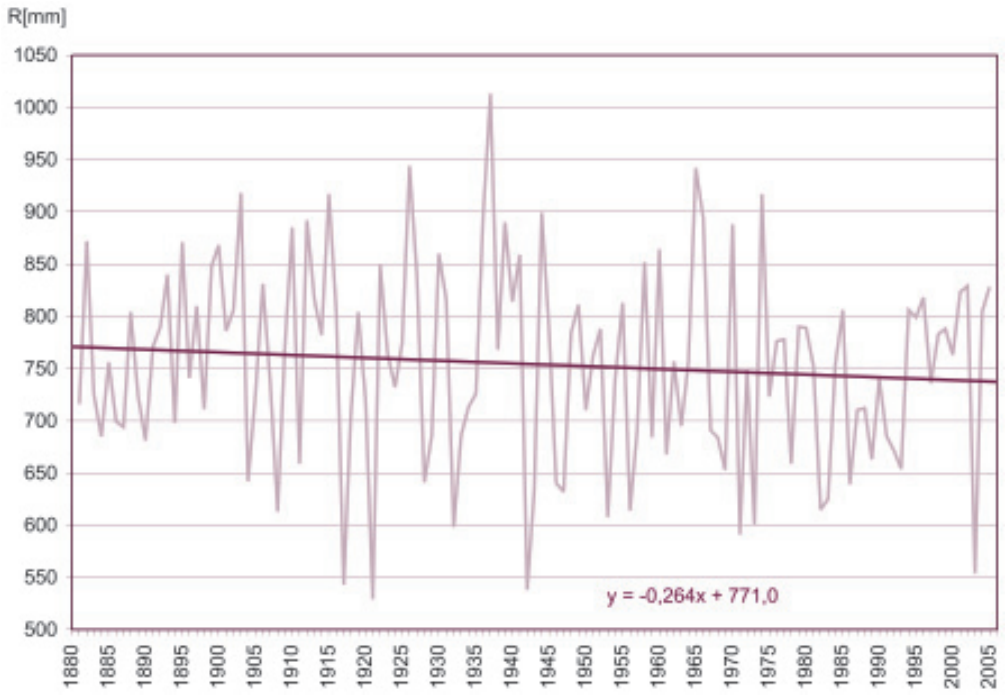
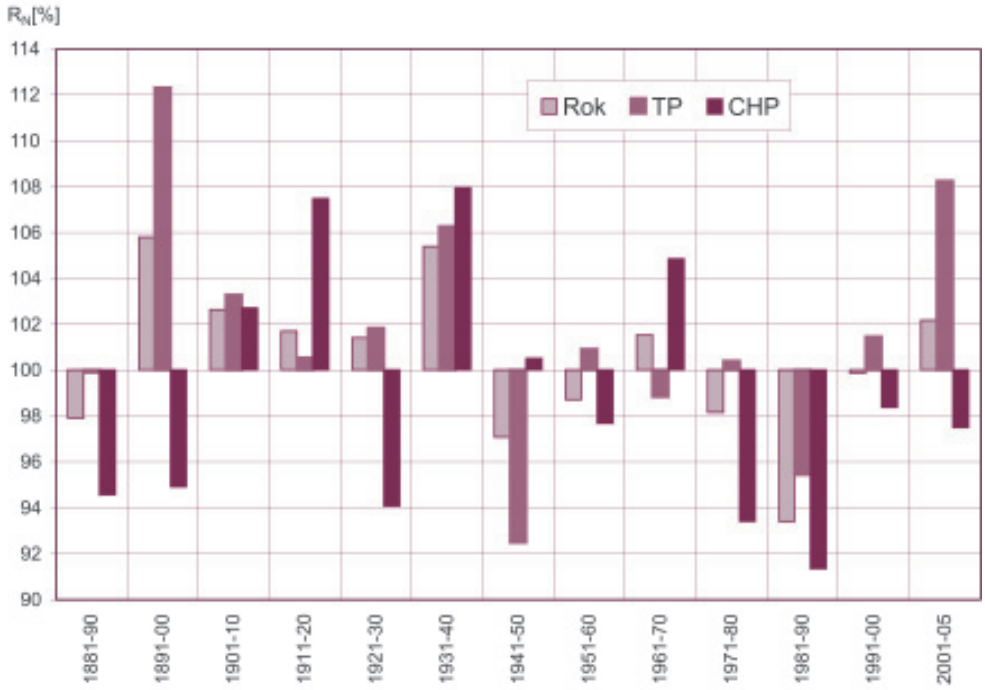


Figure 2.3 Areal average annual precipitation in 1881-2005 calculated as double weighted average from 203 stations



Particular attention is paid to the parameters of climate change, such as amount of precipitation. Over the last 11 years, a significant increase of the extreme daily precipitation volume was observed. These occasions resulted in higher risks of local floods. On the other hand, in the period of 1989-2004, local and regional droughts caused by long periods of relatively warm weather, are recorded. Particularly, the drought occasions in 1990-1994, 2000, 2002 and 2003 were destructive. Based upon the indicators of air temperature, precipitation amounts, evapotranspiration, snow coverage and other elements, the decade of 1991-2000 (as well the period 2001-2005) approached the conditions expected about 2030 with respect to potential scenarios of climate change in Slovakia (figure 2.3) (3).

2.4 Population development

The analysis of the population development showed significant disruption in the long-term demographic trend at the beginning of the 1990's. Reproductive behavior of inhabitants has decreased and 15 of 70 districts in Slovakia recorded a reduction in children born. These districts are located in the central and southwestern areas which are mainly rural areas of Slovakia. Starting in 2001, a negative natural population increase was recorded; -0.2 % in 2001, -0.1 % in 2002, and -0.1 % in 2003 (4). In 2005, the negative increase was stopped and number of born inhabitants exceeded inhabitant's reduction.

Slovakia has 5.38 mil. inhabitants (as of 31. 12. 2003). The average population density is 110 inhabitants/km^2. The population is concentrated in the cities in the lowlands and the main basins. Mountains areas are randomly populated. In Slovakia, there are 47.8 % of inhabitants are economically active.

The largest city is Bratislava with 425 533 inhabitants (as 31.1 2. 2003). It is the capital of the Slovak Republic.

2.5 Economic profile

Since 2000, macroeconomic development of the Slovak Republic has been influenced by implementation of measures with respect to the preparation of the country for EU membership. Among the most important measures were the removal of price distortions, changes in indirect taxes, and reconciliation of public financing mechanisms. In 2001, the growth in GDP reached 3.3 %. In 2003, the Slovak economy continued its positive development, when the growth of gross domestic product (GDP) at constant prices reached 4.2 %, which is a comparable to the growth of the most developed economies in transition and a double that of the EU25 countries. The GDP development is shown in table 2.1.

In 2003 an acceleration of growth of the Slovak economy was caused by foreign trade demand in the of automobile production sector. However, increased export capacity of the Slovak economy was the result of direct foreign investments implemented in previous years. The dynamics of GDP growth was contributed to by the industry and construction sectors, where growth of the GDP exceeded the overall productivity of the economy.

Table 2.1 Development of GDP (ESA methodology)

Parameter	1990	1994	1998	2000	2001	2002	2003
GDP, constant prices of 1995 (bill. Sk)	599.2	511.6	641.1	690.7	716.8	749.9	783.4
GDP, current prices (bill. SK)	257.7	466.2	750.8	934.1	1 009.8	1 098.6	1 201.2
Rate of exchange SK/USD	18.0	32.0	35.2	46.2	48.3	45.3	36.7
GDP, constant prices of 1995 (bill. USD)	21.5a	15.9	18.2	15.0	14.8	16.5	21.3
GDP, current prices (bill. USD)	14.3	14.5	21.3	20.2	20.9	24.2	32.7
GDP/inh., constant prices of 1995 (thousand USD)	4.1[a]	2.9	3.4	2.8	2.7	3.1	4.0
GDP/inh., current prices (thousand USD)	NA	7.2	9.8	9.5	10.0	10.9	11.2

* - constant prices of 1992; NA Not Applicable; source: www.statistics.sk

In 2003, tax reform was implemented. A uniform 19 % tax was applied on personal and corporate income and the same rate applies to the value added tax.

In 2003, an improvement in the labor market was recorded. Due to direct foreign investments, new jobs and working opportunities were created. The average unemployment rate decreased to 17.4 %. In spite of the positive trend in employment, regional disparities persist. The most marginal regions are in the east and the middle- south of Slovakia. These regions are characterized by a low level of education and the high share of groups of inhabitants at risk.

The current account deficit in the balance of payments in 2003 reached 10.2 bill. Sk and against the previous year, it dropped by 77.1 bill. Sk. The increased export activity, especially to EU countries, manifested itself in export growth by 151 bill. Sk.

Inflow of foreign investment reached approximately 20.5 bill. Sk (annual drop of 8.4 bill Sk) in 2003 and it was targeted to Slovak banks and companies. On the other hand, more investments came into industrial production.

At the conclusion of 2003, the Slovak Republic showed an accumulated gross foreign debt in the amount of USD 18.3 bill., which compared to the end of 2002 represented an increase of USD 5.2 bill. The accumulated gross foreign debt per capita in SR reached approx. USD 3 406 and the share of this debt of GDP was 47.4 % at the end of 2003 (in 2002 48.2 %). The development of internal and external economic relationships is characterized by additional parameters such as inflation rate, average interest rate of credits and deposits and foreign trade balance. These parameters are shown at table 2.2.

Table 2.2 Selected internal and external economic parameters

Parameter	1990	1994	1998	2001	2002	2003
Inflation rate (%)	10.4	13.2	6.7	7.3	3.4	8.5
Average interest rate of						
- credits (%)	NA	14.6	13.5	9.3	9.1	7.3
- deposits (%)	NA	9.3	10.2	5.2	4.6	3.0
Balance of foreign trade						
- import (FCO) (bill. Sk)	61.2	211.8	460.7	714.1	747.9	826.7
- export (FCO) (bill. Sk)	52.0	214.4	377.8	611.3	652.0	803.2
Balance (bill. Sk)	-9.2	2.6	-82.9	-102.7	-95.9	-23.4

Source: www.statistics.sk; NA = Not Applicable

2.6 Energy sector

In 2003, the energy sector reached a 2.5 % share on the total GDP. Energy intensity calculated on purchasing power is gradually decreasing, and was 1.9 times higher than the average recorded in the EU. The reason is a high proportion of heavy-energy-demanded industry contributing to the GDP (figure 2.4).

Consumption of primary energy sources (PES) per capita slightly increased and reached approximately 90 % of the EU25 average.

Almost 90 % of PES (including nuclear fuel) is imported. Domestic energy sources are limited to renewable energy sources and brown coal. Domestic oil and natural gas production in Slovakia is insignificant. The development of the structure of PES and final consumption of fuels and energy in the Slovak republic is shown in tables 2.3-2.6.

Compared to developed countries, the highest consumption of all types of fuels occurs in industry, while the poplation has a relatively low share (figure 2.5).

Table 2.7 shows information on electricity generation, classified by the source of production.

Figure 2.4 Development of GDP and energy intensity

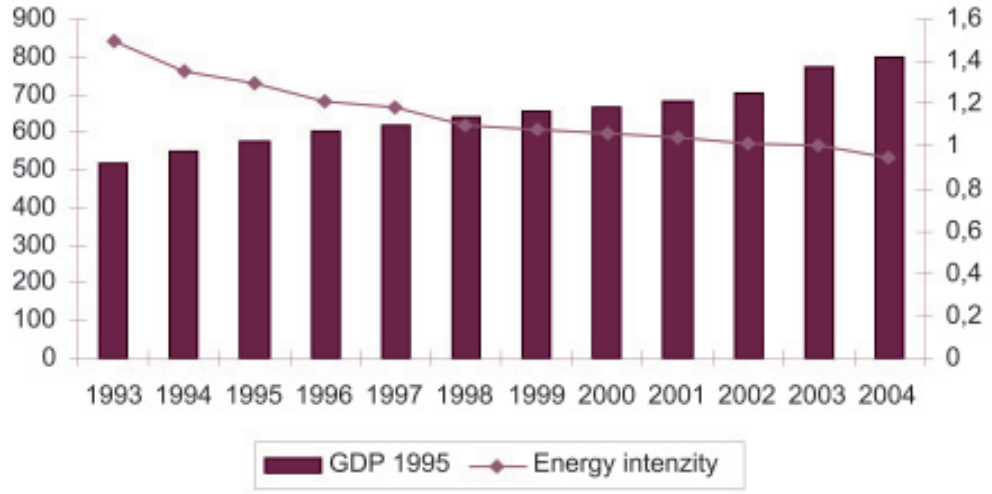


Table 2.3 PES and final consumption of solid fuels (PJ)

Parameter	1990	1994	1998	2001	2002	2003
PES	360.2	235.4	198.8	189.7	181.3	190.0
Final consumption	150.2	90.8	67.4	58.1	36.1	29.2
of which						
Industry and construction	58.3	50.9	45.3	51.0	21.6	24.1
Agriculture	4.6	1.6	0.8	0.4	0.1	0.1
Transport	1.4	0.7	0.7	0.5	-	-
Trade and services	33.9	25.9	14.2	2.9	8.9	1.5
Population	52.0	11.7	6.3	3.2	5.4	3.4
Share of FC/PES (%)	41.7	38.6	33.9	30.6	19.9	15.4

Source: www.statistics.sk

Table 2.4 PES and final consumption of liquid fuels (PJ)

Parameter	1990	1994	1998	2001	2002	2003
PES	197.6	134.8	146.3	124.9	276.4	362.3
Final consumption	95.3	83.7	71.4	67.9	96.1	93.6
of which						
Industry and construction	29.2	37.6	14.2	11.1	17.6	19.5
Agriculture	19.5	9.1	7.4	6.0	2.7	3.0
Transport	17.9	12.0	9.0	8.8	72.2	68.7
Trade and services	12.7	14.7	25.6	29.5	2.7	1.9
Population	15.9	10.2	15.2	12.5	0.9	0.4
Share of FC/PES (%)	48.3	62.1	48.8	54.3	34.8	25.8

Source: www.statistics.sk

The strategic objective to enhance energy efficiency has been stated in the Energy Policy of Slovakia (6). The policy presents, inter alia, the Calendar of the modification of regulated prices, including energy (electricity, gas, heat for industry and households) up to 2002. The cross-subsidies for electricity power were ended by the decisions of The Regulatory Office for Network Industries adopted in 2003. The transitional period ended on January 1, 2004 and since that date all subsidies for households and industry have been cancelled (6).

Table 2.5 PES and final consumption of gas fuels (PJ)

Parameter	1990	1994	1998	2001	2002	2003
PES	223.0	198.4	239.8	262.1	245.6	237.4
Final consumption	177.8	153.4	181.9	197.9	169.9	160.9
of which						
Industry and construction	103.8	63.5	55.5	99.6	69.9	75.9
Agriculture	3.1	2.4	2.5	2.0	1.8	3.2
Transport	0.5	1.3	0.2	1.1	0.1	0.1
Trade and services	40.2	46.9	61.4	24.6	30.2	13.9
Population	30.1	39.3	62.4	70.6	67.1	67.4
Share of FC/PES (%)	79.7	77.3	75.9	75.5	69.2	67.8

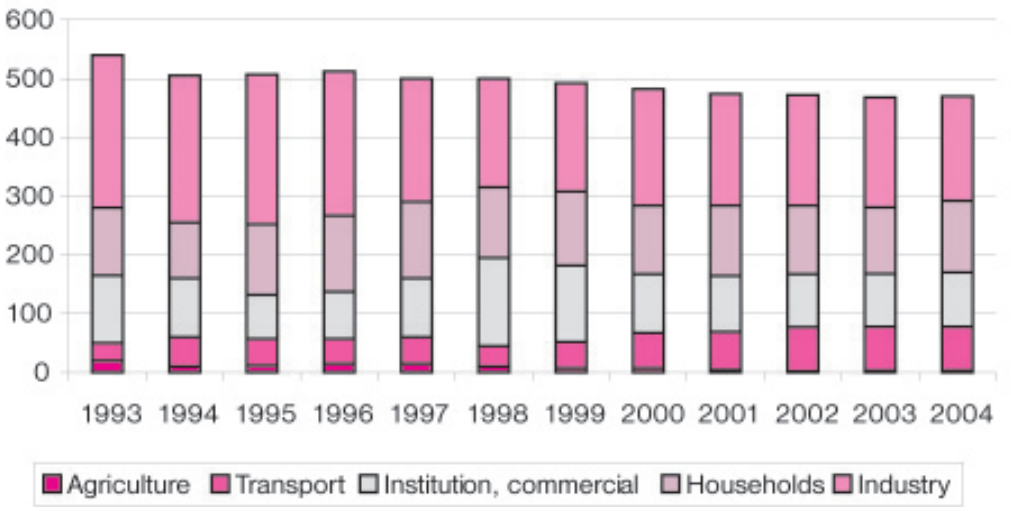
Source: www.statistics.sk

Table 2.6 PES and final consumption of electricity (PJ)

Parameter	1990	1994	1998	2001	2002	2003
PES	25.5	17.2	21.3	17.5	18.9	12.5
Final consumption	84.3	73.2	75.7	84.2	81.7	82.6
of which						
Industry and construction	54.0	36.4	33.9	34.8	32.5	40.8
Agriculture	4.1	3.4	3.0	1.9	1.8	3.3
Transport	4.2	5.3	3.6	2.7	2.6	2.6
Trade and services	8.7	11.8	14.8	25.9	27.2	17.7
Population	13.2	16.2	20.2	18.8	17.6	18.1
Share of FC/PES (%)	330.9	425.0	355.5	481.1	432.3	660.8

Source: www.statistics.sk

Figure 2.5 Final consumption of energy according sectors



In 2001, Slovakia has launched restructuring and privatization processes. It resulted in the establishment of three regional joint stock companies (ZSE, SSE, and VSE) with the majority state shares. Foreign shareholders are EON, EBRD, EDF and RWE. In 2002, the outcome of the transformation process in SE, a.s. was the division of electricity production (represented by the SE, joint stock company) and electricity transmission network (SEPS). Also, the Heating Plant Kosice, a.s. was established. It is envisaged that the SEPS (transmission network) will not be privatized with the full ownership of the state. Currently, the privatization process of the SE, a.s. was started. It is proposed that 51 % of shares will be sold and 49 % of shares will be designated to municipalities.

Table 2.7 Electricity generation (TWh)

Type of generation	1990	1994	1998	2000	2001	2002	2003
Steam	9.5	9.2	10.0	9.3	9.9	9.5	9.7
Nuclear	12.0	12.1	11.4	16.5	17.1	17.9	17.9
Hydropower	2.5	4.3	4.6	5.1	4.9	5.4	3.6
Total	24.1	24.7	26.0	28.2	28.3	28.7	31.1

Source: (5)

2.7 Industry

The internal structure of the Slovak industry prior to EU membership recorded significant changes. The share of mining, distribution of electricity, gas and water in the industrial sector input decreased and are close to those in developed countries. On the other hand, the share of industrial production on the GDP generation slightly increased. The overall share of industry in the formation of GDP reached 26.9 % in 2003. Industrial production experienced a slight slowdown of growth dynamics (from 6.8 % to 5.7 %) in 2003 against the previous year, caused by the production decline in the sectors of extraction of minerals and production and distribution of electricity, gas and water. On the other hand, the development of industrial production was positively influenced by ongoing growth of industrial production targeted to foreign markets (production of automobiles, rubber and plastic goods, electric and optic equipments). Decrease of domestic demand appeared mainly in the sectors of chemical production, production of food, beverage and tobacco products, coke production, refinery products and nuclear fuels. On-going restructuring of the industrial companies resulted in the reduction of over-employment in mining, distribution of electricity, gas and water sectors. On the other hand, favorable development in industrial production influenced the employment rate in this sector that increased 0.5 % in comparison with the previous year. Development of value added in the industry sector according to the classification of economic activities is shown in table 2.8.

Table 2.8 Development of value added in current prices according to classification of economic activities (mil. Sk)

Sectors	1994	1998	2000	2001	2002	2003
Total economy	436 946	696 660	828 147	909 425	984 434	1 082 524
Agriculture incl. fishery	30 242	37 614	38 915	44 943	44 452	43 677
Mining	5 168	6 233	7 253	6 859	6 754	6 074
Industrial production	101 229	160 405	194 954	223 918	218 108	230 004
Production of electricity, gas, water	40 286	24 409	35 650	23 806	32 811	56 095
Construction	26 277	50 174	45 288	46 911	52 722	58 791
Trade	69 390	101 929	120 764	128 487	141 941	154 841
Hotels, restaurants	5 047	10 668	14 220	13 362	12 797	11 216
Transport, telecom, post	48 083	77 325	91 091	111 210	114 607	119 346

Method ESNÚ 95, according to quarterly national accounts; Source: www.statistics.sk

Industry (including the construction industry) is a sector that contributes to the highest final energy consumption. The development in a final energy consumption shows a positive trend characterized by a decrease in this sector of total energy consumption (in 1995, this share was 56 %, in 1999 it was 42 %, while in 2000 the share again increased to 53 %).

The following branches in the industrial sector contribute to fuel and energy consumption: metallurgy and energy industry 32 %, chemical and pharmaceutical industry 11 %, wood processing 4 %, machinery 3 %, textile 2 %, electro technical, glass processing, leather and shoemaking industries 1 %.

2.8 Transportation

The transport network of the Slovak Republic currently is characterized by a poorly developed infrastructure, mainly in the areas of road and rail (7). The air transport infrastructure has a poor level of security facilities at airports. Goods transportation in the last 10 years recorded falls in all types of transport due to the effect of a decrease in the production branches of industry, mainly in construction.

In 2003, the transport network included 17 772 km of roads and motorways. Motorways represented 313 km of the network. The length of railways was 3 657 km, with 1 558 km of electrified lines. The length of navigable watercourses remained unchanged at 172 km, with channel length of 38.45 km.

Road transport is typical for the food industry, production of machinery and electronic equipment, as well as for production requiring supply logistics in just-in-time operations. Rail transport services are mainly focused on the transport of bulk goods (mineral resources, substrates, agricultural commodities, etc.). These industries have recorded a decline in production (e.g. a 9 % decline in mining of mineral resources in 2002 alone) and a resultant decline in the transport of these types of goods. By contrast, the development of small and medium-sized enterprises resulted in higher road transport.

Water transport is operated on the navigable rivers Danube, Vah, Morava and Bodrog, with a total length of 256 km.

The share of air transport is very small and is too small (and it is not included in the table 2.9).

Table 2.9 Transport of goods (thousand of tons)

Parameter	1993	1998	2000	2001	2002	2003
Road	37 826	29 889	39 680	34 773	33 035	30 682
Rail	64 85	56 569	54 177	53 588	49 863	50 520
Water	1 399	1 172	1 607	1 551	1 365	1 239
Aviation	5.9	0.6	0.7	0.7	0.5	0.8

Source: (2)

Passenger transport in the years 1990 - 2003, did not see the substantial fall in the number of persons transported (in persons) nor in transport capacity (in person km) as in freight transport. Changes have been occurring in the division of transportation to the detriment of forms of public transport. A recovery has occurred in air transport and permanent growth is occurring in individual automobile transport (table 2.10).

Table 2.10 Transport of passengers (thousand of passengers)

Parameter	1990	1995	2000	2003
Road	937 528	722 510	604 249	493 706
Rail	119 262	89 471	66 806	51 274
Public transport	574 405	515 593	404 539	394 465
Water	383	138	80	214
Aviation	129	118	159	387

Source: (2)

In the past 10 years, the number of automobiles increased by 17 %. This increase was recorded mainly in the individual automobile sector. Compared to 1990 the intensity of transport in 2003 has increased by 160 % for motorways, by 139 % for class I roads, by 123 % for class II roads and by 7 % for class III roads.

The increase in number of cars resulted in an increase of automobile gasoline consumption. However, the relationship between the consumption of gasoline and generation of GHG emissions is not linear; it is connected to better technical parameters of new cars. The declared intention to shift transport means from individual towards public transport fails; contrary, the share of the most environmentally unfriendly transport means (individual cars) is gradually increasing. From 2000, the development of alternative fuels is positive, mainly due to an increase of number of vehicles in public transportation using liquid natural gas and LPG. Data on number of vehicles and fuel consumption in road transportation are shown in table 2.11.

2.9 Agriculture and forestry

At the end of 2003, soil represented 4 903 389 ha. Agricultural soil covers 2 436 878 ha (49.7 %), forestry soil 2 004 100 ha (40.9 %) and other non-agricultural and non-forestry soils represent 462 410 ha (9.4 %).

Agriculture production shows a long lasting decrease in the share of GDP and employment (8). Share of GDP (in constant prices) was 4.55 % in 2003 (9). Over the last 10 years, only a slight decrease in acreage of utilized agriculture soil was recorded. The percentage of tilled areas reached 6.17 % in 2003 (table 2.12).

Table 2.11 Number of motor vehicles and fuel consumption in road transport

No. of vehicles	1990	1994	1998	2000	2001	2002	2003
Person cars	875 550	994 046	1 196 109	1 292 843	1 292 843	1 326 891	1 356 185
Vans, trucks	91 994	102 470	111 081	120 399	120 399	130 334	142 140
Special	53 537	45 484	43 690	39 188	36 082	34 150	32 033
Buses	14 301	12 066	11 293	10 920	10 649	10 589	10 568
Tractors	67 056	64 729	63 448	64 351	63 422	62 644	61 690
Motorcycle	371 593	320 355	272 056	246 916	253 303	261 067	267 226
Fuel consumption (t)							
Gasoline	437 460	534 320	670 102	602 000	701 760	743 242	662 876
Diesel	1 058 600	698 080	780 148	825 000	726 375	899 428	843 626
LPG	-	780	510	14 800	21 787	28 501	30 483

Note: In the category "motorcycles" numbers include small motorcycles below 50 cm^3 without registration label which are not in records of the Policy of the Slovak republic

Source: Analytical documents in the area of the environment in the transportation sector, VUD Žilina, 2000, www.statistics.sk

Table 2.12 Gross agricultural production in prices of 1995 (mil. Sk)

Parameters	1997	1998	1999	2000	2001	2002	2003*
GAP	62 052	57 884	51 412	45 068	48 578	58 297	56 274
of which:							
Gross vegetable production	27 117	28 479	24 389	17 793	20 929	26 831	23 609
Gross animal production	34 935	29 405	27 023	27 275	27 649	32 096	32 665

Source: VUEPP Bratislava; *estimate

The structure of vegetable production was changed. On arable soil, the share of cereals, oil plants and vegetable increased, while on areas of annual and multi-year forage, potatoes, corn and leguminous plants were reduced. In the total structure of agricultural soil, the areas of permanent grass cover have increased and the share of hop-gardens, vineyards and orchards has decreased.

In animal production, the problems persist with the nutrition, fodder techniques and care of animals that result in ineffective production. A long lasting decrease in the number of cattle is accompanied with changes in breed structure. This brings a higher share of milk production with a lower number of milk cows. In addition, technological changes in stabling are applied. Production of pigs is stagnant, however, and does not cover domestic consumption. Poultry has experienced a positive growth trend.

The share of total GDP generated by the forestry management is decreasing and is below 1 % (1990-0.97 %, 2001-0.54 %). Value added of the forest functions is 2-3 times higher than production value; however, the environmental value is not captured in the GDP figures. The wood processing industry contributed by 8 % to the GDP. Investments in forest management vary from 0.36 % to 0.19 % on the total investments in Slovakia. Investment rate dropped from 20.48 % in 1990 to 11.63 % in 2001.

Selected parameters of agricultural and forestry industries are shown in table 2.13.

2.10 Waste management

Assessment of waste generation and handling pursuant to the new Waste catalogue was conducted for the first time in 2002 (the Act 223/2001 on Waste and implementing Regulation 284/2001 on the Waste Catalogue).

This legislation transposed the European Waste Catalogue and has brought about the following two fundamentals changes:

- Unlike the original three waste categories: O - other, Z - special, N - hazardous there two waste categories have been introduced: O - other waste and N - hazardous waste,
- The waste classification approach was changed to accommodate the possibility of classifying the same waste under more waste types through an approach found in Annex 5 of the pertinent Regulation.

In addition, new reporting and coding of waste processing were introduced; the categories R1- R13 for the recovery of waste and D1 - D15 for the disposal of waste. This new reporting method refined differentiation of waste disposal.

In comparison with 2001 (old Waste Catalogue), the records on total amount of waste generated is at the level of 83 %. In 2003, the overall quantity of 17.4 million tons of waste produced in the Slovak Republic was recovered (about 62.3 %). The most common methods of recovery are applied in agriculture and metallurgy.

Table 2.13 Selected parameters of agricultural and forestry development

Parameter	1990	1995	1998	2000	2001	2002	2003
Animal production (thousand pieces)							
Cattle	1 563	929	705	646	625	607	593
Pigs	2 521	2 076	1 593	1 488	1 517	1 554	1 443
Sheep	600	428	326	348	316	316	325
Poultry	16 478	13 382	13 117	13 580	15 590	13 959	14 217
Vegetable production (thousand ha)							
Agricultural soil	2 448	2 446	2 444	2 440	2 439	2 438	2 437
of which							
- arable soil	1 509	1 479	1 491	1 450	1 441	1 433	1 430
- hop gardens	2	1.3	1.0	0.8	0.6	0.6	0.5
- Vineyards	31	29	28	27	27	27	27
- Gardens	78	78	78	77	77	77	77
- Orchards	20	19	19	19	18	18	18
- TTP	808	839	848	865	874	882	883
Forestry							
Forestry soil (ths. ha)	NA	1 992	1 998	2 001	2 002	2 003	2 004
Logging (ths. m^3b.k)	5 277	3 965	5 532	6 179	6 184	6 248	6 652
Forestation (ha)	17 399	9 339	11 842	11 278	12 420	11 002	9 812

TTP - permanent grass cover; NA = Not Applicable

The overall trend in waste management is towards an increase of material and energy recovery and a decrease in the disposal by incineration and land filling. This is in compliance with the national Waste Management Strategy (9) that supports the separation of selected types of waste. At the end of 2001, the Recycling Fund was established that aims to support waste recycling projects. It collects obligatory payments from importers and producers and finances projects that deal with collection, recovery and processing of selected types of waste.

In 2003, the amount of disposed waste from all generated waste was approximately 27 %. Land filling predominates with a share of 24.1 %. Additional methods of waste disposal are physical - chemical treatment (5.5 %), biological treatment (5.2 %), and incineration (2.6 %).

In 2003, 47 incineration facilities were operating, of which 19 were incinerators for industrial waste, 23 incinerators for hospital waste and 3 incinerators for combined incineration. Many of these facilities are being prepared for reconstruction and in some cases the operation will be phased out.

In 2003, an average of 297 kg/year of waste was generated by each inhabitant. Final disposal of municipal waste is still much greater than waste recovery (249.5 kg/year disposed, 33.9 kg/year recovered). In other words, only 12 % of municipal waste is recovered and 88 % is disposed, mainly by land filling (table 2.14).

Table 2.14 Municipal waste in 2002, 2003 (tons)

Parameter	2002	2003
Municipal waste total	1 524 404	1 599 377
of which		
- separated components	46 138	54 129
- waste from gardens, parks	79 651	76 953
- other municipal waste	1 323 325	1 380 159
- small construction waste	75 291	88 136

Source: (11)

The highest portion of inhabitants involved in waste separation is located in Trencin, Zilina, Banska Bystrica, and Trnava regions. The amount of separated components of municipal waste is 6.9 kg/year/capita.

2.11 Housing sector - households and public buildings

The household sector contributed to total energy consumption by 28 % in 2002. More than 70 % of total energy consumption is used for heating; approximately 20 % to heating of water, and the rest about 10 % is for other activities such as lighting, cooking and use of electrical devises (11). Main energy source in households is burning of fossil fuels (tables 2.15 and 2.16).

Table 2.15 Type of heating in households (%), 2001

Collective central heating	41.5
Individual central heating	40.9
Independent heating devices	9.7*
Other	7.9

* tile stoves; Source: Survey to the meeting of the EU expert group "Strategies in favor of the reduction of CO_2 emissions in the housing sector", Luxemburg, June 2005

Existing houses are in bad technical condition, characterized by a high loss of energy and ineffective use. Coefficient of energy consumption presents 50 - 100 kWh/m^2.year in new houses and 70 - 130 kWh/m^2.year in the case of older houses, respectively.

Table 2.16 Basic energy sources used for heating (%), 2001

Electricity(from non-renewable sources)	4.0
Coal	18.0*
Gas	66.6
Heat oil	0.6
Wood	NA
Renewable energy sources	NA
Other	10.8

*Solid fuels total; Source: Survey to the meeting of the EU expert group "Strategies in favor of the reduction of CO_2 emissions in the housing sector", Luxemburg, June 2005

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3. Greenhouse gas emission inventory

The GHGs emission inventories in the Slovak Republic are annually developed according to the requirements of the UN FCCC and the Kyoto Protocol. These are developed according to the methods (Guidelines for National GHG Inventory 1996, Good Practice Guidance 2000 a Good Practice Guidance for LULUCF 2003) recommended by the IPCC. The chapter presents the results of the GHG emission inventory within the period 1900 - 2003 as determined by April 15, 2005. Aggregated anthropogenic emission of all GHG dropped by 30 % in comparison of the reference year 1990. This indicates that achieving the Kyoto Protocol 2008 - 2012 is feasible, however in order to reach sustainability, additional strategies and measures should be endorsed.

3.1 Introduction

The most important greenhouse gas (GHG) in the atmosphere is a water vapor (H_2O) that contributes by two third to the total greenhouse effect. Its concentration in the atmosphere is not directly affected by human activities. In general, it is determined by a natural water cycle or deference between evaporation and precipitation. Carbon dioxide (CO_2) contributes to the greenhouse effect by more than 30 %, methane (CH_4), nitrous oxide (N_2O), and ozone (O_3) totally by 3 %. Group of synthetic substances HFCs (partially fluorinated hydrocarbons), PFCs (perflourocarbons) and SF_6 are other greenhouse gases that are released into the atmosphere exclusively by human activities. Photochemical active gases such as carbon monoxide (CO), nitrogen oxides (NO_X) and non-methane volatile organic hydrocarbons (NMVOC) are not greenhouse gases, but they contribute indirectly to the greenhouse effect in the atmosphere. They are generally referred to as ozone precursors because they affect the creation and destruction of ozone in the troposphere.

Aerosols belong to the second most important human impact on the climate change. These together with other pollutants in the atmosphere (SO_2) contribute to the greenhouse effect.

The Kyoto Protocol defines the obligation to record and monitor six greenhouse gases CO_2, CH_4, N_2O and F-gases (these include HFCs, PFCs a SF_6) according to the IPCC method (1). Growth of GHG concentrations (incurred by anthropogenic activities) causes a magnification of greenhouse effect and warming of the atmosphere. Current climate models estimate a global warming in average of 1.4 - 5.8 °C in the period of 1990 - 2100.

The Chapter 3 presents national emissions of CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NO_X, CO, NMVOC, SO_2 and its aggregated equivalents from 1990 - 2003 as determined by April 15, 2005 (the 2003 Emission Inventory was published in 2005).

All emissions are represented in the units of molecular weight (e.g. Gg CO_2, not Gg C). Values of global warming potential (GWP100) are used according to the IPCC recommendations (1) (Climate Change 1995, The Science of Climate Change CO_2=1, CH_4=21, N_2O=310, F-gases =140-23 900).

The GHG emissions presented in the Third National Communication (3) were updated and converted using the newest available methods, national conditions and data published by the Slovak Statistical Office. Total GHG emission represented 46 758.8 Gg in 2003 (without sinks from land and forestry use (LULUCF)). This represents a reduction by 33 % in comparison with the reference year 1990. In comparison with 2002, the emissions increased by 1.5 %. Total GHG emissions in Slovakia are stable or slightly increasing (in 2003) due to recovery of economic activities, increase in transport, and expected increase in actual emissions of F-gases (mainly HFCs and SF_6). Total GHG emissions including sinks from LULUCF sector are peaked and exceeded 1998. Significant changes are expected in the next year (2004 inventory) as the EU legislation came into effect in Slovakia. Also, revisions of the NEIS database and changes in balance methodology in sector Agriculture and LULUCF were applied (4) (table 3.1).

Table 3.1 Aggregate (2) anthropogenic GHG emissions (Tg) in Slovakia in 1990 - 2003

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Gas	CO_2 eqvivalent [Tg]													
Net CO_2	57.0	48.6	44.3	41.2	39.2	41.2	42.0	43.3	41.7	41,0	37.7	37.3	37.0	37.9
CO_2*	59.4	52.1	48.4	45.4	42.4	43.8	44.4	44.7	43.6	42.6	40.1	42.6	42.3	42.8
CH_4	6.3	5.9	5.5	5.1	5.0	5.2	5.2	5.0	4.7	4.6	4.6	4.5	4.7	4.7
N_2O	6.0	5.2	4.4	3.9	4.1	4.2	4.2	4.3	4.0	3.8	3.8	4.0	3.9	3.9
HFCs, PFCs, SF_6	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total (with net CO_2)	**69.7**	**60.0**	**54.4**	**50.3**	**48.4**	**50.7**	**51.5**	**52.6**	**50.5**	**49.5**	**46.2**	**46.0**	**45.6**	**46.8**
Total*	**72.1**	**63.5**	**58.6**	**54.6**	**51.7**	**53.4**	**54.0**	**54.0**	**52.4**	**51.2**	**48.6**	**51.3**	**50.9**	**51.6**

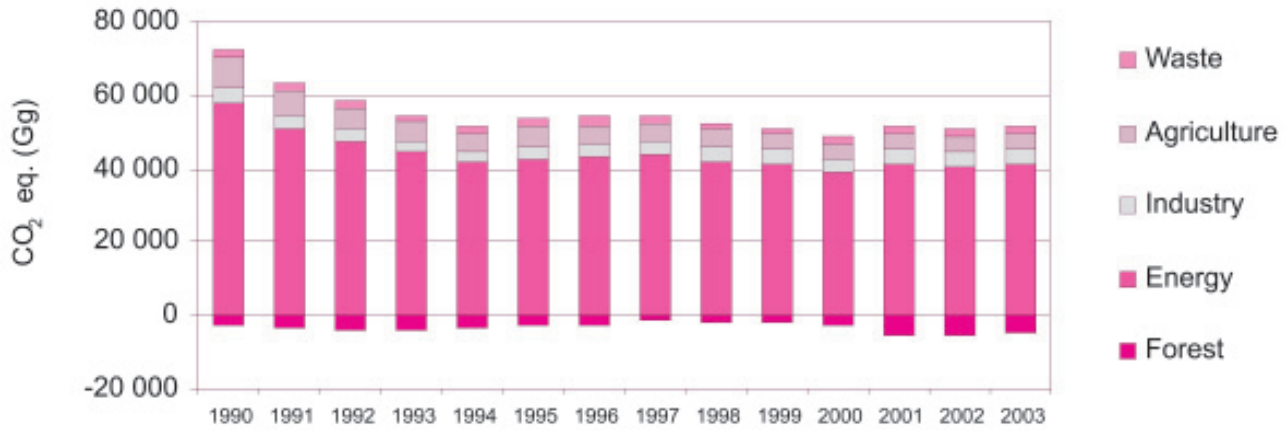
Emissions determined by April 15, 2005

* CO_2 emissions without sinks in LULUCF sector (Land use-Land use change and forestry)

3.2 CO_2 emissions

The most important anthropogenic source of CO_2 is combustion and transformation of fossil fuels that represent more than 95 % of total emissions of CO_2 in Slovakia. CO_2 also occurs in technological processes such as production of cement, lime, and magnesite, and use of limestone. The balance includes also the production of coke, iron, and steel. CO_2 emissions also occur at the aluminium and ammonium productions. Emission factors, determined based upon the content of carbon in fuels were used to calculate the CO_2 emissions. CO_2 is emitted also in the process of conversion of grassland and forest areas into agricultural soil, during forest fire and solid waste incineration (figure 3.1).

Figure 3.1 Share of individual sectors on CO_2 emissions (Gg) in period 1990-2003



Emissions determined as April 15, 2005

Total net CO_2 emissions increased in 2003 by more than 1 % compared with the previous year, totally decreased by more than 33 % compared with the reference year 1990. The most important changes occurred in the Energy sector; a significant increase by 1 000 Gg of CO_2 emissions compared to 2002 was caused by stationary sources. Among the most important reasons appears the recovery of the Slovak economy, followed by new sources of pollution, and a shift to solid fuels due to the increased prices of natural gas. Similarly, increased trend in CO_2 emissions is also at the transport sector. It is anticipated a gradual increase of CO_2 emissions in this sector.

Determination of CO_2 emissions released from fossil fuel combustion of stationary sources is described by two IPCC methods (1). Basis for the determination of emissions from stationary sources by the method of the reference approach (top-down) is information published by the Slovak Statistical Office. The Office collects data on energy balance, including import, export and consumption of fossil primary and secondary fuels, and biomass. This information is expressed in energetic (TJ) and weight (Gg) units. Conversions factors (TJ/Gg) are annually calculated from statistical data and might annually varied. The emission factors (t C/TJ) are determined for individual types of fuels based on international methods (IPCC (1), OECD, IAEA) and national measurements. Based upon the Decision of the EC 2004/156/EC, the values of share of oxidized carbon in energy balance changed in 2003 and are 0.995 for liquid and 0.99 for solid fuels. Slovakia uses the reference approach of determination of CO_2 emissions from stationary sources as the basis of total national emissions from 1990, due to the fact that the consistent data in period of 1990 - 2000 are only by application of the top down approach. The sector approach or so-called bottom-up determination of CO_2 emission from stationary pollution sources is based on database of the National Emission Inventory System (NEIS) that replaced the system REZZO and is used from 2000. These two systems provide for compatible data only at national level. The reference and sector approaches are based on two independent files of data and deviation is annually up to 2 %. Differences are caused by the use of average NCV (net calorific values) in top-down approach (applied by the Slovak Statistical Office) and specific NCV applied in the sector approach that are reported by operators of stationary source.

The Slovak Republic anticipates in-depth revisions of sector and reference approaches in the determination of CO_2 emissions from stationary sources for inventories of 1990 - 2004. The revision will be based on assessment of bottom-up approach used from 1990, in order to ensure consistency of determination of emissions. This is in line with the requirement of the UN FCCC Secretariat regarding the national GHG emission assessment based on the sectoral approach.

Significant source of CO_2 emissions are mobile sources, as well. These are road, aviation, rail and water transports where emissions annually increase. Determination of emissions from road transport sector is based on method COPERT III (5). Emissions from non-road transport are determined based upon the consumption of fuels and application of official emission factors.

CO_2 emissions of industrial processes occur in production of cement, lime and products from magnesite. Similarly, emissions are from glass, coke and aluminium production. However, these emissions are included in Energy sector as they come from combustion of fossil fuels. Contribution of Industrial Processes sector seems to be much lower compared to energy sector. The reason is that only technological and chemical processes are taken into account.

The territory of the Slovak Republic is 49 036 km^2 of which, 41 % are forest areas. At the beginning of the century, a part of agricultural soil is gradually transferred into forest soil. In the period of 1950 - 2003, amount of carbon fixed in the forest increased by more than 50 Tg. This is a result of increase in forestation and increase of hectare storage of wood mass. Carbon fixation in forest ecosystems is determined based upon the balance of carbon in the part of forest above ground (trees, plant, cover, overlying humus) and below ground (roots, humus in soil) including the estimate of logging and forest fires. In the next year, it is anticipated to change balancing of LULUCF sector emissions and the sinks will be revised from 1990.

3.3 CH_4 emissions

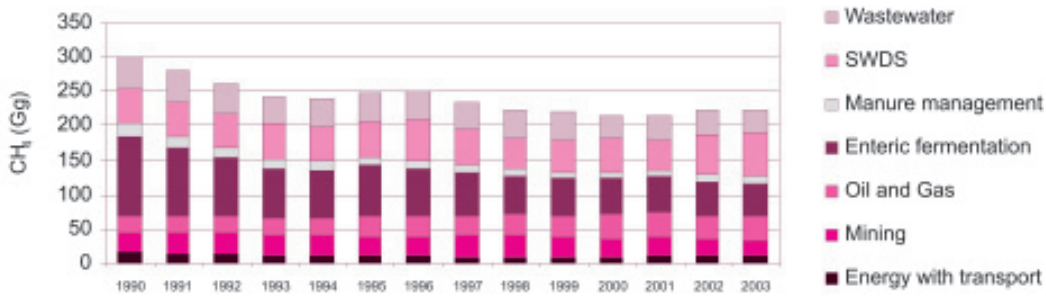
The most significant source of methane in Slovakia is agriculture, cattle farms and pig breeding. Methane is a direct product of metabolism of herbivorous animals and as a product of organic degradation of animal excrements. The calculations of emissions are based on annual data of the Slovak Statistical Office and the Green Report of the Ministry of Agriculture (6). The default IPCC emission factors were modified based upon specific national conditions with respect of an increased efficiency of breeding. A decreasing trend in number of cattle has started since 1993 and has resulted in the decrease of methane emissions. After 2001, this trend is not considerable.

Significant sources of methane are fugitive emissions from mining and processing of brown coal and lignite production (underground mines). The amount of methane released from these processes is estimated based upon the extracted volume of coal using the official emission factors of the IEA (7). The fugitive emissions of natural gas in low pressure distribution networks belong to key sources of methane. Basic data on mining, transport, transit, consumption and balance of natural gas are provided by SPP, joint-stock company (Slovak Gas Industry Company). Fugitive emissions of methane were revised in 2003 using the newest knowledge on emission factors and national conditions.

Methane emissions occurring by fossil fuel combustion are calculated on the basis of fuel consumption records. These are annually published by Energy Yearbook by the IPCC method Tier 1 (1) and application of default emission factors. Significant share of methane emissions also comes from small sources, and biomass combustion, respectively. These emissions are not substantial in Slovakia. Annual increase of emissions is obvious from mobile sources that are determined by the method COPERT III (5).

Additional important sources of methane are emissions from solid waste landfills and wastewater treatment (septic and holding tanks). Methane occurs of anaerobic conditions. Methane emissions are determined by the IPCC method (1) based upon the amount of solid waste disposed at the landfill, share of biologically degradable waste and share of methane in landfill gas. Besides municipal waste, the waste from industry (paper, textile, food, wood processing) and agriculture is taken into account (Figure 3.2).

Figure 3.2 Share of individual sectors on CH_4 emissions (Gg) in period of 1990-2003



Emissions determined as April 15, 2005

Total methane emissions reached in 2003 an increase compared to the previous year by 1 %. However, emissions decreased by 26 % compared to the reference year 1990. The most important changes were recorded in the sector of fugitive emissions from mining of brown coal, mining and transport of oil and natural gas. The revision of emission factors and selection of appropriate parameters were carried out. The revision dealt with the data from 1990. The most significant increase in methane emissions was in the case of landfill waste. This was caused by a higher percentage of landfilling mainly by waste of industrial character. This trend is anticipated in the future as well (4).

3.4 N_2O emissions

The mechanism of emissions and removals of N_2O is not clearly described. Values obtained are biased by a high degree of uncertainty. The main cause of direct and indirect N_2O emissions is surplus of mineral nitrogen in the soil (intensive fertilization) and unfavorable aerial regime in soils (use of heavy machinery). Emissions in the Energy sector and transport were determined on the basis of total fossil fuel consumption by application of default emission factors according to the IPPC (1). Wastewater treatment plants are also the source of N_2O emissions.

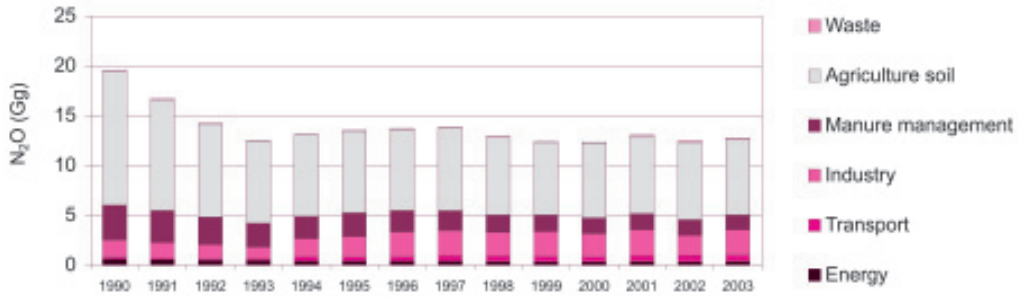
Emissions from Energy sector were determined based upon the total consumption of fossil fuels (energy balance of the Slovak Statistical Office), the application of default emission factors (IPPC method), and national conditions. Emissions from mobile sources were determined by the method COPERT III (5).

Production of nitric acid in the sector of Industrial Processes consumes about 20 % of all ammonium produced. Based upon this observation, the analysis of the Slovak producers of nitric acid was carried out. Following this, emission factors for N_2O and NO_x were adjusted. Changes occurred mainly after 1996 - the introduction of the operation of the catalytic reduction of nitrous gases.

In sector of Agriculture, direct emissions were assessed from management at arable lands, emissions from handling with animal waste. Indirect N_2O emissions from agricultural soil were determined taking into account different soil types (vegetation and application of organic manure). Consumption of synthetic fertilizers decreased in the last decade from 222.3 Gg in year 1990 to 81.3 Gg in year 2003 (a forecast is 80 Gg in year 2005). In 2003, synthetic fertilizers were used on 60.7 % of arable soils and 62.5 % of soils with cereals (8).

N_2O emissions from wastewater treatment were determined by the methods of IPCC (1) and ISI (9). The IPCC method takes into account the population and a daily consumption of proteins per capita. The independent method ISI takes into account the amount of wastewater treated at the treatment plant with application of denitrification. The later method better reflects actual emissions (Figure 3.3).

Figure 3.3 Share of individual sectors on N_2O emissions (Gg) in the period 1990-2003



Emissions determined as April 15, 2005

In 2003, the total N_2O emissions slightly increased compared with the year 2002. However, the drop compared to the reference year 1990 is almost 35 %. The most substantial increase was recorded in transport sector and Industrial Processes sector (chemical industry). The later regards to increase in chemical production (nitric acid). After the surprising increase of N_2O in 2002 in wastewater, in 2003, a slight decrease is recorded. This relates to the amount of industrial wastewater treatment (4).

3.5 Emissions of HFCs, PFCs a SF_6

Whereas concentrations of chlorinated hydroflourocarbons (CFCs) covered by the Montreal Protocol has been stabilized, the level of "long-lived" gases such as PFCs, HFCs and SF_6 is being increased. These gases are used as carrier gases in sprays, cooling and extinguishing agents, insulation, and solvents. Besides they attack the stratospheric ozone, these gases are inert greenhouse gases with a high negative impact on the environment.

The IPCC method (1) is used to assess sources and emissions of fluorinated gases. The real and potential emissions in the period of 1995 - 2003 are determined. In Slovakia, these gases are not produced. Source of emissions are the gases, which are used as coolants, slacks, puffers, in solvent products, SF_6 as insulating gas in transformers and metallurgy industry. CF_4 and C_2F_6 occur by aluminium production. From 1995, the use of HFCs, PFCs a SF_6 has increased and it is anticipated the increasing trend in the future.

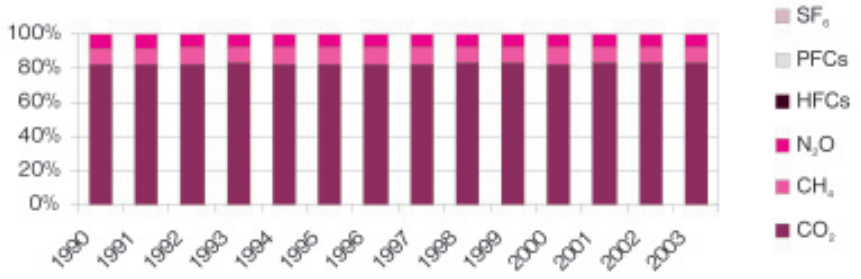
In 2003, total F-gases emissions considerable increased. This trend was expected due to a special feature of the emissions. They have a long lifespan and both actual and potential emissions are taken into account. Compared with 2002, the emissions increased by 24 %. However, compared to the reference year 1990, the decease is more than 37 %. The most significant increase of emissions was recorded in the case of HFCs that substituted use of the PFCs. Emissions of CF_4 a C_2F_6 together with emissions of SF_6 are released in the production of aluminium. Their concentrations increased due to an increased production capacity (4).

3.6 Aggregated emissions of greenhouse gases

In 2003, the aggregated emissions compared to 2002 slightly increase by 1.5 % representing more than 700 Gg (without sinks from LULUCF). However, compared with the reference year 1990, the emissions of greenhouse gases showed a significant decrease by 20 465 Gg, or 28 % respectively (without removals from LULUCF). The Energy sector has the most significant impact on the GHG emissions, representing almost 80 % share in 2003. Other sectors (Industrial Processes, Agriculture) contribute together by 8 % each on the total emissions. Waste sector contributes by 4 %. These shares are determined as emissions in CO_2 of aggregated equivalents (4).

The GHG emissions reached the highest level at the end of 80-ies. In the period of 1990 - 1994 the reduction was about 25 %. From 1994, the emissions have been stable. In 2000, a significant decrease was recorded. In recent years, emissions increased, mainly emissions of CO_2, due to recovery of the industrial production, transport and changes in fuels used (Figure 3.4).

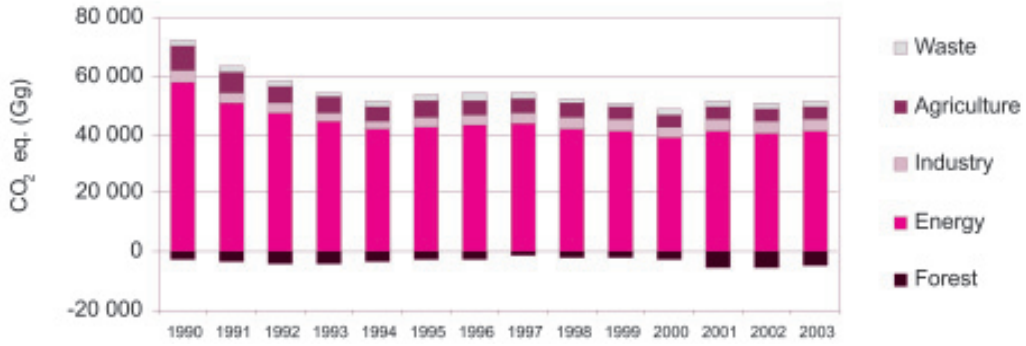
Figure 3.4 Share of individual gases on aggregated emissions (%) in 1990-2003



Emissions determined as April 15, 2005

The share of the Slovak Republic on the global anthropogenic emissions of GHG is about 0.2 %. Annual emission of CO_2 per capita is about 7.7 t/year that classifies Slovakia as the countries with the highest emissions in Europe (Figure 3.5).

Figure 3.5 Share of individual sectors on aggregated emissions (CO_2 *eq.* Gg) in period of 1990-2003



Emissions determined as April 15, 2005

3.7 Emissions of basic air pollutants

Table 3.2 shows emissions of NO_x, CO, NMVOC and SO_2 from 1990. Emissions of NO_x, CO and SO_2 were adopted from the National Emission Inventory System (NEIS). The categories of sources are determined based upon the national air protection legislation and do not correspond with the structure used by the CRF. Therefore, it is not possible to provide information on emissions and emission factors as requested. The main source of SO_2, NO_x and CO is production of electricity and heat. Transport contributes to increased NO_x and CO emissions. Metallurgy industry is a significant source of CO emissions.

NMVOC emissions have been regularly determined in the framework of the National Reduction Program of the NMVOC. The year 1990 was used as a reference year; an update was carried out for 1990, 1993, 1996-1998 and 2002-2003. The major sources of emissions come from the use of solvents, transport, refinery, oil storage, and transport of gasoline and crude oil.

3.8 Principles of good practice and uncertainty management

3.8.1 Description of key sources

In order to reduce uncertainty of emission inventory, it is necessary to determine and classify key sources and categories. The key sources were selected according to a cumulative contribution to the total emissions. They represent more than 95 % of total GHG emissions. Key sources and categories were determined according to the IPCC (1) method. In 2003, the Slovak Republic determined 14 key sources to be assessed according to the level and 16 key sources to be assessed according to anticipated trends. The most important key categories are combustion of fossil fuels, road transport, and agricultural emissions, waste disposal, enteric fermentation, production of nitric acid, cement, iron and steel productions. Composition of key sources has not been changed.

Table 3.2 Anthropogenic emissions of NO_x, CO, NMVOC a SO_2 (Gg) in 1990-2003

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO	**505**	**482**	**441**	**452**	**427**	**416**	**359**	**359**	**342**	**330**	**307**	**309**	**306**	**302**
Stationary	345	335	296	297	268	255	204	201	183	180	179	169	159	178
Transport	154	142	141	151	155	157	151	153	154	145	122	134	141	118
Other*	6	5	4	4	4	4	4	5	5	5	6	6	6	6
NO_x	**222**	**201**	**188**	**180**	**170**	**178**	**135**	**127**	**133**	**121**	**109**	**108**	**105**	**98**
Stationary	165	154	144	138	126	133	90	82	87	78	71	67	60	59
Transport	57	47	44	42	44	45	45	45	46	43	38	41	45	39
Other*	0.35	0.28	0.23	0.24	0.2	0.23	0.25	0.27	0.26	0.3	0.33	0.33	0.33	0.36
NM VOC	**138**	**NE**	**NE**	**113**	**NE**	**107**	**105**	**95**	**92**	**85**	**80**	**83**	**82**	**82**
Energy	13	NE	NE	12	NE	10	10	8	9	8	8	9	8	8
Industry	11	NE	NE	8	NE	5	5	5	3	3	3	3	3	3
Oil	26	NE	NE	20	NE	17	17	17	15	13	13	12	12	12
Solvents	48	NE	NE	38	NE	41	40	32	32	29	30	31	31	32
Transport	35	NE	NE	31	NE	33	32	32	32	29	25	27	27	26
Other**	5	NE	NE	2	NE	1	1	1	1	1	1	1	1	1
SO_2	**526**	**445**	**390**	**328**	**245**	**246**	**231**	**205**	**184**	**173**	**127**	**131**	**103**	**106**
Stationary	523	442	388	326	243	244	228	202	181	172	126	130	102	105
Transport	3	3	2	2	2	2	3	3	3	1	1	1	1	1

* Combustion of biomass and forest fires
** Waste and agriculture
NE Not Estimated; Emissions determined as April 15, 2005

3.8.2 General analysis of uncertainty

The GHG emission inventory should be assessed based upon its complexity due to uncertainty. These are caused and influenced by uncertainties of statistical data on fuel consumption. The applied emissions factors are another source of uncertainty. An additional error in calculation of the other GHG emissions may occur as a result of less exact methods and it can not be quantified. In spite of this, the uncertainty analysis determined by the Tier 1 method of the IPCC (1) estimated that the GHG emission inventory of 2003 is 9.99 % (according level assessment) and 3.15 % (according trend assessment).

3.8.3 Process of QA/QC

The Slovak Hydrometeorological Institute, the Department of Air Quality collects the emission balances developed by external experts. These data are controlled and re-calculated. The activity data of major polluters are compared with the national statistical data, compared with previous emission inventories and/or are consulted with the operators. Energy balances are compared based upon the fuel consumption according to pollution sources. The fuel consumption in transport sector is compared with the results of the COPERT III models (5). The emission inventories are annually reviewed by experts from the Czech Republic. The Slovak Republic gradually introduces the National Inventory System in the framework of the Kyoto Protocol.

3.8.4 Completeness

The Slovak Republic annually reports on the emissions and sinks of GHG from all relevant sectors, sub-sectors and categories from 1990. From 2000, the reports are developed according the CRF. The national inventory team devotes a high effort to maintain consistency of emission and activity data; however in some categories (waste incineration, off-road mobile devices) there is still a lack of entry data on emission sources.

3.9 Conclusion

The balance tables in the CRF and the National Inventory Report (NIR) are an integral part of the annual GHG emission inventory. Since 2000, the tables and report have been developed (4). They include all available information with respect to six GHG in seven IPCC (1) sectors. In order to ensure consistency of the method for determination of the emissions, the timelines starting with the reference year 1990 are periodically recalculated.

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4. Policy and measures to mitigate greenhouse gas emissions

Climate change issue has become a priority of the Slovak Government. It is reflected in all conceptual documents of affected sectors and strategic objectives. In the Program Declaration the Slovak Government "...has pledged to apply the principles of sustainable development through a developing policy emphasizing balanced economic, social and environmental dimensions. The Slovak Government feels the shared responsibility with EU countries in dealing with global problems of air protection, ozone layer protection and climate change and it will support an increased share of renewable energy resources and control of technologies. The government will participate in the emission trade together with developed countries in order to achieve the commitments under the Kyoto Protocol on the reduction of greenhouse gas emissions...".

4.1 Overview of environmental protection strategies

Overview of strategy documents, programs, and action plans that define direct or indirect instruments to meet commitments to mitigate negative impacts of climate change and reduction of GHG emissions are summarized in this chapter.

Strategy, principles and priorities of the state environmental policy

The document titled the Strategy, Principles and Priorities of the State Environmental Policy (1) was approved by the Government Resolution 619/1993. The Strategy was developed in the consultative process. It determines priorities and formulate the long-term, medium-term and short-term strategies for the implementation. The short-term strategy explicitly comprised the development of a national program to mitigate GHG emissions that should be implemented in 2000 - 2010. The measures to achieve the objectives of the Strategy in all ten sectors were included in the first National Environmental Action Plan (NEAP). The NEAP was adopted by the Government Resolution 350/1996. The NEAP was followed by the 9 regional (KEAP) and 79 district (OEAP) environmental action programs.

National Environmental Action Plan II

The NEAP II (2) was based upon the results of the international process from Rio de Janeiro (UN Conference on the Environment and Development). It is the second comprehensive program document adopted by the Government Resolution 350/1006. The NEAP II assesses achievement of short and medium term objectives and intends to formulate feasible measures in changing economic and social conditions of the state development.

National Strategy for Sustainable Development

In 1999 - 2000, the Slovak Government adopted several important cross cutting documents, which rose from the principles of the National Strategy for Sustainable Development. The most important was the Concept of decentralization of public administration (2000). Several other cross cutting documents deals with regional development. These include the Integrated Plan of regional and social development to implement PHARE 2000 program (1999), Rural Development Plan to implement the SAPARD Program (1999), and National Plan of Regional Development (2001).

Strategy to achieve commitments under the Kyoto Protocol

The Strategy to the Kyoto Protocol (3) is the comprehensive strategy document that was adopted in 2002. It defines objectives in three periods:

Short-term (up 2002):
- to ratify the Kyoto Protocol by 2002.

Medium-term (2003 - 2007):
- to reach development of GHG emissions by 2005 that will clearly allow to achieve the Kyoto Protocol commitments,
- to complete the National Inventory System (NIS) in compliance with the requirements of the Art. 5 KP, Decision 20/CP.7, and Decision 296/1999/EC to the end of 2005.

Long-term (2008 - 2020):
- to reduce GHG emissions in 2008 - 2012 (by 8 % compared to reference year 1990. Aggregate emissions may not exceed 333.6 mil. tons in five year period,
- to establish positive conditions to reduce further 5 % of the GHG emissions in the second target period (Art.3 (13) of the KP),
- to achieve control over GHG emissions development in order to gradually stabilize the GHG emission after 2015. The strategy to achieve reduction of GHG emissions should be developed.

The document defines the strategy to meet the reduction goals (for sectors of production and consumption of energy, transportation, agriculture, forest and water management, waste management, sector of education and public awareness). It also identifies priority areas to strengthen capacities to meet the objectives of the UNFCCC and KP. Proposals to adaptation measures were not subject of the document due to specific character. The short-term objective to ratify the KP was achieved on May 31, 2002. Currently, the completion of the NIS is the priority tasks under the responsibility of the Ministry of Environment and the SHMU.

Proposal of Energy Policy of the Slovak Republic

The objective to increase energy efficiency was declared in the proposal of the Energy Policy in 2005. The proposal (4) is under the public discussion and is placed at the web page: www.economy.gov.sk. The document represents the analytical set of data on technical, economic and market potentials of energy savings for individual sectors. It includes possibilities to finance energy saving projects. Based upon the background study, the main areas of active policy will be oriented to the sectors of industry, transport and housing. Strategic objectives of the proposal of the Energy policy 2005 are as follows:

- to ensure safe and reliable energy supply in requested amount and quality at the optimal costs with respect to sustainable economic growth,
- to ensure maximum self-supply electricity production,
- to reduce energy demand,
- to ensure sustainable development of energy sectors.

One of the proposals to reduce dependence of Slovakia on the import of fossil fuels defined in the proposal is to increase the use of renewable energy sources (OZE). The Government has established a minimum indicative goal of 19 % share of OZE (including hydropower generation) on a total electricity production by 2010. In spite of the long term effort and preparation, the Act on Energy Efficiency was not adopted. This proposal was listed in the Third National Communication (5). The activities are concentrated to implement the EU directives in this area.

National Strategy of the Industrial Policy Development

The Strategy intends to enforce the principles of sustainable development in industrial sector. It aims also to increase investments with respect to the implementation of the integrated prevention and pollution control (Act 245/2003).

Program "de minimis"

The Ministry of Economy has introduced the Program "de minimis" that aims to support the energy efficiency and use of OZE. The energy saving scheme was developed in compliance with the decisions of Association Council (6/21001) between the EU and the Slovak Republic and is in force from 2002. Significant incentive for application of direct and indirect legal and regulation measure in the Energy sector is the transposition of the EU legislation in the national legal system. However, the implementation of the EU requirements is dependent on the strengthening of existing capacities. Projects aimed to energy efficiency and utilization of OZE are supported by structural funds of the EU.

Concept of utilization of renewable energy sources

The Concept was adopted by the Government in February 2002. It outlines current status and quantifies potential available from renewable sources. It proposes implementation mechanisms to utilize OZE. One of the elements is the Management Program of the Development of Renewable Energy Sources. The steering committee comprises representatives of relevant sectors (MH, MP, MŽP, MVRR, MŠ, MDPT) and the Regulatory office for Network Industries (URSO).

Sector Operation Program: Transport and Telecommunication, Transport Policy till 2015.

The Program Transport and Telecommunication for 2004-2006 is oriented to the priority of the development and modernization of transport infrastructure in the seven regions in Slovakia. The global aim is to remove inappropriate parameters of transport infrastructure in order to increase the efficiency and quality of transport system including the environmental protection. The program was adopted in 2003. Basic documents of the transport policy include:

- Project of transformation and restructuring of Railways of the Slovak Republic (ŽSR) No. 830/2000,
- Concept of modernization of mobile stock of the ZSR, Resolution 89/2001,
- Concept of the development of combined transportation, Resolution 37/2001,
- Concept of the development of aviation transportation, Resolution 649/2001,
- Concept of the development of water transportation, Resolution 469/2000,
- Project of the construction of highways, Resolution 162/2001.

Program to enhance rational consumption of fuels and energy in transport

The program comprises set of technical and administrative measures aimed to reduce consumption of fuels. The measures are grouped as follows:

- acceleration of public transport,

- reduction of specific consumption in individual transport,
- endorse regulations to transpose strategic objectives of energy saving,
- technical measures of vehicle stock in the public transport,
- enhancement of bicycle and walk transport,
- awareness raising and information dissemination.

Waste management program

Waste Management Program till 2005 (6) was adopted in 2002. It involves objectives to be achieved by 2005 in municipal waste disposal as follows:

- to reach 35 % share of municipal waste recovery, 15 % share of energy recovery of municipal waste, and 50 % of landfilling,
- to reduce landfilling of biologically degradable municipal waste by 30 % of the reference year 2000,
- to reduce incineration of biologically degradable municipal waste by 10 % of the reference year 2000,
- to reach 35 % share of composting of biologically degradable municipal waste.

Legal framework in the waste management is covered by the Act 223/2001 on Waste and its implementing regulation 283/2001. An important economic instrument is the Recycling Fund that was established to collect financial sources and allocate them to projects dealing with collection, recovery and waste processing. There are two ways of allocating money: either through funding projects on waste recycling (non-obligatory) or through subsidies to municipalities (obligatory) to cover 95 % of the costs concerning separate collection and recovery of municipal waste.

Concept of GHG emission reduction in construction and public works sectors till 2005

The Concept was developed under the Ministry of Construction and Regional Development. The construction activities after the recession in 1990 - 1996 undertook the recovery that leads to increased generation of CO_2 emissions. The document lays down set of measures of technological characters. They include measures of incineration processes, change in fuel stock, insulation of houses, and other energy saving possibilities.

Concept of cattle breeding in 2000 - 2005

The strategy of the cattle breeding development (7) is based on two requirements:

- production of appropriate amount of high quality products to internal market,
- increase in a production efficiency.

Subsidies of final prices are gradually decreasing as Slovakia joined the EU.

National plan of regional development

The aim of the Plan is to increase efficiency and development in energy sector, restructuring of energy sources and increase of renewable energy sources utilization. The National plan includes projects that use geothermal energy sources and biomass.

Adaptation of agriculture to climate change

In 2000, the ministry of Agriculture developed the cross cutting study "Adaptation of agriculture to climate change in Slovakia". This study was partially transposed in the Medium-term Agricultural Policy for 2004 - 2006, adopted by the Government resolution 1090/2002.

Concept of forestry policy

Forestry policy till 2005 was adopted in 2000. It creates the policy framework of medium term measures in forest management towards sustainable utilization of forest and stabilization of carbon supply in forests. The Forest strategy supports competitiveness of forestry sector within the EU member states.

Action plan for transport and the environment

The Action plan was adopted by the Government Resolution 102/1999. Following principles are stipulated:

- minimization of unfavorable impact of transportation on the health status of the population,
- minimization of negative impacts of transportation on the environment,
- minimization of negative impacts on ecosystems,
- minimization of non-renewable energy sources demand and consumption,
- optimization of utilization of renewable sources.

Research

In 1991, the National Climate Program (NKP) was established. Since 1993 the national program has been funded by the MZP SR. Research results of the period 1993 - 2001 are summarized in 11 collections. Since 2001 NKP has stagnated due to the lack of finances from MŽP SR. Monitoring of climate change and the participation at the GCOS program is carried out by the SHMU. The research projects with respect to renewable sources are carried out by the research institutes, universities and specialized organizations. The Ministry of Education is a central authority in the area of research and development. It is also responsible for the coordination of the projects of the 6th Framework Program and grants (VEGA, APVT). In the Agriculture sector, there are four projects oriented towards climate change research:

- Research of stocks and the balance changes of carbon in highlands,
- Impact of global climate change on forests of Slovakia,
- Progressive climate change and its impacts on the development of society,
- Measures taking into account the adaptation of meadows and pastures on climate change.

4.2. Overview of policy and measure to reduce GHG emissions

Indicated positive emission trend in recent years is the result of several changes in economic sector and other heavy pollution sectors, restructuring of the industry and adoption of environmental legislation. This chapter deals with the assessment of policies and measures declared in the Third National Communication, and provide for the overview of newly adopted measures in the area of GHG emission reduction. The measures are evaluated with respect to current stage of implementation and, where relevant information is available, the impact of measures (and supporting programs) is quantified.

4.2.1 Cross sectoral measures

4.2.1.1 Cross sectoral measures from the Third National Communication on Climate Change

These measures represent activities and instruments, the effect of which shows in several categories, sectors of several greenhouse gases.

Act 309/1991 on Protection of the Air against Pollutants

Type of measure: regulatory, economic

Current status: outdated, replaced by the Act 478/2002 on Air Protection

Initially strict regulatory instrument represented one of the most important instruments to reduce GHG emissions. The Act was revised and replaced by the Act 478/2002 that introduced possibility to delay the termination of operation of polluter sources that did not met the limits by targeted year 1998. These sources might be operated by December 2006 at the latest, however, they are subject of increased pollution charges.

Act 286/1992 on Income Taxes

Type of measure: economic

Current status: outdated, replaced by the Act 595/2003 on Income Taxes

The Act provided for economic instruments that declared the possibility to obtain income tax allowance for the operation of small hydroelectric power plants with installed output up to 1 MW, heat pumps, solar equipment for utilization of geothermal energy, equipment for biogas production, equipment for production of biologically degradable substances. The Act was replaced by a new Act 595/2003 that does not allow tax allowances to support the utilization of renewable energy sources.

Liberalization of energy and fuel prices

Type of measure: economic

Current status: Directives 2003/54/EC and 2003/5/EC on Common Rules of Internal Market with Electricity and Gas, respectively

In 2001, Slovakia has launched restructuring and privatization processes. It resulted in the establishment of three regional joint stock companies (ZSE, SSE, and VSE) with the majority state shares. Foreign shareholders are EON, EBRD, EDF and RWE. In 2002, the outcome of the transformation process in SE, a.s. was the division of electricity production (represented by the SE, joint stock company) and electricity transmission network (SEPS). Also, the Heating Plant Kosice, a.s. was established. It is envisaged that the SEPS (transmission network) will not be privatized with the full ownership of the state. Currently, the privatization process of the SE, a.s. was started. In October 2005, the Slovak Government adopted the Resolution on the division of Slovak Gas Company (SPP, a.s.) that will divide transit transport of natural gas and distribution of the gas to domestic consumers. Features of the operation of energy network do not allow the release of regulation. The aim is to transparent supply, mitigation of risks of dominant position at the market and protection of final consumers.

Act 237/2000 on the State Environmental Fund

Type of measure: economic

Current status: outdated, replaced by Act 587/2004 on Environmental Fund

In 2001, all state funds were cancelled. In 2004, a new Environmental Fund was established that is directly managed by the Ministry of Environment.

National Program of Environmental Assessment and Eco-labelling

Type of measure: regulatory with indirect economic incentive

Current status: Act 469/2002 on Environmental Eco-labelling of Products

In 1996, the program of assessment and eco labelling was launched. In 1997 - 1998, 10 products were labelled by environmental friendly products. The system of eco labelling is now covered by the legislation that is in compliance with the EU system.

4.2.1.2 Actual cross-sectoral measures to reduce GHG emissions

Act 478/2002 on Air Protection

Type of measure: regulatory and economic

Current status: implemented measure, replaces an initial Act on the Air Protection and amends the Act 401/1998 on Pollution Charges

The Act governs rights and obligations of legal and physical persons with respect to the release of polluting substances to the air. It also stipulates the quality objectives, responsibilities of authorities and liabilities with respect to violation of obligations. According to the Act, each operator of the pollution source is obliged to pay progressively increasing charges (coefficients are defined for each year) depending on the amount and type of polluting substances emitted to the air. The pollution charges for the CO_2 emissions are not established.

Act 572/2004 on Trade with Emission Quotas and its implementing Regulation 711/2004

Type of measure: regulatory and economic

Current status: implemented measure

The Act was adopted in 2004 and transposed the requirements of the Directive 2003/87/EC. This Directive deals with the scheme of trading with emission quotas of GHG emissions. The Act stipulates rights of all stakeholders that participate at the scheme. It also stipulates the system of trading, the scope and responsibilities of the national authorities. Selected technologies fall under the Decision 2004/156/EC that provides for the rules of monitoring and reporting obligations.

Act 587/2004 on Environmental Fund

Type of measure: economic, indirect

Current status: implemented measure

The Environmental Fund was established by the Ministry of Environment. The income of the Fund is generated from pollution charges from large and medium pollution sources, penalties for the violation of the legal provisions and other sources. The financial means could be provided for the activities aimed to achieve the objectives of the state environmental policy, support of the research or public awareness projects.

Act 243/2003 on Integrated Prevention and Pollution Control

Type of measure: regulatory, indirect

Current status: implemented measure

The Act provides for rights and obligations of the operators of selected industrial activities. It also stipulates the competencies of national authorities and defines the conditions of authorized persons to provide consultancy services. The Act transposed the obligations of the Directive 96/6/EC.

Act 205/2004 on Collection, Storage and Dissemination of Information on The Environment

Type of measure: regulatory, indirect

Current status: implemented measure; amends the Act 211/2000 on the Free Access to Information

The Act governs conditions and procedures with respect to the collection, storage and dissemination of information on the environment. The system should meet he principle of transparency and effective access of the public to the information. In order to implement the Act, the National Register of Environmental Pollution was established that assure the quality of data.

4.2.2 Energy sector including transport

4.2.2.1 CO_2 emissions

The Energy sector is one of the most difficult sectors to comply with the EU directives that aim to the environmental improvements. These are indirect instruments to limit the generation of emissions and include the Directive 2001/77/EC on the Support of Electricity Produced from Renewable Energy Sources, Directive 2003/30/ES on the Support of Bio-fuels Utilization, Directive 2002/91/EC on Energy Efficiency of Buildings, Directive 2004/8/EC on Support of Co-generation, and the Directive (under the preparation) on Energy Efficiency of final utilization of energy and energy services.

The Act 572/2004 on Trade with Emission Quotas is one of the most important direct regulatory and economic instruments to control CO_2 emissions in the sectors of electricity, heat and steam productions, oil refinery, production of iron and steel, paper, and construction materials. This Act creates a permanent pressure on the operators with respect to implementation of measures that aim to limit the GHG emission generation. The emissions in transport sector should be affected by the introduction of the Directive 2003/30/EC on the Support of Bio-fuels and other Renewable Energy Sources. The indicative objectives are set up as a 2 % share of bio-fuels in the transport sector till 2005. This share should increase to 5.25 % in 2010. The implementation of this directive will provide for better monitoring of the consumption of alternative fuels and sale of fuels.

4.2.2.1.1 Overview of measures from the Third National Communication on Climate Change in the Energy sector including transport

Program supporting energy savings and utilization of alternative energy sources

Type of measure: economic

Status of implementation: completed

The program supporting energy savings that was supported by the Ministry of Economy was completed.

Regulation 144/2000 on Requirements for Fuel Quality, keeping operating records

Type of measure: regulatory

Status of implementation: implemented measures, amends the Regulation 61/2004 on Keeping Operation Records

The Regulation stipulates requirements for the quality of solid fossil fuels, liquid oil fuels, gasoline and diesel fuels and defines conditions for keeping operation records (type, extent and way of providing data to air protection authorities) for fuel producers, importers and distributors. Extended requirements and other data on stationary pollution sources are provided by the Regulation 61/2004.

Act 70/1998 on Energy Sector

Type of measure: regulatory

Status of implementation: cancelled, replaced by the Act 656/2004 on Energy Sector

The Act stipulated the conditions for trade in electrical engineering, gas industry and heat supplies, rights and obligations of consumers of these media and the regulations in Energy sector, in general. It declared the obligation of electricity buyers, heat distributors of other stakeholders in Energy sector. The act was cancelled and replaced by two acts: Act 656/2004 on Energy Sector and 657/2004 on Heat Energy Sector.

Proposal of the Act on Energy Efficiency

Type of measure: regulatory

Status of implementation: cancelled

A long time prepared act supposed to govern the effective use of energy in all economic sectors including the introduction of higher utilization of renewable energy sources. The act was not adopted. It is anticipated that the directive of the EU (under the preparation) will be soon transposed.

Act on Regulation of Network Branches

Type of measure: regulatory

Status of implementation: implemented, the Act 276/2001 on Regulation of Network Branches (amendment 658/2004)

The Act was adopted in 2001 and regulates legal, economic and organization procedures of the energy regulation. The Act provides for extent, conditions and procedures of regulation, competencies of the National Office for Regulation of Network Branches. The Office supervises the activities that are subject of regulations and functioning of the market at the monopoly conditions of sale.

4.2.2.1.2 Overview of actual measures in Energy sector including transport

Act 656/2004 on Energy and Act 657/2004 on Heat Energy

Type of measure: regulatory

Status of implementation: implemented measure

These acts support the implementation of the EU legislation after the joining the common European market. The Act on Energy Sector stipulates conditions for entrepreneurship and business in electro-energy sector, gas industry. It also provides for rights and obligations of stakeholders in this market and supervision of the national authorities. The Act on Heat Energy Sector similarly provides for provisions with respect to heat energy business.

Directive 2003/54/EC on Common Rules of Internal Market with Electricity and Directive 2003/55/EC on Common Rules of Internal Market with Gas

Type of measure: economic

Status of implementation: implemented measure

The aim of market liberalization is to create competitive conditions even at the existence of natural monopolies. These Directives require that all dealers in Energy sector met the obligations with respect to economic interests. These obligations include safety and reliability of the system and network, quality of electricity supply and high energy efficiency and the environmental protection.

Directive 2001/77/EC on Support of Electricity Generated from Renewable Resources

Type of measure: regulatory

Status of implementation: implemented measure

According to this Directive, producers of electricity from renewable energy resources will be granted by green certificates. It will also provide for stabile prices of the electricity generated from renewable resources. The Directive includes support programs and rules for business (flexible depreciation of investments). Slovakia declared an indicative objective of 19 % share production of the electricity from renewable resources in 2010. However, current Slovak legislation does not provide for the obligation to buy the electricity generated from renewable resources, thus, it is anticipated to amend this provision.

Directive 2002/91/EC on Energy Economy of Production (energy efficiency) in Buildings

Type of measure: regulatory

Status of implementation: implemented measure, the Act on Energy Economy in Buildings is under the preparation

The Act is under the preparation in order to transpose the Directive 2002/91/EC that aims to improve energy efficiency in buildings. The sector of households and buildings represent more than 40 % share on the final consumption of energy in the EU. The Directive defines measures that lead to improvement of parameters of buildings, methods of integrated standards of energy consumption in buildings, recommends temperatures and climate conditions in pubic buildings. The Directive requires regular inspections of cooling and heating systems. A platform of the program Intelligence Energy 2003 - 2006 contributed to the preparation of the Directive. Also the cooperation and experience with the CEN were applied.

Regulation 61/2004 on Keeping Operation Records and Other Data on Stationary Pollution Sources

Type of measure: regulatory

Status of implementation: implemented measure, it amends the Act 144/2000 on Requirements of Fuel Quality

The Regulation was adopted in 2004 and stipulates requirements on keeping operation records of stationary pollution sources and other data that the operators of sources must provide to district environmental authority. The Regulation is applied to large and medium sources of pollution.

Act 725/2004 on Operation of Vehicles and Regulation 584/2004 on Measures to Reduce Emissions from Combustion Engines Installed in Non-road equipments

Type of measure: regulatory, indirect

Status of implementation: implemented measure

The Act provides for conditions of the operation of road and special vehicles with regard to air protection. It stipulates the conditions of the construction, certification and phasing out of vehicles from the operation. It also requires regular technical inspection, emission controls. The Regulation 584/2004 regulates the non-road equipments with respect to the reduction of emissions of gaseous and solid polluting substances.

Directive 2003/30/EC on Support of Bio-fuels and other Renewable Energy Resources Utilization in Transport

Type of measure: regulatory

Status of implementation: implemented measure

The directive aims to increase a share of the use of alternative fuels in the transport. Indicatives objectives are 2 % share in 2005, 5.25 % share in 2010. This will lead to an increase of LPG and CNG fuels utilization. The Directive was transposed in July 2004.

4.2.2.1.3 Overview of legal measures under the preparation in transport sector

Type of measure: regulatory, indirect[1)]

Status of implementation: implemented measure

- Regulation on technical requirements on certification of motor vehicles (Directive 70/156/EC),
- Regulation on technical requirements regarding measure against pollution of the air by gases from vehicles with ignition (Directive 70/220/EC),
- Regulation on technical measures against emissions from diesel engines (Directive 72/306/EC, 88/77/EC),
- Regulation on technical requirements on fuel consumption of motor vehicles (Directive 80/1268/EC).

4.2.2.2 CH_4 emissions

Sources of methane are fugitive emissions from mining and processing of brown coal and lignite production (underground mines), level of technological equipment of oil and gas processing, and the transport and distribution of natural gas.

4.2.2.2.1 Overview of measures from the Third National Communication on Climate Change in the Energy sector

Transit network

Type of measure: regulatory

Status of implementation: implemented measure

The transit of natural gas through the territory of Slovakia represents about 400 bill. m^3 of natural gas in the last five years. Turbine compressed units are used in the transport. These units utilize natural gas or electricity as a source of the energy and are one of significant sources of emissions. These large sources of pollution are under the Act 572/2004 obliged to trade with emission quotas. It represents an incentive to reduce GHG emissions.

1 With respect to impact on GHG emissions

4.2.2.2.2 Overview of actual measure in Energy sector

Directive 2004/67/EC Regarding Safety of Natural Gas Supply

Type of measure: technical

Status of implementation: measure under preparation

The directive provides for conditions to ensure safety of the supply of natural gas and reporting requirements. The Directive stipulates the conditions of monitoring and the procedures for the development of crisis plans. It is anticipated that the Directive will be implemented in 2006.

Regulation 123/2005 on Rules of Functioning of Market with Gas

Type of measure: technical, regulatory

Status of implementation: implemented measure

The Regulation provides rules on functioning of market including the access to the network, connections to distribution network, transport and distribution of natural gas, supply of gas to households, avoidance of overload of transport and distribution network, gas storage and network balance.

4.2.2.3 Other gases emissions

Photochemical active gases such as carbon monoxide (CO), nitrogen oxides (NOx) and non-methane volatile organic compounds (NMVOC) are not greenhouse gases, but they contribute indirectly to the greenhouse effect in the atmosphere. They are generally referred to as ozone precursors because they affect the creation and destruction of ozone in the atmosphere.

Directive 2001/81/EC on National Emission Ceiling, Regulation 60/2003 on Establishment of National Emission Caps and Emission Quotas

Type of measure: regulatory

Status of implementation: implemented measure

These regulations provide for national emission ceiling of pollution substances (sulphur oxides, nitrogen oxides, ammonium and non-methane volatile organic compounds) and emission quotas of SO_2 till 2010.

Act 245/2003 on Integrated Prevention and Pollution Control

Type of measure: regulatory

Status of implementation: implemented measure

The Act on IPPC provides the condition for integrated prevention and pollution control of selected operators of industrial activities. It also stipulates competencies of environmental authorities and decision making process. The information system on integrated prevention and pollution control is established.

4.2.3 Sector Industrial processes including fluorinated gases

The sector Industrial processes is the source of CO_2, CH_4, N_2O, NO_X, CO, NM VOC, SO_2, CF_4, C_2F_6, and SF_6 emissions. Main sources of pollution are processing of mineral raw materials, metallurgy, chemical and food processing industries. These are branches with a high energy demand and low level of state of art processes. Sector of production of construction materials, cement, lime and magnesite is characterized by an increased value added in recent years. The most important legal measure to limit the CO_2 emission generation is Act 572/2004 on Trading with Emission Quotas. In addition, following measures were quantified and assessed in this sector:

- to reduce N_2O generation in the production of nitric acid,
- to reduce PFCs generation in the production of aluminum,
- to reduce HF gases and SF_6 in cooling and other processes.

4.2.3.1 CO_2 emissions

4.2.3.1.1 Overview of actual measures in the sector of Industrial Processes

Cement production

Cement production and consumption steeply increased in recent years. In Slovakia, the annual consumption of cement is about 330 kg/inh. The average consumption in the EU is 510 kg/inh. It is obvious that the consumption of cement will continue to grow to the level the EU (approximately 500 kg/inh) and about 600 - 800 kg/inh in the time horizon 5-10 years. The largest producers of cement and lime are obliged to participate at the emission quotas trading (according to Act 572/2004).

Sectoral Operation Program Industry and Services

Type of measure: economic, indirect

Status of implementation: endorsed measure

Table 4.1 Effect and characteristics of measures in Energy sector (including transport)

Measure	Type of measure	Status	Applied in scenario	IPCC sector	Year	2010	2015	2020	2025
					gas	GHG CO_2 eq.			
Act 572/2004	Regulatory economic	I	with measures	1.A*	CO_2	838	920	1 029	1 156
					CH_4	-6	-7	-8	-9
					N_2O	-12	-15	-18	-21
					sum	820	898	1 003	1 125
Directive 2001/77/ES	Regulatory	I	with additional measures	1.A.1.a	CO_2	476	476	476	476
					CH_4	0	0	0	0
					N_2O	1	1	1	1
					Sum	477	477	477	477
Directive 2001/91/ES	Regulatory	I	with additional measures	1.A.4.b	CO_2	0	74	118	168
					CH_4	0	5	8	11
					N_2O	0	0	0	0
					sum	0	79	126	179
Directive 2003/30/ES	Regulatory	S	with additional measures	1.A.3.b	CO_2	324	350	361	361
					CH_4	0	0	0	0
					N_2O	0	0	0	0
					sum	324	350	361	361

(*except 1.A.4.b and 1.A.3)
I - policy and measures have been already implemented
S - adopted, approved policy or measures
P - planned, prepared policy/measures

SOP Industry and Services was adopted in 2003 by the Ministry of Economy. It defined priorities and measures in 2004 - 2006 in following areas:

- impact of business activities on the environment (waste, wastewater and CO_2, NO_2 and SO_2 emissions) - reduction by 2 % in 2006 compared to 2001,
- reduction of energy demand in supported companies by 2.5 % in 2006 compared to 2001,
- implement 25 projects aimed to energy savings in 2006,
- reduce energy and raw material demands in industrial processes by 2.5 % compared to 2001,
- reduce energy costs in 2006 by 2.5 % compared to 2001.

4.2.3.2 HFCs, PFCs and SF_6 emissions

Legal framework was adjusted to the EU standards. It involves requirements for collection, recycling and final disposal of coolants, non-returnable packages and application of coolants in different sectors.

4.2.3.2.1 Overview of actual measures in Industrial Processes sector

Type of measure: economic, indirect

Status of implementation: endorsed measure

Based upon the Act 76/1998 on Protection of Ozone Layer, the methodology to control technical performance of products was endorsed. The Directives 2037/2000/EC and 2002/91/EC provide for regular inspections on sealing of cooling and air conditioning equipment. Total impact on greenhouse effect is assessed by the factor TEWI that is the sum of direct impact of coolant releases and indirect impact caused by the consumption of electricity. Thus, inspections are carried out with respect to sealing and energy efficiency as well.

Coolants

Based upon Directive 2037/2000/EC on substances that deplete ozone layer (and its amendments 2038/2000/EC, 2039/2000/EC and 1804/2003/EC), CFC coolants must not be used in Slovakia. Removed CFC coolant is the waste that must be disposed. Newly produced NCFC coolants could be used by December 2000. Other HCFC will be banned in January 2015.

Collection of coolants and oils

Collection coolants and oils from CFCs, HCFC and HFC is supported by the Act 76/1998 on Protection of Ozone Layer of the Earth. The oils that ware removed from coolants are defined as hazardous waste that is not suitable for recycling and must be incinerated.

Recycling and regeneration of coolants

Stricter requirements on recycling will be implemented after 2005. In Slovakia, there are not services dealing with recycling and regeneration of coolants. These services could be conducted in the member states of the EU.

Disposal of coolants and oils

Removed coolants might consist of 30 % (volumetric) of oils. In Slovakia, there are not facilities for thermal disposal of coolants and oils due to small volumes generated. Currently, coolants and oils could be exported for the final disposal.

Disposal of insulations

CFC substances were used in Slovakia by 1994. The HCFCs substances were used by 1998. Disposal of insulation foams from CFC, HCFC is problematic in Slovakia.

Disposal of products

It refers to products such as refrigerators, freezers, distribution and other cooling equipments. According to Directive 2002/96/EC on Waste from Electric Equipments, it is obliged to remove all CFC, HCFC, HFC, HC prior to recycling. Also, the Directive requires that 80 % of products to be collected and 75 % of materials from collected products to be recycled. It is anticipated to implement these objectives by December 2006 and December 2008, respectively. Establishment of collection networks, system of collection and labeling of products must be completed by August 2005. The Recycling fund is to be an instrument to support this initiative. The Waste management act has been amended to meet these requirements.

Non-returnable bottles

Directive 2037/2000/EC prohibits placement of regulated substances at the market. Thus, HCFC coolants are not allowed to be sailed in non-returnable packages after 2005.

Table 4.2 Impact and characteristics of measures in sector Industrial Processes

Measure	Type of measure	Status	Applied in scenario	Sector	Year	2010	2015	2020	2025
					Gas	GHG CO_2 eq.			
Modernization of production ofHNO_3	regulatory, technical	S	With measures	2.B.2	N_2O	4	6	5	6
New technology of emission sinks	regulatory, technical	S	With additional measures	2.B.2	N_2O	128	997	997	997
Modernization of production of aluminium	regulatory, technical	S	With measures	2.F	PFCs	0.009	0.009	0.009	0.009
Installment of inert anodes	regulatory, technical	S	With additional measures	2.F	PFCs	0	0	0	0.012
Reduction of releases in compliance with the EU legislation	regulatory	I	With additional measures	2.F	HFCs	0.123	0.145	0.129	0.129
	regulatory	I	With additional measures	2.F	SF_6	0.004	0.004	0.006	0.006

I - policy and measures have been already implemented
S - adopted, approved policy or measures
P - planned, prepared policy/measures

4.2.4 Agriculture sector

The framework of agriculture and food processing policy in Slovakia is those applied in the EU. One of the most important objectives is to adjust the agriculture to environmental requirements with respect to the protection of soil, waster, air, biological diversity and the protection of traditional genes sources. These objectives are included in the Program of the Development of Agriculture till 2010.

4.2.4.1 CH_4 emissions

Following measures are proposed reduce methane emissions:
- reduction in number of cattle and change of species of cattle,
- processing of waste from animal production to bio-gas.

4.2.4.1.1 Overview of measures from the Third National Communication on Climate Change in the Agriculture sector

Act 83/2000 on Protection of Agriculture Soil
Type of measure: regulatory
Status of implementation: cancelled, replaced by Act 220/2004
The Act 83/2000 was replaced by the Act 220/2004 on the Protection and Utilization of Agriculture Soil.
Act 136/2000 on Manures
Type of measure: regulatory
Status of implementation: replaced by Act 555/2004 on Manures
The Act 136/2000 on Manures was replaced by the Act 555/2004 in September 2004. The Act stipules requirements of the application of manures, substrates and other substances, including registration, storage and use of manures and chemicals. It also provides for certification procedures.

4.2.4.1.2 Overview of actual measures in Agriculture sector

Act 220/2004 on Protection and Utilization of Agriculture Soil
Type of measure: regulatory
Status of implementation: implemented
The Act stipulates measures for the protection of properties and functions of agricultural soil with the aim of sustainable management of the soil. It is a framework legal instrument to protect ecological and genetically important elements of the soil. It deals with the measures aimed to protect the soil against degradation, erosion and risks substances.
Act 136/2000 on Manures
Type of measure: regulatory
Status of implementation: implemented
The Act on Manures supplements the Act 136/2000 and introduces the certification of manures in compliance with the requirements of the EU.
Act 415/2002 on Ecological Agriculture and Production of Bio-foods
Type of measure: regulatory
Status of implementation: implemented, amends Act 224/2998
The Act aims to support ecological agriculture. The measures to be implemented till 2010 are set out to support eco-farming projects.

4.2.4.2 N_2O emissions

Intensification of vegetable and animal production leads to an increase in industrial fertilizers consumption. Higher consumption results in higher production of residua and higher content of mineralized nitrogen in the soil. Reduction of input costs and better management are the most important trends in southern Slovakia. In mountains areas, it is anticipated that pasture agriculture will prevail.

4.2.4.2.1 Overview of measures from the Third National Communication on Climate Change in the Agriculture sector

Act 307/1992 on Protection of Agriculture Soil (part 3, §§ 4,5,6)
Type of measure: regulatory
Status of implementation: cancelled, replaced by Act 220/2004
The Act 220/2004 on Protection and Utilization of Agriculture Soil replaced the previous legislation. According to this Act, farmers are obliged to manage the agriculture activities in such a manner that the negative impact on the environment is minimized.
Code of good agriculture practice
The Code was adopted in 1996 and amended in 2000 and 2001 (8). It deals with protection of soil fertility, protection against degradation and soil pollution and protection of water and air regime of soils. It also provides for the classification of soils including vulnerable zones.

4.2.4.2.2 Overview of actual measures in Agriculture sector

Act 188/2003 on Application of Sludge and Bottom Sediments on the Soil
Type of measure: regulatory
Status of implementation: implemented

The Act stipulates the condition for the application of sludge and sediments on agricultural and forest soils in such a manner to avoid the deterioration of the soil, water, human and animal health and the environment. It defines obligations of producers of sludge and recommends the application procedures. It is in compliance with the EU Directive.

Act 364/2004 on Water, § 35 on protection against pollution by nitrates from agricultural sources
Type of measure: regulatory, indirect
Status of implementation: implemented

The Water Act defines measures aimed to protect waters against pollution by nitrates from agricultural sources, manipulation and application of manures and fertilizers. Some measures are also defined in the Code of Good Agricultural Practice.

Table 4.3 Impact of measures to reduce GHG emissions in the Agriculture sector

Measure	Type of measure	Status	Applied in scenario	Sector	Year	2010	2015	2020	2025
					Gas	GHG CO_2 eq.			
Disposal of animal waste	Regulatory	I	With additional measures	4.B	CH_4	47	78	105	108
			With measures		N_2O	77	107	138	169
			With additional measures			0	65	44	39
New manures	Regulatory	I	With measures	4.C	N_2O	307	430	552	675

I - policy and measures have been already implemented
S - adopted, approved policy or measures
P - planned, prepared policy/measures

4.2.5 Sector - Land Use, Land Use Change and Forestry

4.2.5.1 CO_2 emissions

The measures aimed to increase CO_2 sinks in the land use are as follows:
- afforestation of non-forest areas,
- protection against forest fires.

The Concept of Forest Policy of the Slovak Republic till 2005 and Medium-term Agriculture Policy for 2004 - 2006 are the basic documents available at the www.mpsr.sk.

4.2.5.1.1 Overview of measures from the Third National Communication on Climate Change in the sector - Land Use, Land Use Change and Forestry

Change in species composition of forests, afforestation, and protection of carbon in forests impaired by imissions
Type of measure: regulatory,
Status of implementation: implemented

All measures listed in the Third National Communication on Climate Change are valid and gradually implemented. The documents are available at www.mpsr.sk

4.2.5.1.2 Overview of actual measures in the sector - Land Use, Land Use Change and Forestry

Medium-term Agriculture Policy for 2004 - 2006 - Forest management

The Policy was adopted in 2004 and creates the framework for the implementation of measures aimed to sustainable management of the forest.

Act 217/2004 on Forest Reproduction Material

Type of measure: regulatory,

Status of implementation: implemented

The Act defines rules for utilization of genes materials in forest management and determines production viability of future forests with respect to sequestration of carbon.

Act 326/2005 on Forests

Type of measure: regulatory,

Status of implementation: implemented

It is a framework legislation to protect forests and forest management. It aims to sustainable wood logging in order to avoid overexploitation of woods.

Table 4.4 Impact of measure to increase sinks and reduce GHG emissions in Land Use, Land Use Change and Forestry

Measure	Type of measure	Status	Applied in scenario	Sector	Year	2010	2015	2020	2025
					Gas	GHG CO_2 eq.			
Afforestation and increased protection against fires	Regulatory economic	I	With additional measures	5.A	CO_2	39,19	62,16	120,62	149,76
					CH_4	0,84	1,05	1,05	1,05
					N_2O	0.,62	0,62	0,62	0,62
				5.B	CO_2	9,45	13,23	24,57	26,46
				5.C	CO_2	12,60	17,64	32,76	35,28
				5.C	CO_2	3,15	4,41	8,19	8,82

I - policy and measures have been already implemented
S - adopted, approved policy or measures
P - planned, prepared policy/measures

4.2.6 Sector Waste

4.2.6.1 CH_4 emissions

Methane is produced in the landfills as a product of anaerobic processes. The methane, if not used or incinerated, is released into the atmosphere. It is estimated that 5-20 % of methane emitted into the air comes from landfills. Municipal and wastewaters contain a high share of organic matter. Thus, wastewaters also contribute to the global methane emissions up to 8-11 %.

4.2.6.1.1 Overview of measures from the Third National Communication on Climate Change in the sector Waste

Act 238/1991 on Waste

Type of measure: regulatory,

Status of implementation: replaced by Act 223/2001 on Waste

Act 223/2001 on Waste is the basic legislation in the area of waste management. According to this Act, each generator of waste is obliged to utilize waste generated as a source of secondary raw material or energy. Landfilling is the final level of the waste disposal. The Act stipules basic rules and obligations of legal and physical persons with respect to generation and minimization of waste. The Regulation 283/2001 sets out the obligation to retain the disposal gas from all types of landfills and use it for energy generation or incineration. From January 2006, it is prohibited to dispose biologically degradable waste from garden, parks, cemeteries and other greens together with municipal waste.

Act 327/1996 on Waste Disposal Charges

Type of measure: economic

Status of implementation: amended by Act 17/2004 on Charges for Waste Disposal

A new Act 17/2004 on Charges for Waste Disposal replaced the previous act.

4.2.6.1.2 Overview of actual measures in the sector Waste

Act 238/1991 on Waste

Type of measure: regulatory,

Status of implementation: implemented

The Act transposed obligations of the EU. It stipulates competencies of environmental authorities, municipalities, obligations of legal and physical persons, and liabilities in the waste management sector. It also establishes the Recycling Fund.

Act 529/2002 on Packages

Type of measure: regulatory,

Status of implementation: implemented

The Act deals with requirements on composition, properties and labeling of package. The aim is to avoid generation of waste from packages and to reduce its amount, in general. It defines types and requirements on composition and properties, recycling, collection and final disposal of waste from packages. It also requires keeping records on packages.

Act 364/2004 on Waters

Type of measure: regulatory,

Status of implementation: implemented

The Water Act is the framework legislation aimed to protect waters. The permit of environmental authority is required prior to discharge of wastewater. Following objectives are set out:

- provide sewage systems and treat wastewaters in agglomerations up to 10 000 PE by 2015,
- provide sewage systems and treat wastewaters in agglomerations higher than 10 000 PE in 2010.

Act 17/2004 on Charges for Waste Disposal

Type of measure: economic

Status of implementation: implemented

The Act regulates payments for waste disposal. The calculation of charges, keeping records and penalties are defined.

Table 4.5 Impact of measures to reduce GHG emissions in the sector Waste

Measure	Type of measure	Status	Applied in scenario	Sector	Year	2010	2015	2020	2025
					Gas	GHG CO_2 eq.			
Measures in waste disposal	regulatory	I	With measures	6.A	CH4	186.06	304.08	409.50	516.81
			With additional measures		CH_4	6.66	7.43	8.14	8.79
Municipal waste waters	regulatory	S	With measures	6.B.2	CH_4	32.76	44.52	77.70	147.00
					N_2O	-5.98	-7.98	-8.64	-9.31
Industrial waste waters	regulatory	S	With measures	6.B.1	CH4	6.51	13.44	21.00	28.98
					N_2O	-3.61	-4.81	-5.21	-5.61

I - policy and measures have been already implemented
S - adopted, approved policy or measures
P - planned, prepared policy/measures

4.2.6.2 N_2O emissions

N_2O emissions from wastewater treatment were determined by the methods of IPCC, CORINAIR or ISI. The most appropriate is the method ISI that takes into account the amount of wastewater treated at the treatment plant with application of denitrification. The number of treatment facilities that apply denetrification processes is increasing in Slovakia due to strict requirements of the EU (Directive 91/271/EC). This Directive requires removal of nitrogen in agglomerations of higher than 10 000 PE in the sensitive areas. However, increased number of denitrification units will results in higher N_2O emissions into the air.

Industrial wastewater are not significant source of nitrogen. The highest concentrations of nitrogen are in waters released by Duslo Sala and Chemko Strazske (producers of nitric acid and fertilizers).

References:

(1) Strategy, Principles and Priorities of the State Environmental Policy, MŽP SR, 1993;
(2) National Environmental Action Program II (NEAP II),1999;
(3) Strategy of the Slovak Republic to meet Commitments of Kyoto Protocol, MŽP SR, Bratislava, 2001;
(4) Proposal of Energy Policy of the Slovak Republic, MH SR, 2005, www.economy.gov.sk;
(5) The Third National Communication on Climate Change, 2001;
(6) Policies and legislation in waste management, MŽP SR, 1997;
(7) Ján Huba, Jozef Macz, Concept of cattle breeding in 2000-2005;
(8) Bujnovský, 2000 VÚPOP a VÚVH, 2001

5. Projection and assessment of measures effects

Since the development of the Third National Communication on Climate Change, important political and economic changes have occurred. In May 2004, the Slovak Republic became a member state of the EU and economic transformation further accelerated. Slovakia has transposed the EU legislation. All these circumstances have been reflected in the development of scenarios. In spite of a voluminous set of data from all sectors and improved methods of projections, there is still a lack of precision due to the uncertainty of predictions for future economic development and the effects of the privatization processes, particularly in the Energy sector. Economic development still cannot be considered as a stable in the longer term. Therefore historical data cannot simply be extrapolated to future development. In addition, other parameters, such as liberalization of the energy market, emission ceiling for basic pollutants as well as CO_2 emission trading, should be considered. Despite existing limitations, results of projections show that the Slovak Republic is going to meet the Kyoto reduction objective for the first commitment period and to stabilize GHG emission generation in the so-called post Kyoto period (after 2012), as well. The year 2003 was chosen as the reference year for modeling emission scenarios, considering the availability and reliability of data.

5.1 Projections of GHG emissions in the Energy sector

Fossil fuel combustion and transformation is the most important source of energy related GHG emissions in Slovakia. Fugitive methane emissions occur from fuel extraction, transport and processing. The following sub-sectors of the IPCC categories are relevant for the Slovak Republic:

1.A.1	**Energy industry**
1.A.1.a	Public Electricity and Heat Production
1.A.1.b	Petroleum Refining
1.A.1.c	Manufacture of Solid Fuels and Other Energy Industries
1.A.2	**Manufacturing Industries and Construction**
1.A.2.a	Iron and Steel
1.A.2.b	Non-Ferrous Metals
1.A.2.c	Chemicals
1.A.2.d	Pulp, Paper and Print
1.A.2.e	Food Processing, Beverages and Tobacco
1.A.2.f	Other
1.A.3	**Transport**
1.A.3.a	Civil Aviation
1.A.3.b	Road Transportation
1.A.3.c	Railways
1.A.3.d	Navigation
1.A.3.e	Other Transportation
1.A.4	**Other Sectors**
1.A.4.a	Commercial/Institutional
1.A.4.b	Residential
1.A.4.c	Agriculture/Forestry/Fisheries
1.A.5.a	**Other**

The following scenarios have been developed based upon the UNFCCC method (FCCC/CP/1999/7):

Scenario without measures

This represents the status that does not take into account policies and measures implemented, adopted or anticipated to be implemented after the reference year 2003.

Scenario with measures

It models effect of adopted and implemented policies and measures. Legal measures adopted after the reference year 2003 are specifically considered.

Scenario with additional measures

It models GHG emission projections considering effects of anticipated policies and measures. The effect of the transposition of the EU Directive 2001/77/EC on the support of renewable energy sources was modeled. The Proposal of the Energy Policy of the Slovak Republic (19) served as a basic framework for the scenario proposals.

5.1.1 Projections of CO_2 emissions in the Energy sector

Projections of CO_2 emissions from fossil fuel combustion and transformation were prepared within the scope identical with this for emission inventory in the Energy sector according to the IPCC approach CO_2 emissions generated by combustion of motor fuels in the transport sector are also taken into account.

5.1.1.1 Basic assumptions for scenario modeling of CO_2 emissions

The optimization model MESSAGE was used to develop projections of CO_2 emissions from combustion and transformation of fossil fuels. This model allows us to estimate also the effect of emission ceiling of CO_2 and SO_2 emissions. Results were compared to these ones achieved from the simulation model ENPEP (module BALANCE and IMPACT). Both approaches indicate that there is not realistic to anticipate significant GHG emission reductions in future due to remaining small room to apply fuel switching

measures[1]. This is due to the fact, that most of industry, services and household source operators have already implemented it due to domestic environmental requirements[2]. It is still in some extent questionable what will be the development in nuclear power plants, as far as the investment plans of future owners were not clearly known at the time of preparing this report. This represents one of the biggest uncertainties in the projections of energy related CO_2 emissions for IPCC category 1.A.1. On the contrary with this, the privatization process and development trend were better known in the category 1.A.1.b - oil refinery and 1.A.1.c - production of coke for metallurgy. These sub-sectors represent the largest industrial contributors to the total CO_2 emissions. However, many innovations have been already implemented in this area, therefore further significant reductions are very limited.

Input parameters and assumptions for modeling are based on following documents:

- EU assumptions on the development of macroeconomic indicators for projections of the GHG emissions - the project EU25, 2005,
- structure of heat consumption in the households and services sector, based upon the data from the National Energy Efficiency Study supported by the World Bank and coordinated by the Energy Center Bratislava The results were adjusted for new demographic scenario data,
- The preliminary plan for introduction of new energy units and assumption of the electricity generation growth rate in Slovak power plants. The plan does not consider the completion of the 3rd and 4th blocks of the nuclear plant in Mochovce Phase out of two units of the nuclear plant in Jaslovske Bohunice in 2006 and 2008 has been considered,
- The reference scenario (without measures) also takes into account strict environmental requirements (new emissions limits of basic pollutants,
- Structure of vehicles in road transport, annual transits and specific consumptions (8),
- Transport outputs in rail, water and aviation transport (7),
- Forecast for the development of industrial production (4),
- Expectations of oil processing in Slovakia (9),
- Directive 2001/91/EC on Energy Management in Buildings,
- NAP for 2005 - 2007 and emission ceiling of SO_2,
- Measures with respect to Directive 2001/77/EC on the Support of Renewable Energy Sources in electricity production.

Tables of basic input data including the HDP growth rates for followed modeling period are shown in Annex P.2.5.

5.1.1.2 Scenarios of CO_2 emissions from combustion and transformation of fossil fuels

Scenario without measures

Unlike for the Third National Communication on CC, the measures stipulated in the Act 478/2002 on Air Protection are taken into account. These are measures implemented before 2003. Except for documents mentioned above, the following studies, and input data dbases were used for the modeling:

- NEIS and the National emission inventory of GHGs for 2003,
- Anticipated development of electricity generation in the Slovenske Elektrarne Company (considered parameters were its participation in the EU emission trading scheme and phasing out of two nuclear units in Jaslovske Bohunice (8),
- Dynamic of interim growth rate for heat consumption in the residential sector has been used from the National Energy Efficiency Study (5),
- Final fuel consumption in the industry was determined based upon an anticipated share of this sector on the GDP. Also, it is assumed that internal energy efficiency improvement (IEEI) in industry will be by 1 % annually. This will lead to the decrease in specific emission generation in industrial CHP and heating plants,
- Expected volumes of processed oil and oil products according to business plan of dominant producer (Annex P.2.5) (9),
- Assumptions on motor fuel consumption in road transport, transport outputs in rail, aviation and water transport as estimated in the Concept of the Ministry of Transport.

Scenario with measures

In proposal of this scenario implementation of measures, particularly the legislation adopted after the reference year 2003 was taken into account. The effect of direct legal instrument - the Act 572/2004 on Trading with Emissions Quotas was assessed. Analysis of input data from the NEIS showed that most of sources have already met emission limits of basic air pollutants, or use less carbon intensive fuels. Therefore, only small space to reduce GHG emissions might be considered in the future. The modeling results show that technically and economically viable measures are as follows:

- shift to combined coal and biomass combustion in the coal boilers up to 30 % share of biomass,
- shift to combustion of natural gas purely in boilers initially combusting,
- liquid fuels in combination with natural gas.

Scenario with additional measures

This scenario evaluates anticipated policy and measures. The following measures were taken into account:

measures with respect to the implementation of Directive 2001/77/EC on the Support of Electricity generated from the renewable energy sources at the internal electricity market. Implementation is stipulated in the Proposal of Energy Policy of Slovakia (19) where indicative objectives to achieve 19 % of RES share on the total electricity production in 2010 are defined (table 5.1).

1 Fuel switch to the less carbon intensive fuel type
2 Act No. 487/2002 Coll on Air Protection

Table 5.1 Indicative objectives for RES according to the Proposal of Energy Policy of the Slovak Republic

Source	Production in 2002	Production in 2010	Assumption of increased share of RES
	GWh	*GWh*	*GWh*
Large hydropower plants	4 924	5 000	76
Small hydropower plants	245	350	105
Biomass	153	350	197
Wind power plants	0	100	100
Geothermal energy	0	1	1
Biogas	6	52	46
Solar energy	0	0	0
TOTAL	**5 328**	**5 853**	**525**

Based upon the modeling, hydropower generation will impact electricity production from the coal units, while other RES might impact peak sources of electricity. This relates namely to the production in EVO 2 (Electricity plant Vojany) and new gas turbines. It is anticipated that biomass will be used as a replacement for brown coal in the ENO (Electricity plant Novaky). The emission reduction effect of these measures in 2010 is shown in Table 5.2.

Table 5.2 Reduction effect of measures in 2010

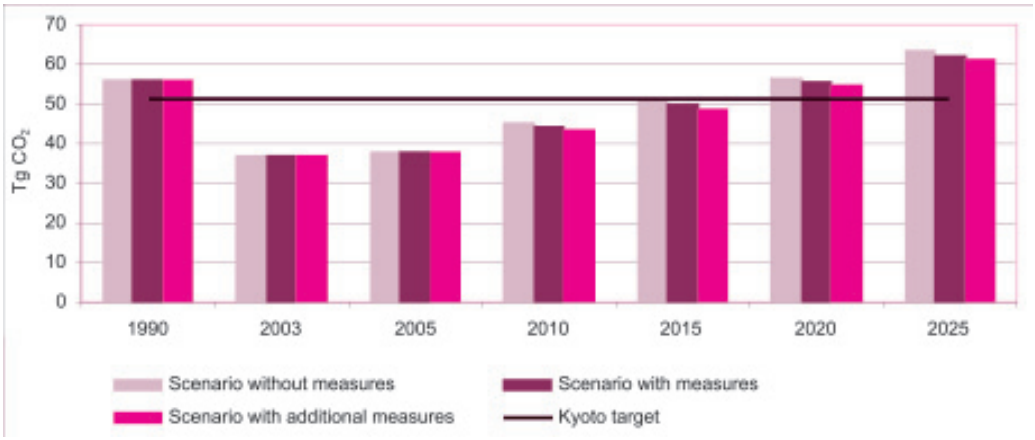
Measure	kt CO_2
Small hydropower plants	108
Other RES	107
Biomass	261

Mitigation potential of the Directive 2003/30/EC (support of bio-fuels use in transport assumed as to reach a 5.75 % share of bio-fuels in 2010) has also been followed. However, it is anticipated that bio-fuels will replace only a small part of motor diesel. The reduction effect of this measure in 2010 represents an emission reduction by 323.5 kt of CO_2.

Projections of CO_2 emissions from combustion and transformation of fossil fuels

Results of modeling the CO_2 emission projections in period up to the year 2025 are shown at Figure 5.1.

Figure 5.1 Scenarios of CO_2 generation without LULUCF



Scenario results are compared to the level of 92 % of CO_2 emission generation from combustion and transformation of fossil fuels in the base year 1990[3)]. It is obvious that the Kyoto reduction objective will be met for all scenarios, even in the scenario without measures. However, the dynamic of economic growth will lead to an increase in CO_2 emissions and long-term stabilization of emissions is not realistic for all scenarios. It could be stated that:

- Implementation of the Act 478/2002 on Air Protection led to a significant increase of natural gas share in the Energy sector. Thus, measures aiming at fuel switching are mostly exhausted to be applied widely,
- Restructuring of the economy causes a high level on uncertainty. Historical data do not provide representative and statistical inputs to estimate elasticity. Elasticity coefficient assuming 1 % reduction of final heat and electricity consumption in industry was used for correlation with the HDP growth rate,
- The assumption of stable iron production was applied in the previous national communication. Actual modeling in the metallurgy sector uses interim growth rate applied also in the EU25 projections.

3 * Base year for the KP target

Table 5.3 CO_2 emission from combustion and transformation of fuels (Tg)

Categories	1990*	2003	2005	2010	2015	2020	2025
Scenario without measures	55.962	37.051	38.033	45.036	50.732	56.696	63.293
1.A.1 Energy industry	NE	13.374	13.291	16.788	18.722	20.553	22.556
1.A.2 Manufacturing Industries and Construction	NE	13.658	14.260	16.682	19.659	23.254	27.455
1.A.3 Transport	5.071	5.143	5.409	6.081	6.533	6.722	6.700
1.A.4 Other Sectors	NE	5.683	5.949	6.675	7.347	8.122	9.007
1.A.5 Others	NE	1.141	1.142	1.147	1.152	1.159	1.167
Carbon Stored	NE	1.947	2.018	2.336	2.680	3.114	3.592
Scenario with measures	55.962	37.051	38.033	44.197	49.812	55.667	62.138
1.A.1 Energy industry	NE	13.374	13,291	16.441	18.377	20.209	22.213
1.A.2 Manufacturing Industries and Construction	NE	13.658	14.260	16.249	19.154	22.654	26.746
1.A.3 Transport	5.071	5.143	5,409	6.081	6.533	6.722	6.700
1.A.4 Other Sectors	NE	5.683	5.949	6.622	7.282	8.042	8.909
1.A.5 Others	NE	1.141	1.142	1.141	1.146	1.153	1.162
Carbon Stored	NE	1.947	2.018	2.336	2.680	3.114	3.592
Scenario with additional measures	55.962	37.051	38.033	43.398	48.912	54.712	61.133
1.A.1 Energy industry	NE	13.374	13.291	15.965	17.901	19.733	21.737
1.A.2 Manufacturing Industries and Construction	NE	13.658	14.260	16.249	19.154	22.654	26.746
1.A.3 Transport	5.071	5.143	5.409	5.757	6.183	6.361	6.339
1.A.4 Other Sectors	NE	5.683	5.949	6.622	7.208	7.924	8.741
1.A.5 Others	NE	1.141	1.142	1.141	1.146	1.153	1.162
Carbon Stored	NE	1.947	2.018	2.336	2.680	3.114	3.592

* Emissions in base year for the KP, NE = Not Estimated

5.1.2 Projections of CH_4 emissions in the Energy sector

The energy related CH_4 emissions occur in fossil fuel combustion and transformation, while fugitive methane emissions occur in fuel extraction, transport and processing. The projections of CH_4 emissions were calculated based upon the fuel consumption according to the IPCC method and recommended IPCC aggregate emission factors. In the case of transport, emission factors of the COPERT III program were applied. All three scenarios were followed to estimate the effect of measures. The annual fugitive emissions of CH_4 was calculated for the following activities (table 5.4):

- underground coal mining,
- processing and storage of oil and oil products,
- storage, transport and distribution of natural gas.

5.1.3 Projections of N_2O emissions in the Energy sector

The energy related N_2O emissions occur in fossil fuel combustion and transformation. The production of N_2O emissions in transportation were the subject to balancing. The IPCC method and recommended emission factors were applied. Also, emission factors of the COPERT III in the case of vehicle stock were used. Figures of projected N_2O emissions are shown in table 5.5.

5.1.4 Total aggregated GHG emissions in the Energy sector

Projections of GHG emissions in the Energy sector are shown in table 5.6. Projected GHG emissions in transportation are shown separately.

Table 5.4 Projections of CH_4 emissions (Gg) in the Energy sector

Category	1990*	2003	2005	2010	2015	2020	2025
Scenario without measures	**69.088**	**61.982**	**61.620**	**60.976**	**61.342**	**61.763**	**62.006**
1.A Fuel Combustion Activities	17.432	5.672	5.965	6.866	7.698	8.573	9.520
- of which Transport 1.A.3	1.039	1.206	1.299	1.514	1.637	1.688	1.681
1.B Fugitive Emissions from Fuel	51.656	56.309	55.655	54.110	53.644	53.190	52.486
1.B.1.a Solid Fuels	27.198	21.114	20.460	18.912	18.445	17.989	17.284
1.B.2.a Oil	0.217	0.147	0.147	0.150	0.152	0.154	0.157
1.B.2.b Natural Gas	21.359	32.187	32.187	32.187	32.187	32.186	32.185
1.B.2.c Venting	2.741	2.733	2.733	2.733	2.733	2.733	2.733
1.B.2.c Flaring	0.141	0.128	0.128	0.128	0.128	0.128	0.128
Scenario with measures	**69.088**	**61.982**	**61.620**	**61,257**	**61,665**	**62.141**	**62.447**
1A Fuel Combustion Activities	17.432	5.672	5.965	7.147	8.021	8.951	9.961
- of which Transport 1.A.3	1.039	1.206	1,299	1.514	1.637	1.688	1.681
1.B Fugitive Emissions from Fuel	51.656	56.309	55.655	54.110	53.644	53.190	52.486
1.B.1.a Solid Fuels	27.198	21.114	20.460	18.912	18.445	17.989	17.284
1.B.2.a Oil	0.217	0.147	0.147	0.150	0.152	0.154	0.157
1.B.2.b Natural Gas	21.359	32.187	32.187	32.187	32.187	32.186	32.185
1.B.2.c Venting	2.741	2.733	2.733	2.733	2.733	2.733	2.733
1.B.2.c Flaring	0.141	0.128	0.128	0.128	0.128	0.128	0.128
Scenario with additional measures	**69.088**	**61.982**	**61.620**	**61.254**	**61.431**	**61.768**	**61.918**
1A Fuel Combustion Activities	17.432	5.672	5.965	7.144	7.787	8.578	9.433
- of which Transport 1.A.3	1.039	1.206	1.299	1.514	1.637	1.688	1.681
1.B Fugitive Emissions from Fuel	51.656	56.309	55.655	54.110	53.644	53.190	52.486
1.B.1.a Solid Fuels	27.198	21.114	20.460	18.912	18.445	17.989	17.284
1.B.2.a Oil	0.217	0.147	0.147	0.150	0.152	0.154	0.157
1.B.2.b Natural Gas	21.359	32.187	32.187	32.187	32.187	32.186	32.185
1.B.2.c Venting	2.741	2.733	2.733	2.733	2.733	2.733	2.733
1.B.2.c Flaring	0.141	0.128	0.128	0.128	0.128	0.128	0.128

* Emissions in base year for the KP

Table 5.5 Projections of N_2O emissions (Gg) in the Energy sector

Categories	1990	2003	2005	2010	2015	2020	2025
Scenario without measures	0.848	0.962	1.000	1.142	1.243	1.318	1.381
- of which Transport 1.A.3	0.246	0.653	0.688	0.767	0.819	0.834	0.827
Scenario with measures	0.848	0.962	1.000	1.182	1.291	1.376	1.450
- of which Transport 1.A.3	0.246	0.653	0.688	0.767	0.819	0.834	0.827
Scenario with additional measures	0.848	0.962	1.000	1.180	1.289	1.374	1.448
- of which Transport 1.A.3	0.246	0.653	0.688	0.767	0.819	0.834	0.827

* Emission in base year for the KP

Table 5.6 Total aggregated GHG emission in CO_2 equivalents (Gg) in the Energy sector

Scenario	1990*	2003	2005	2010	2015	2020	2025
Without measures	57 676	38 651	39 637	46 670	52 405	58 402	65 023
- of which Transport 1.A.3	5 169	5 371	5 649	6 350	6 821	7 017	6 991
With measures	57 676	38 651	39 637	45 850	51 507	57 399	63 898
- of which Transport 1.A.3	5 169	5 371	5 649	6 350	6 821	7 017	6 991
With additional measures	57 676	38 651	39 637	45 050	50 602	56 435	62 882
- of which Transport 1.A.3	5 169	5 371	5 649	6 027	6 471	6 655	6 631

* Emissions in base year for the KP

5.2 Projections of GHG emissions in the Industrial Processes sector

5.2.1 Projections of non-energy CO_2 emissions in Industrial Processes

The production of cement, lime and magnesite directly influence CO_2 generation that is energy and non-energy origins as well. While in 1995-2000, the construction sector was in recession, recent development shows the recovery in that sector. The future growth is anticipated due to the fact that the annual cement consumption in Slovakia is 330 kg comparing to 510 kg/inh. in the states of the EU. The projections indicate a continuous increase till 2025. Only one scenario is applied. Measures aimed to decrease the CO_2 emissions by fuel saving and replacement of fossil fuels by RES were already considered in the with measures scenario for the Energy sector (category 1A.2.f) (table 5.7.)

Table 5.7 Projections of CO_2 emissions (Gg) on non-energy origin in the Industrial Processes sector

Emissions of CO_2 of non-energy origin	1990*	2003	2005	2010	2015	2020	2025
2.A.1 Cement production	1 438	905	959	1 203	1 545	1 959	2 431
2.A.2 Lime production	770	552	585	734	942	1195	1 483
2.A.3 Limestone and Dolomite Use	302	375	401	496	623	787	983
2.A.7 Magnesite Use	432	450	481	596	749	945	1 180
2.C Metal production	542	703	738	865	1 014	1 183	1 391
Total	**3 484**	**2 984**	**3 164**	**3 894**	**4 873**	**6 069**	**7 468**

* Emissions in base year for the KP

5.2.2 Projections of N_2O emissions in the Industrial Processes sector

The production of nitric acid in two chemical companies is the sources of the N_2O emissions. In one company, a new technology using catalytic reduction of NO_X was installed. The result is a slight increase of N_2O emissions (by 20 %). Projections were calculated for the forecasted growth of activities based upon the inventory data (2003). After 2000, a constant level of production was assumed. In comparison with 1990, the projected N_2O emissions are significantly lower due to innovations and the extent of the expected activities. The following scenarios were developed:

- scenario without measures assumes that the nitric acid production in 2020 will reach maximum operation capacity,
- scenario with measures assumes that application of denitrification technology will be applied at the maximum production level,
- scenario with additional measures assumes that advanced technology will be installed in 2015 - 2020 (table 5.8).

Table 5.8 Projections of N_2O emissions (t) at the HNO_3 production

Scenarios	1990*	2003	2005	2010	2015	2020	2025
Scenario without measures	1 639	2 530	2 625	3 114	3 627	4 018	4 018
Scenario with measures	1 639	2 530	2 625	3 114	3 613	4 000	4 000
Scenario with additional measures	1 639	2 530	2 625	3 114	3 200	785	785

* Emissions in base year for the KP

5.2.3 Emissions of PFCs, HFCs a SF_6

The PFC emissions relate to alluminium production. In 1996, a modern technology was applied. Many HF and other fluorides are recycled back in the production process. Three scenarios were projected:

- scenario without measures that represent the current level of production and status of technology,
- scenario with measures that assumes to improved technology improvements towards meeting emissions cap after 2005,
- scenario with additional measures assumes that emissions of carbon will not be generated after 2025 as the result of installment of inert anodes.

Only two scenarios were applied in the case of HFC and SF_6 emissions:

- scenario without measures that does not consider any measures after 2003,
- scenario with additional measures that assumes the effect of a proposed Regulation of the EC for F-gases (table 5.9).

Table 5.9 Projections of emissions PFCs HFCs and SF_6 (Gg CO_2 equivalent)

	1990*	2003	2005	2010	2015	2020	2025
Scenario without measures	271	169	210	318	353	334	334
2.F – PFCs		21	21	21	21	21	21
2.F – HFCs		133	173	279	311	291	291
2.C - SF6		15	16	19	21	22	22
Scenario with measures	271	169	201	309	343	325	325
2.F – PFCs		21	12	12	12	12	12
2.F – HFCs		133	173	279	311	291	291
2.C - SF6		15	16	19	21	22	22
Scenario with additional measures	271	169	173	182	194	190	178
2.F - PFCs		21	12	12	12	12	0
2.F - HFCs		133	145	156	166	163	163
2.C - SF6		15	16	15	17	16	16

* Emissions in base year for the KP

Total aggregated GHG emissions in the Industrial Processes sector

Total anthropogenic GHG emissions are shown in table 5.10. These are expressed as the sum of CO_2 emissions of non-energy origin, N_2O emissions and F-gases.

Table 5.10 Total aggregated GHG emissions (Gg CO_2 equivalent) in the Industrial Processes

	1990*	2003	2005	2010	2015	2020	2025
Without measures	4 264	3 938	4 188	5 178	6 350	7 649	9 048
Emissions of CO_2 non-energy origin in industry	3 484	2 984	3 164	3 894	4 873	6 069	7 468
Emission of N_2O	508	784	814	965	1 124	1 245	1 245
Emission of F-gases	271	169	210	318	353	334	334
With measures	4 264	3 938	4 178	5 169	6 336	7 634	9 033
Emissions of CO_2 non-energy origin in industry	3 484	2 984	3 164	3 894	4 873	6 069	7 468
Emission of N_2O	508	784	814	965	1 120	1 240	1 240
Emission of F-gases	271	169	201	309	343	325	325
With additional measures	4 264	3 938	4 151	5 042	6 059	6 502	7 889
Emissions of CO_2 non-energy origin in industry	3 484	2 984	3 164	3 894	4 873	6 069	7 468
Emission of N_2O	508	784	814	965	992	243	243
Emission of F-gases	271	169	173	182	194	190	178

* Emissions in base year for the KP

5.3 Projections of GHG emissions in the Agriculture sector

5.3.1 Basic development scenarios for development in Agriculture after 2005

Proposals of the scenarios are based on national policies in agriculture and forestry developed in 1999-2004. These policies deal with changes in livestock, animal waste management and methods of agriculture practice. Internal factors include measures stipulated in the "Analysis of the Agriculture and Food Processing in 1990-1990" and "Medium-term Concept of Agriculture" adopted in 2004. External factors are the result of international relationships and international agriculture market of the EU and the OECD. Available are projections under Economic Service of the UES and the WTO.

5.3.2 Projections of CH_4 emissions in the Agriculture sector

Methane sources in the agriculture were discussed in the chapter 4. The main potential to reduce emissions includes:

- reduction in the number of livestock, changes in the structure of livestock,
- processing of animal waste and production of bio-gas.

The following scenarios are proposed:

- Scenario without measures that is determined in the Medium-term Concept of Agriculture. This document is in line with the requirements of the EU. The scenario does not take into account adaptation measures. The level of emissions is determined by the number of livestock,
- Scenario with measures is based upon the development of the agriculture sector as indicated in the Medium-term Concept of Agriculture. The scenario also includes the application of adaptation measures - processing of part of animal waste into the bio-gas,
- Scenario with additional measures does not consider further adaptation measures (table 5.11).

Table 5.11 Projections of CH_4 emissions (Gg) in the Agriculture sector

Scenario	1990	2003	2005	2010	2015	2020	2025
Without measures	135.15	57.01	54.11	41.98	37.03	35.06	33.93
4.A Enteric Fermentation	116.30	47.75	45.87	33.25	28.62	26.79	25.75
4.B Manure Management	18.85	9.26	8.24	8.73	8.41	8.27	8.18
With measures	135.15	57.01	54.11	41.98	37.03	35.06	33.93
4.A Enteric Fermentation	116.30	47.75	45.87	33.25	28.62	26.79	25.75
4.B Manure Management	18.85	9.26	8.24	8.73	8.41	8.27	8.18
With additional measures	135.15	57.01	53.26	39.76	33.33	30.04	28.80
4.A Enteric Fermentation	116.30	47.75	45.87	33.25	28.62	26.79	25.75
4.B Manure Management	18.85	9.26	7.39	6.51	4.71	3.25	3.05

* Emissions in base year for the KP

5.3.3 Projections of N_2O emissions in Agriculture sector

- Reference scenario (scenario without measures) is based on the development of livestock and inputs of nitrogen. The scenario does not consider the application of adaptation measures that would lead to the reduction of N_2O emissions,
- Scenario with measures assumes intensification in the area of animal nutrition, application of effective fodders. Although, current data on pure amino acids and other auxiliaries are not available, after 2010, it is assumed that they will be applied. This scenario is based on the concept of high dynamics of animal and vegetable productions. It is expected that animal and vegetable productions will require higher application of fertilizers that will result in higher concentration of mineralized nitrogen in the soil. Intensive cultivation of corn and crop is expected in the lowlands; mountain areas will be used as pastures. It is estimated that measures aimed to reduce emissions might be applied for 80 % of the livestock population,
- Scenario with additional measures assumes higher application of fertilizes and animal waste in the soil. The emission reduction depends on the technical performance of farms. Only the partial effect of N_2O reduction is anticipated (table 5.12).

5.3.4 Total aggregated GHG emissions in the Agriculture sector

Total aggregated GHG emissions according to the considered scenarios in the Agriculture sector are shown in table 5.13.

Table 5.12 Projections of N_2O emissions (Gg)in Agriculture sector

Scenario	1990	2003	2005	2010	2015	2020	2025
Without measures	16.20	9.09	5.28	6.07	6.34	6.75	7.19
4.B Manure Management	3.61	1.50	1.39	1.12	1.01	0.97	0.94
4.D Agriculture Soil	12.59	7.59	3.88	4.95	5.33	5.78	6.25
With measures	16.20	9.09	5.28	5.82	6.00	6.30	6.64
4.B Manure Management	3.61	1.50	1.39	0.87	0.66	0.52	0.40
4.D Agriculture Soil	12.59	7.59	3.88	4.95	5.33	5.78	6.25
With additional measures	16.20	9.09	5.28	4.83	4.61	4.52	4.46
4.B Manure Management	3.61	1.50	1.39	0.87	0.66	0.52	0.40
4.D Agriculture Soil	12.59	7.59	3.88	3.96	3.95	4.00	4.07

* Emissions in base year for the KP

5.3.4 Total aggregated GHG emissions in the Agriculture sector

Total aggregated GHG emissions according to the considered scenarios in the Agriculture sector are shown in table 5.13.

Table 5.13 Total aggregated GHG emissions (Gg CO_2 equivalent) in the Agriculture sector

Scenario	1990	2003	2005	2010	2015	2020	2025
Without measures	7 860	4 015	2 772	2 763	2 744	2 828	2 941
4.A Enteric Fermentation	2 442	1 003	963	698	601	563	541
4.B Manure Management	1 515	659	605	531	490	473	463
4.D Agriculture Soil	3 903	2 353	1 203	1 534	1 653	1 792	1 936
With measures	7 860	4 015	2 772	2 687	2 637	2 690	2 772
4.A Enteric Fermentation	2 442	1 003	963	698	601	563	541
4.B Manure Management	1 515	659	605	454	382	335	295
4.D Agriculture Soil	3 903	2 353	1 203	1 534	1 653	1 792	1 936
With additional measures	7 860	4 015	2 754	2 333	2 129	2 032	1 989
4.A Enteric Fermentation	2 442	1 003	963	698	601	563	541
4.B Manure Management	1 515	659	587	408	305	230	187
4.D Agriculture Soil	3 903	2 353	1 203	1 227	1 224	1 240	1 261

* Emissions in base year for the KP

5.4 Projections of GHG emissions in the sector LULUCF

Projections of CO_2 sinks in the forestry and land use were modeled based upon the measures defined in this sector (18) and include the following areas:

- afforestation of non-forest areas,
- protection against forest fires.

In addition to the reference level for projections of CO_2 sinks, the effects of individual measures in two alternatives were assessed. These alternatives involve minimum and maximum effects of a given measure. The reference level refers to basic concepts of agriculture and forestry development (the Forest Policy till 2005, the Medium-term Concept of Agriculture in 2004 -2006). The results are shown in table 5.14 according to individual landscape types as required by the IPCC method and the COP recommendations. The projections are divided into three scenarios.

- scenario without measures corresponds to the current status of forest management according to valid legislation and estimated development of forests without implementation specific measures,
- scenario with measures refers to measures implemented before the end of 2005. In the period of 2000 - 2005, any mitigation measures have not been implemented, this the scenario is identical with the scenario without measures,
- scenario with additional measures represents the effect of anticipated measures after 2005. This includes mitigation measures with respect to afforestation projects as stipulated in the Decision of the European Agriculture Fond of Rural Development for 2007 - 2013 and the Decisions "Forest Focus" (dealing with protection against fires).

The first two scenarios correspond to the current development of CO_2 emissions under the LULUCF category in 1990 - 2003. The whole period represents the CO_2 sink of 1 - 5 Tg of CO_2. An exception is the year 2005 when a wind calamity impacted the CO_2 sink development. The third scenario estimate afforestation of 25 thousand ha of grass areas until 2030. The implementation of the "Forest Focus" program will reduce the risk of forest fires to the level of 90 % of the period 2000 - 2003.

Table 5.14 Projections of CO_2 sink (Gg)

Scenario	1990*	2003	2005	2010	2015	2020	2025
Without measures	-2 407	-4 833	2 098	-443	-555	-1 059	-1 688
5.A – Forest Land	-4 454	-5 156	1 770	-773	-885	-1 389	-2 018
5.B – Crop Land	3 287	1 416	1 425	1 430	1 430	1 430	1 430
5.C – Grassland	536	-1 363	-1 370	-1 375	-1 375	-1 375	-1 375
5.F – Other Land	-1 775	269	273	275	275	275	275
With measures	-2 407	-4 833	2 098	-443	-555	-1 059	-1 688
5.A – Forest Land	-4 454	-5 156	1 770	-773	-885	-1 389	-2 018
5.B – Crop Land	3 287	1 416	1 425	1430	1430	1 430	1 430
5.C – Grassland	536	-1 363	-1 370	-1375	-1375	-1 375	-1 375
5.F – Other Land	-1 775	269	273	275	275	275	275
With additional measures	-2 407	-4 833	2 089	-508	-653	-1 245	-1 908
5.A – Forest Land	-4 454	-5 156	1 767	-812	-947	-1 509	-2 168
5.B – Crop Land	3 287	1 416	1 423	1 421	1 417	1 405	1 404
5.C – Grassland	536	-1 363	-1 372	-1 388	-1 393	-1 408	-1 410
5.F – Other Land	-1 775	269	271	272	271	267	266

* Emissions in base year for the KP

Table 5.15 Projections of CH_4 from forest fires (Gg)

Scenario	1990*	2003	2005	2010	2015	2020	2025
Without measures	NE	0.730	0.730	0.750	0.750	0.750	0.750
With measures	NE	0.730	0.730	0.750	0.750	0.750	0.750
With additional measures	NE	0.730	0.720	0.710	0.700	0.700	0.700

* Emissions in base year for the KP, NE = Not Estimated

Tabul'ka 5.16 Projections of N_2O from forest fires (Gg)

Scenario	1990*	2003	2005	2010	2015	2020	2025
Without measures	NE	0.730	0.730	0.750	0.750	0.750	0.750
With measures	NE	0.730	0.730	0.750	0.750	0.750	0.750
With additional measures	NE	0.730	0.720	0.710	0.700	0.700	0.700

* Emissions in base year for the KP, NE = Not Estimated

Table 5.17 Total aggregated GHG emissions (Gg CO_2 equivalent) in the sector LULUCF

Scenario	1990*	2003	2005	2010	2015	2020	2025
Without measures	-2 345	-4 815	2 116	-424	-536	-1 040	-1 669
With measures	-2 345	-4 815	2 116	-424	-536	-1 040	-1 669
With additional measures	-2 345	-4 815	2 107	-490	-635	-1 228	-1 891

* Emissions in base year for the KP, NE = Not Estimated

5.5 Projections of GHG emissions in the Waste sector

5.5.1 Projections of CO_2 emissions from waste incineration

The incineration of waste was modeled under the sector 1A.5.a. Only one scenario is projected for this activity. It is expressed under the aggregated scenarios of the Waste sector.

5.5.2 Projections of CH_4 emissions in waste handling and wastewaters

The projections of scenarios until 2025 are based on the current status in the production and composition of waste. It also includes trends in the development of waste generation as stipulated in the national legislation that was approximated with the EU Directives. Projections of methane emissions from the treatment of municipal wastewater comprise time horizons as stipulated in the Directive 91/271/EC. This Directive requires an increase of municipal wastewater treatment and thus, an increase of methane emissions generation. Individual legal measures are discussed in chapter 4. The implementation of measures are incorporated into the following scenarios:

- reference scenario (without measures) represents the current status and it is an extrapolation of the measures adopted before 2003,
- scenario with measures represent measures that will be implemented after 2003. These measures include:
  1. support of separated collection and composting of biological waste that will lead to the reduction of biodegradable components at landfills,
  2. removal and utilization (or incineration) of landfill gases that will lead to decrease of CH_4 emissions,
- scenario with additional measures includes anticipated policy and legislation.

The program anticipates the implementation of the following objectives in the area of municipal waste management:

- to reach material recovery of municipal waste by 35 % by the year 2005,
- energy recovery of municipal waste by 15 %,
- landfill of municipal waste by 50 %,
- to reduce landfilling of biologically degradable municipal waste by 30 % by 2005 compared to the year 2000,
- to reduce incineration of biodegradable municipal waste by 10 % in 2005 compared to the year 2000,
- to reach 35 % share of composting of biodegradable components of municipal waste by 2005,
- to provide sewage systems and appropriate municipal waste water treatment in agglomerations of 2 000 - 10 000 PE by 2015,
- to provide sewage systems and appropriate municipal waste water treatment in agglomerations of more than 10 000 PE by 2010 (table 5.18).

Table 5.18 CH_4 emissions from waste (Gg)

Scenario	1990*	2003	2005	2010	2015	2020	2025
Without measures	98.00	97.87	98.71	99.77	101.06	101.84	102.72
6.A Solid Waste Disposal on Land	50.00	65.76	66.73	67.70	68.90	69.63	70.60
6.B.2 Domestic and Commercial Wastewater	28.00	25.93	25.91	25.82	25.68	25.43	25.05
6.B.1 Industrial Wastewater	20.00	6.18	6.07	6.25	6.48	6.78	7.07
6.B Wastewater Handling	48.00	32.11	31.98	32.07	32.16	32.21	32.12
With measures	98.00	97.87	95.05	89.04	83.82	77.64	69.73
6.A Solid Waste Disposal on Land	50.00	65.76	63.40	58.84	54.42	50.13	45.99
6.B.2 Domestic and Commercial Wastewater	28.00	25.93	25.58	24.26	23.56	21.73	18.05
6.B.1 Industrial Wastewater	20.00	6.18	6.07	5.94	5.84	5.78	5.69
6.B Wastewater Handling	48.00	32.11	31.65	30.20	29.40	27.51	23.74
With additional measures	98.00	97.88	80.29	72.10	63.29	54.81	46.60
6.A Solid Waste Disposal on Land	50.00	65.76	50.17	43.73	37.57	31.68	26.06
6.B.2 Domestic and Commercial Wastewater	28.00	25.94	24.35	22.74	20.20	17.69	15.21
6.B.1 Industrial Wastewater	20.00	6.18	5.77	5.63	5.52	5.44	5.33
6.B Wastewater Handling	48.00	32.12	30.12	28.37	25.72	23.13	20.54

* Emissions in base year for the KP

5.5.3 Projections of N_2O emissions in waste management

Projections of N_2O emissions were modeled in two scenarios:

- scenario without measures assumes that the amount of municipal wastewaters that are subject of nitrogen removal will not increase,
- scenario with measures represents the situations that amount of wastewater treatment will include nitrogen removal and after 2025 will gradually increase.

The ISI method is based on the data on the number of inhabitants that are connected to the wastewater treatment with the nitrogen removal process. Therefore estimates are defined based upon the number of inhabitants and are listed in Annex P.2.5. It is estimated that industrial wastewater will be treated by the removal of nitrogen after 2025. The table 5.19 shows projections in the sector of municipal and industrial wastewaters in the time horizon to 2025.

Table 5.19 Projections of N_2O emissions (Gg) from wastewater handling

Scenario	1990*	2003	2005	2010	2015	2020	2025
Without measures	0.130	0.089	0.089	0.090	0.090	0.091	0.092
6.B.2 Domestic and Commercial Wastewater	0.065	0.051	0.051	0.051	0.051	0.051	0.051
6.B.1 Industrial Wastewater	0.065	0.031	0.031	0.031	0.031	0.031	0.031
6.B Wastewater Handling	0.130	0.081	0.081	0.081	0.081	0.081	0.081
6.C Waste Incineration	IE	0.008	0.008	0.008	0.009	0.010	0.010
With measures	0.130	0.089	0.089	0.121	0.131	0.135	0.140
6.B.2 Domestic and Commercial Wastewater	0.065	0.051	0.051	0.070	0.076	0.079	0.081
6.B.1 Industrial Wastewater	0.065	0.031	0.031	0.042	0.046	0.047	0.049
6.B Wastewater Handling	0.130	0.081	0.081	0.112	0.123	0.126	0.129
6.C Waste Incineration	IE	0.008	0.008	0.008	0.009	0.010	0.010
With additional measures	0.130	0.089	0.089	0.121	0.131	0.135	0.140
6.B.2 Domestic and Commercial Wastewater	0.065	0.051	0.051	0.070	0.076	0.079	0.081
6.B.1 Industrial Wastewater	0.065	0.031	0.031	0.042	0.046	0.047	0.049
6.B Wastewater Handling	0.130	0.081	0.081	0.112	0.123	0.126	0.129
6.C Waste Incineration	IE	0.008	0.008	0.008	0.009	0.010	0.010

* Emissions in base year for the KP
IE = Included Elsewhere

5.5.4 Total aggregated GHG emissions in Waste sector

Table 5.20 shows total aggregated GHG emissions in the Waste sector.

5.6 Projections of total aggregated GHG emissions

Projections of total aggregated emissions were calculated for three scenarios: without, with and with additional measures. Figures of projected emission levels in cross years are given in table 5.21.

Projections of aggregated GHG emissions in 2000 - 2015 are shown in figure 5.2. Observed trends clearly indicate that the Kyoto Protocol reduction objective will be achieved for the time horizon by 2010 even for the reference without measure scenario. As has been already noted, according to current projections further reduction of emissions during the post-Kyoto period will be complicated to achieve even for the scenario with additional measures.

Table 5.20 Total aggregated GHG emissions (Gg CO_2 equivalent) in the Waste sector

Scenario	1990*	2003	2005	2010	2015	2020	2025
Without measures	2 098	2 223	2 243	2 271	2 307	2 334	2 365
6.A Solid waste Disposal on Land	1 050	1 381	1 401	1 422	1 447	1 462	1 483
6.B Wastewater Handling	1 048	700	697	699	701	702	700
6.C Waste Incineration	NE	143	145	151	160	170	183
With measures	2 098	2 223	2 166	2 056	1 958	1 839	1 687
6.A Solid waste Disposal on Land	1 050	1 381	1 331	1 236	1 143	1 053	966
6.B Wastewater Handling	1 048	700	690	669	655	617	539
6.C Waste Incineration	NE	143	145	151	160	170	183
With additional measures	2 098	2 223	1 856	1 700	1 527	1 360	1 202
6.A Solid waste Disposal on Land	1 050	1 381	1 054	918	789	665	547
6.B Wastewater Handling	1 048	700	658	631	578	525	471
6.C Waste Incineration	NE	143	145	151	160	170	183

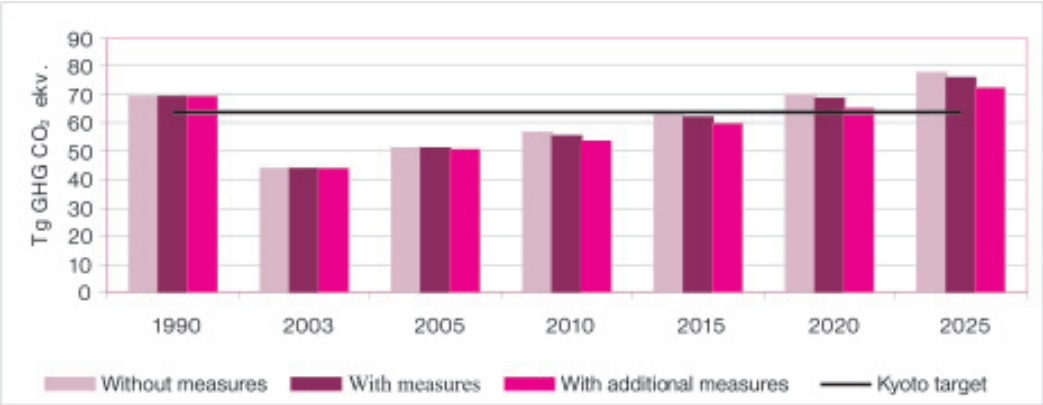
* Emissions in base year for the KP
NE Not Estimated

Table 5.21 Projections of aggregated emissions (Gg CO_2 equivalent)

Scenario	1990*	2003	2005	2010	2015	2020	2025
Without measures	69 553	44 013	50 956	56 458	63 270	70 172	77 707
Energy	57 676	38 651	39 637	46 670	52 405	58 402	65 023
- of which transport	*5 169*	*5 371*	*5 649*	*6 350*	*6 821*	*7 017*	*6 991*
Industrial processes	4 264	3 938	4 188	5 178	6 350	7 649	9 048
Agriculture	7 860	4 015	2 772	2 763	2 744	2 828	2 941
LULUCF	-2 345	-4 815	2 116	-424	-536	-1 040	-1 669
Waste	2 098	2 223	2 243	2 271	2 307	2 334	2 365
With measures	69 553	44 013	50 870	55 336	61 902	68 522	75 721
Energy	57 676	38 651	39 637	45 850	51 507	57 399	63 898
- of which transport	*5 169*	*5371*	*5649*	*6 350*	*6 821*	*7 017*	*6 991*
Industrial processes	4 264	3 938	4 178	5 169	6 336	7 634	9 033
Agriculture	7 860	4 015	2 772	2 687	2 637	2 690	2 772
LULUCF	-2 345	-4 815	2 116	-424	-536	-1 040	-1 669
Waste	2 098	2 223	2 166	2 056	1 958	1 839	1 687
With additional measures	69 553	44 013	50 505	53 634	59 682	65 102	72 071
Energy	57 676	38 651	39 637	45 050	50 602	56 435	62 882
- of which transport	*5 169*	*5 371*	*5 649*	*6 027*	*6 471*	*6 655*	*6 631*
Industrial processes	4 264	3 938	4 151	5 042	6 059	6 502	7 889
Agriculture	7 860	4 015	2754	2 333	2 129	2 032	1 989
LULUCF	-2 345	-4 815	2 107	-490	-635	-1 228	-1 891
Waste	2 098	2 223	1 856	1 700	1 527	1 360	1 202

* Emissions in base year for the KP

Figure 5.2 Projections of aggregated GHG emissions



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6. Expected impacts of climate change, vulnerability assessment and adaptation measures

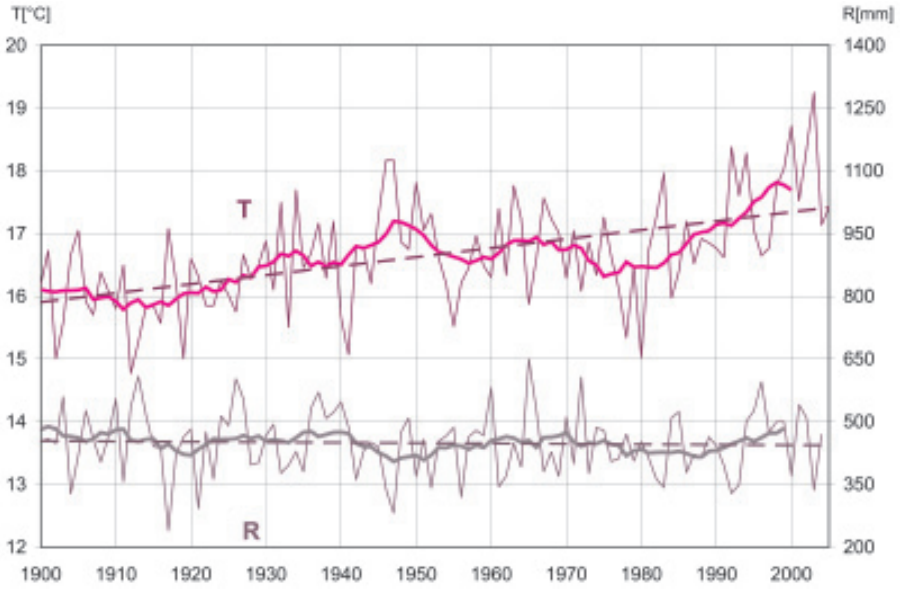
This chapter deals with the evaluation of research results on climate change and variability in Slovakia; preparation of regional scenarios of climate change till 2100; estimates of vulnerability of selected social and economic sectors and proposal of adaptation measures to mitigate negative impacts and utilization of positive consequences of climate change in Slovakia. The data used come from the National Climate Program of the Slovak Republic, research projects results, the reports of the IPCC and other relevant sources. Analysis of all documents confirms that climate change and variability might result in negative impacts. The analysis also shows that there are several effective solutions to mitigate potential damage caused by the climate change.

6.1 Climate change in Slovakia in recent years

In Slovakia, the average annual temperature of the air increased by about 1.1 °C and annual atmospheric precipitation decreased by about 5.6 % in the 20th century. In southern Slovakia, the decrease was more than 10 % of total precipitation; in the north and northeast of Slovakia, an increase of up to 3 % over the century was documented. A significant decrease in the relative humidity of the air of up to 5 % and a decrease in snow coverage over the whole territory were recorded. In addition, potential and actual evaporation, soil humidity and total radiation balance changes confirm a gradual desertification of Slovakia. However, characteristics of sun radiation did not change significantly (except for a decrease in 1965-1985). Similar development continues after 2000 (Figures 6.1, 6.2).

Figure 6.1 Development of average air temperature (T) at Hurbanovo and areal atmospheric precipitation (R) in Slovakia (from 203 stations) during warm half-years (April-Sept.) in 1900 - 2004

The Hurbanovo station is a representative station in Slovakia and it is one of the best metrological stations in Central Europe. In the period of 1871-2004, the linear trend in increase of average annual air temperature was 1.4 °C. This temperature increase is typical also for other localities in Slovakia. Precipitation developments slightly differ in the south and north localities. The graphs illustrate enormous the development in air temperature and precipitation over the last decade in Slovakia.



6.2 Climate change scenarios in Slovakia

Totally nine General circulation models (GCMs, models of the atmospheric general circulation) from four world climate centers have been utilized in Slovakia. The most important are models CCCM 2000 and GISS 1998.

The method of statistical downscaling is used in regional modification of the GCMs outputs. This means that outputs from global climate models are statistically interpolated to individual selected points in Slovakia. The sets of measured data are also applied. Climate change scenarios are provided with regard to annual development of individual climate elements for certain time horizons. The scenarios also include time scales of selected elements up to 2100. Climate change scenarios are developed for several climate elements, such as air temperature, atmospheric precipitation, global solar radiation, and air humidity. Illustration of scenarios for monthly average air temperature and monthly precipitation totals are shown in tables 6.1 and 6.2. The tables are designed for 50-year time horizons 2010 (1986-2035), 2030 (2006-2055) and 2075 (2051-2100) for middle and whole Slovakia according to outputs of three GCMs models. While temperature scenarios might be used for the whole of Slovakia, precipitation scenarios vary at individual stations by more than 10 % (in winter, there is higher increase in precipitation in the north, in summer, there is a higher decrease in the south).

In addition to the method based upon the outputs of climatic models, the analogue method of climate change scenarios is also being developed in Slovakia. A combined method that uses the GCMs scenarios for air temperature and precipitation and analogues obtained by correlation and regression methods for some other variables has been developed as well. As an example snow cover, wind, evaporation, soil humidity, and runoff can bee listed. The scenarios developed purely based upon the GCM models are not reliable for these parameters for the whole territory of Slovakia.

The IPCC has updated the emissions scenarios in 2001 that were used in the Third Assessment Report (TAR). New emission scenarios (called as SRES) replaced the emission scenarios IS92.

The average annual air temperature increases for Hurbanovo in 1990-2100 (according to all three scenarios of CCCM 2000 model, Figure 6.3). It should be noted that current development of the world economy and the world GHG emissions copes with the scenario A2 -SRES.

Figure 6.2 Development of average air temperature (T) at Hurbanovo and areal atmospheric precipitation (R) in Slovakia (from 203 stations) during cold half-years (Oct.-March) in 1900-2004

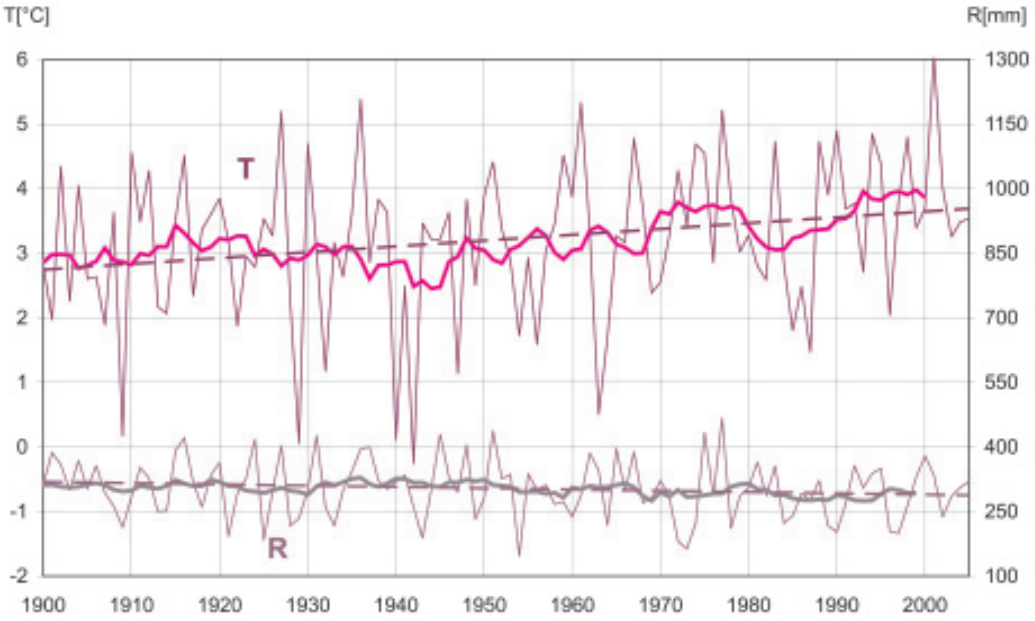


Figure 6.3 Scenarios of annual average air temperature [°C] at Hurbanovo in 1990-2100 according to CCCM 2000 model based upon different emission scenarios

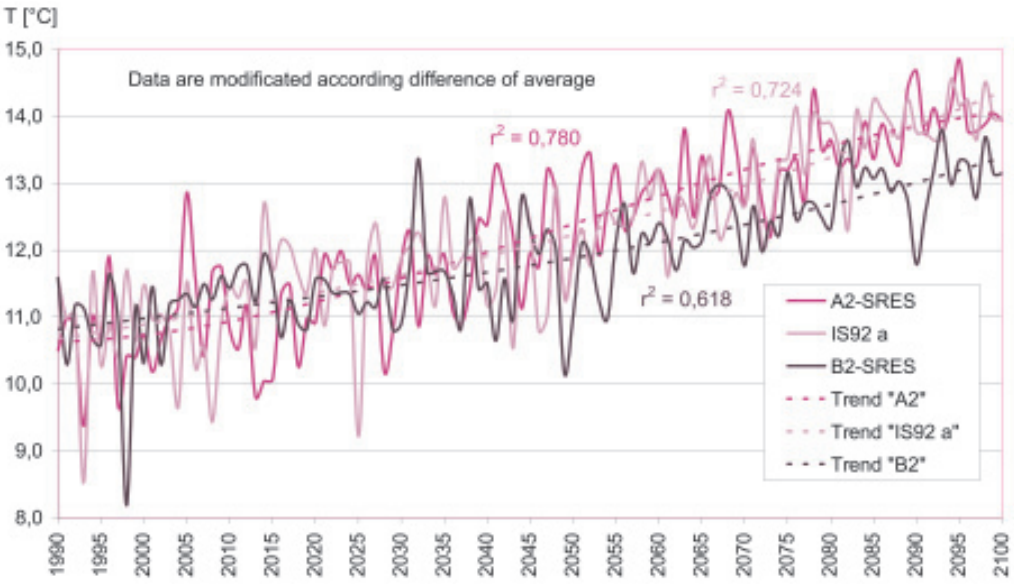


Table 6.1 Scenarios of monthly average air temperature changes [°C] in 50-year horizons regionally adjusted for Slovakia in comparison with the normal of 1951-1980 according to GCMs (CCCM 1997, CCCM 2000, and GISS 1998)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Horizons	CCCM 1997											
2010	0.5	0.7	0.9	0.7	0.4	0.6	0.9	1.0	1.0	0.9	0.6	0.4
2030	0.9	1.2	1.4	1.1	0.8	1.1	1.4	1.5	1.6	1.2	0.7	0.7
2075	2.2	2.9	2.8	2.3	2.3	2.9	3.4	3.6	3.6	3.0	2.0	1.8
	CCCM 2000											
2010	0.6	0.8	1.9	1.8	1.5	0.8	1.4	1.2	1.2	0.9	0.3	0.4
2030	1.4	1.5	2.6	2.4	2.0	1.3	2.0	1.8	1.6	1.3	0.8	1.2
2075	3.5	4.2	4.8	3.8	3.2	2.7	3.5	3.4	3.3	3.0	2.2	2.6
	GISS 1998											
2010	0.3	0.3	0.5	0.7	0.7	0.6	0.6	0.4	0.3	0.5	0.6	0.5
2030	1.2	1.0	0.8	0.8	0.9	0.8	0.8	0.7	0.7	0.9	1.2	1.2
2075	2.7	2.4	2.3	2.2	1.9	1.8	2.1	2.4	2.3	2.3	2.6	2.8

Table 6.2 Scenarios (quotients) of monthly precipitation total changes in 50-year horizons for middle Slovakia in comparison with the normal of 1951-1980 according to GCMs (CCCM 1997, CCCM 2000 and GISS 1998)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Horizons	CCCM 1997											
2010	1.03	0.97	1.08	1.00	1.09	0.95	0.93	0.94	1.04	1.08	1.07	1.03
2030	1.05	0.99	1.12	1.06	1.13	0.97	0.94	0.95	1.05	1.10	1.11	1.06
2075	1.22	1.12	1.17	1.04	1.07	0.87	0.89	0.94	1.03	1.09	1.18	1.20
	CCCM 2000											
2010	1.05	0.98	1.06	0.98	1.06	0.91	0.90	0.92	1.06	1.13	1.11	1.04
2030	1.06	1.02	1.11	0.99	1.02	0.86	0.84	0.89	1.05	1.13	1.13	1.06
2075	1.14	1.10	1.18	1.01	1.06	0.88	0.84	0.92	1.11	1.18	1.17	1.11
	GISS 1998											
2010	0.98	0.97	0.98	1.01	1.02	1.00	0.98	1.02	1.06	1.03	1,00	1.00
2030	0.96	0.98	1.00	1.01	1.02	1.01	0.98	1.02	1.07	1.03	0.98	0.96
2075	1.18	1.16	1.10	1.07	1.05	0.99	0.97	0.98	1.02	1.05	1.05	1.10

The second phase of statistical modification is used in concrete applications. It means that time variability of annual, monthly and daily values measured in a specific reference period of the 20th century is modified (Figure 6.4). It should be noted that the values of individual months and years should not be considered as a forecast. The models intend to express the temporal variability and trends at individual parameters (change of climate regime). In this study, the examples of outputs of CCCM 2000 model are shown. Similar results were obtained from other models (tables 6.1 and 6.2).

Annual air temperature changes in the period of 2081-2100 are the highest according to the scenario A2-SRES compared to the period 1971-1990. An average temperature at Hurbanovo might increase by 5.2 °C in March and by 3.3 °C in November (by 3.8 °C per year). The smallest increase is indicated at the scenario B2-SRES, representing a warming by 3.1 °C on average (Figure 6.5).

According to previous emission scenario IS92a and the model CCCM 2000, the annual precipitation at Hurbanovo would slightly decrease in the first half of the 21st century and would increase in the second half of it (Figure 6.6). According to a new scenario A2-SRES, a gradual decrease of atmospheric precipitation is forecast. This decrease is mainly caused by a significant decrease in summer period at the end of the 21st century (Figure 6.7). The drop in precipitation totals is not significant in the north of Slovakia.

The specific air humidity (in grams per kg of the air) at the ground surface (at the height of 2 m) should gradually increase at Hurbanovo according to all three emission scenarios of the CCCM 2000 model. The highest increase of annual averages of specific air humidity is indicated in the original emission scenario IS92a, and very similar according to the scenario A2-SRES. The smallest increase is forecasted in the emission scenario B2-SRES (Figure 6.8).

The increase in specific air humidity is not related to the increase of relative air humidity. However, it is clear that a potential evaporation in the summer will significantly increase and that will result in a decrease of soil humidity in the south Slovakia and a decrease of runoff in mountains areas.

Figure 6.4 Scenarios of annual average air temperature [°C] at Hurbanovo in 2006-2100 according to CCCM 2000 model (data are modified to average and variability in individual months) based upon various emission scenarios (for period 1901 - 2005 values are measured data)

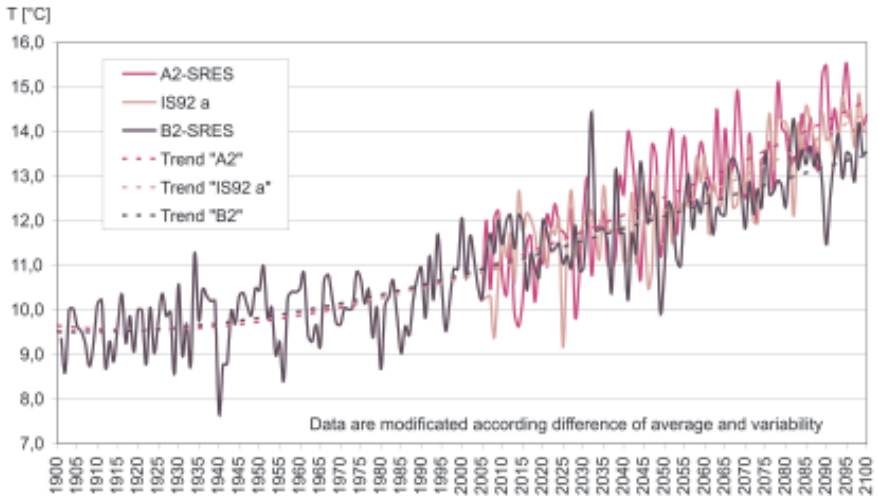


Figure 6.5 Annual air temperature changes [°C] at the 2 m level in 2081-2100 and 1971-1990 at Hurbanovo station according to CCCM 2000 based upon emission scenarios

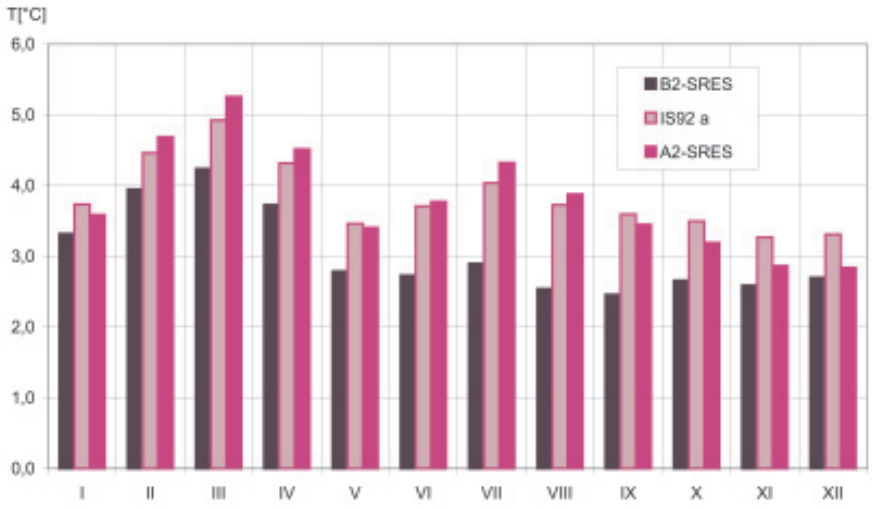


Figure 6.6 The scenarios of annual precipitation totals [mm] at Hurbanovo in 1990-2100 according to CCCM 2000 model based upon various emission scenarios

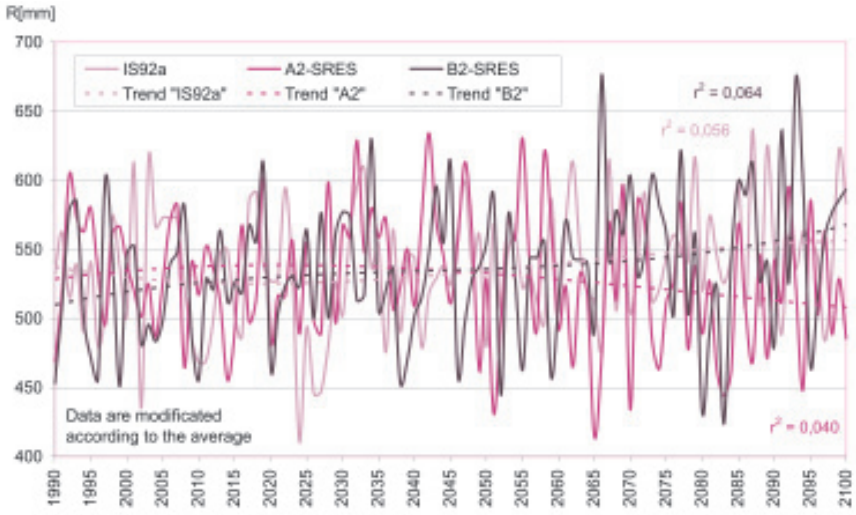


Figure 6.7 Annual precipitation changes expressed as quotients of averages in 2081-2100/1971-1990 at Hurbanovo according to CCCM 2000 model and various emission scenarios

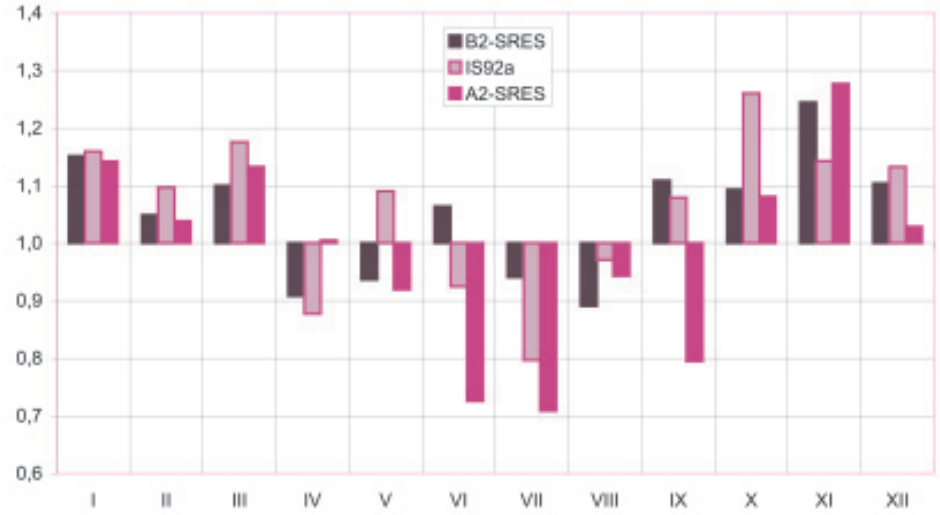
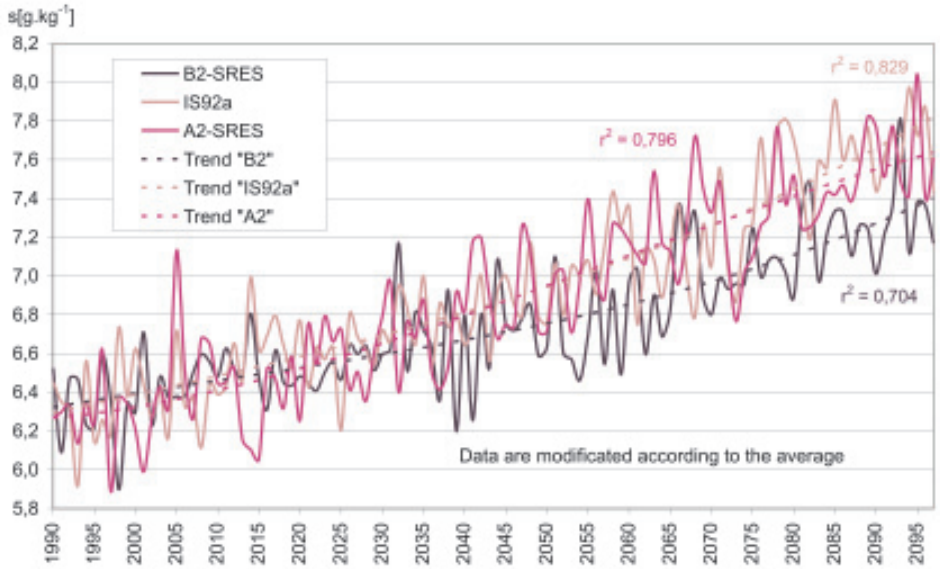


Figure 6.8 The scenarios of annual averages of specific air humidity [g.kg-1] at Hurbanovo in 1990-2097 according to CCCM 2000 model based upon various emission scenarios



6.3 Scenarios of potential changes in distribution of daily values and extremes

The assessments of scenarios result at daily values of air temperature and precipitation at Hurbanovo are shown in Figures 6.9-6.12. These regard emission scenarios A2-SRES and B2-SRES according to the CCCM 2000 model in the 21st century. Annual average air temperature in 30-year periods of 2016-2045 and 2071-2100 at Hurbanovo according to the CCCM 2000 model is compared to measurements in the period of 1961-1990 (Figures 6.9 and 6.10). It is interesting that both scenarios outline well known singularities (so called "Medard cooling" in May and June and "Christmas warming" in December).

Figure 6.9 Annual air temperature (5-day moving averages) [°C] in 2016-2045 and 2071-2100 at Hurbanovo according to the CCCM 2000 model and emission scenario A2-SRES compared to measurements in 1961-1990

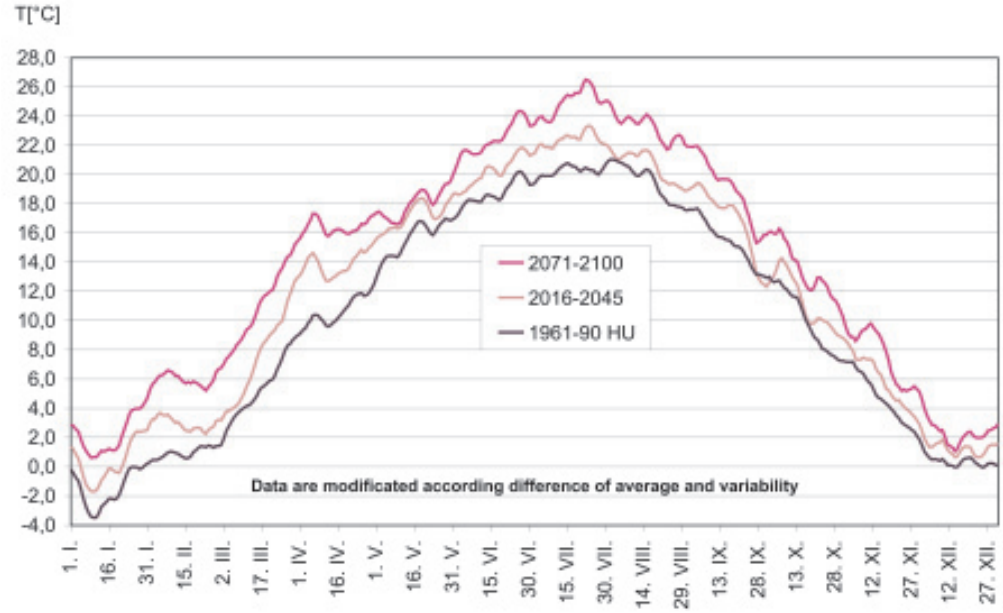
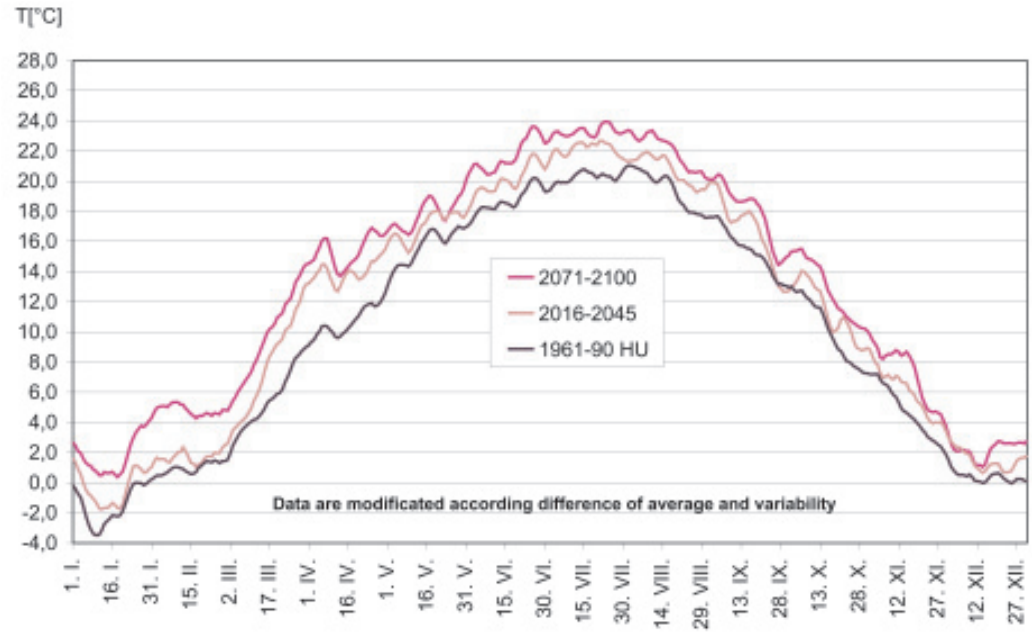


Figure 6.10 Annual air temperature (5-day moving averages) [°C] in 2016-2045 and 2071-2100 at Hurbanovo according to the CCCM 2000 model and emission scenario B2-SRES compared to measurements in 1961-1990



The Figures 6.11 and 6.12 show examples of scenarios for number of days with selected average air temperature development at Hurbanovo. The figures document a dramatic increase in number of very warm days (T 20 °C) by more than 100 % and a decrease of cool days (T -5 °C). In addition, the CCCM model output is in conformity with the measurements from 1951-2004. Vegetative period with the average air temperature T 10 °C might significantly prolong during the 21st century as shown in Figure 6.12.

6.4 Hydrological cycle, water resources and water management

The assessment of climate change impact on the hydrological cycle is carried out based upon mathematic modeling of potential changes of the hydrological regime. Climatic characteristics (air temperature and precipitation) served as the input values. The changes of the hydrological regime were assessed based upon hydrological balance models. A spatial model using GIS methods was developed to construct anticipated changes of long time average runoff. The relationship between average annual runoff, average

annual precipitation and air temperature was assessed. The maps of changes in a long-time average annual precipitation were developed compared to the reference period (1951-1980). The maps including assessment of future average air temperature were used as input maps for the Turc model. The methods of map algebra were applied to calculate areal averages of percentage changes of runoff for selected basins of Slovakia.

The mathematical model of hydrologic balance was used to model the runoff from the basin in monthly steps. The model was developed at the Department of Water Management and Landscape of the STU Bratislava. The default period of 1951-1980 was used to forecast potential climate change.

The assessment of changes of long time average annual flow was carried out in four scenarios, CCCM 97, GISS98, SD and WP. The most optimistic was the scenario CCCM97. The highest decrease in runoff was reached by the scenario WP. The results of selected scenarios are discussed as follows.

The CCCM97 model anticipates both growth and a drop in total precipitation, an increase of average annual air temperature for the total territory of Slovakia in all time horizons. In spite of a slight increase of total precipitation considered in this scenario, most of Slovakia would be impacted by a drop in runoff (Figure 6.15). Almost 64 % of the territory would experience a drop from -5 to -20 % (time horizon 2010) and more than 77 % of the territory would drop from -20 to -40 % (time horizon 2075). Similarly, the drop

Figure 6.11 Development of number of days with the average air temperature 20 °C and -5 °C at Hurbanovo until 2100 according to the CCCM 2000 model and scenario A2-SRES compared to measurements in 1951-2004

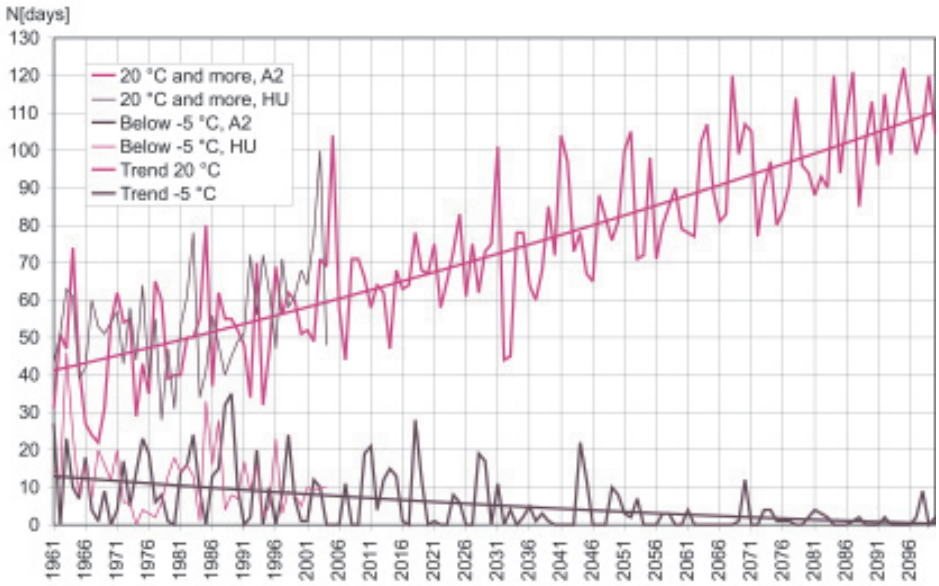
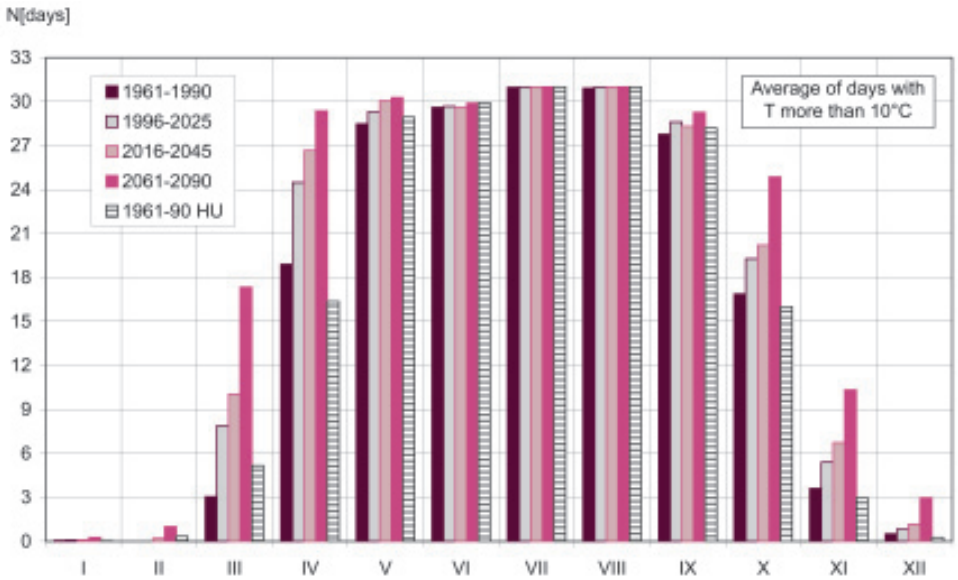


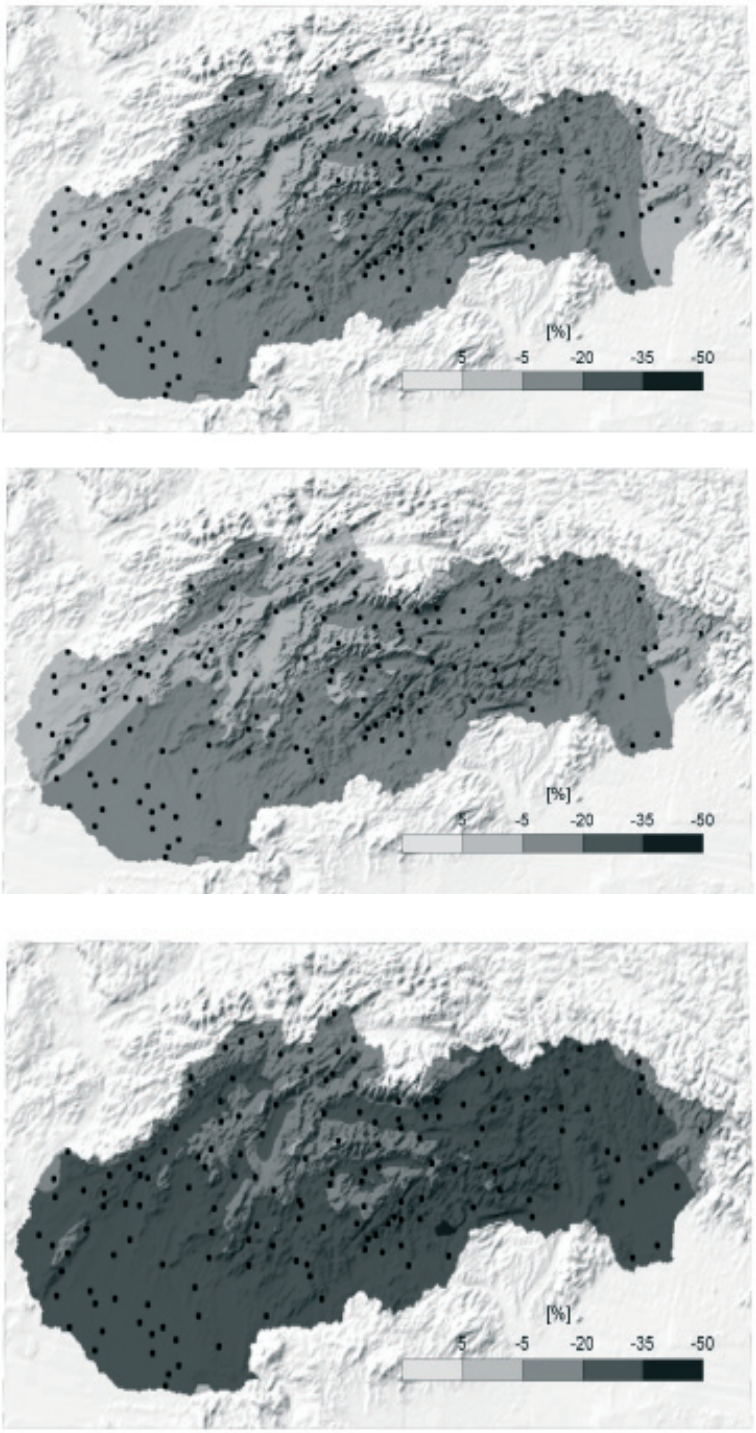
Figure 6.12 Number of days with average air temperature 10 °C at Hurbanovo according to the CCCM 2000 model and scenario A2-SRES compared to measurements in 1961-1990



in runoff would be manifested in different altitudes; the current status would maintain at more than 800 m a. s. l. in 2010 and 2030. Slight or significant drop in runoff is forecast in other altitude zones. The biggest drop is anticipated in lowlands (more than -27 % in 2075 time horizon). Slight runoff drop is forecast in the basins of western Slovakia in the time horizons 2010 and 2030.

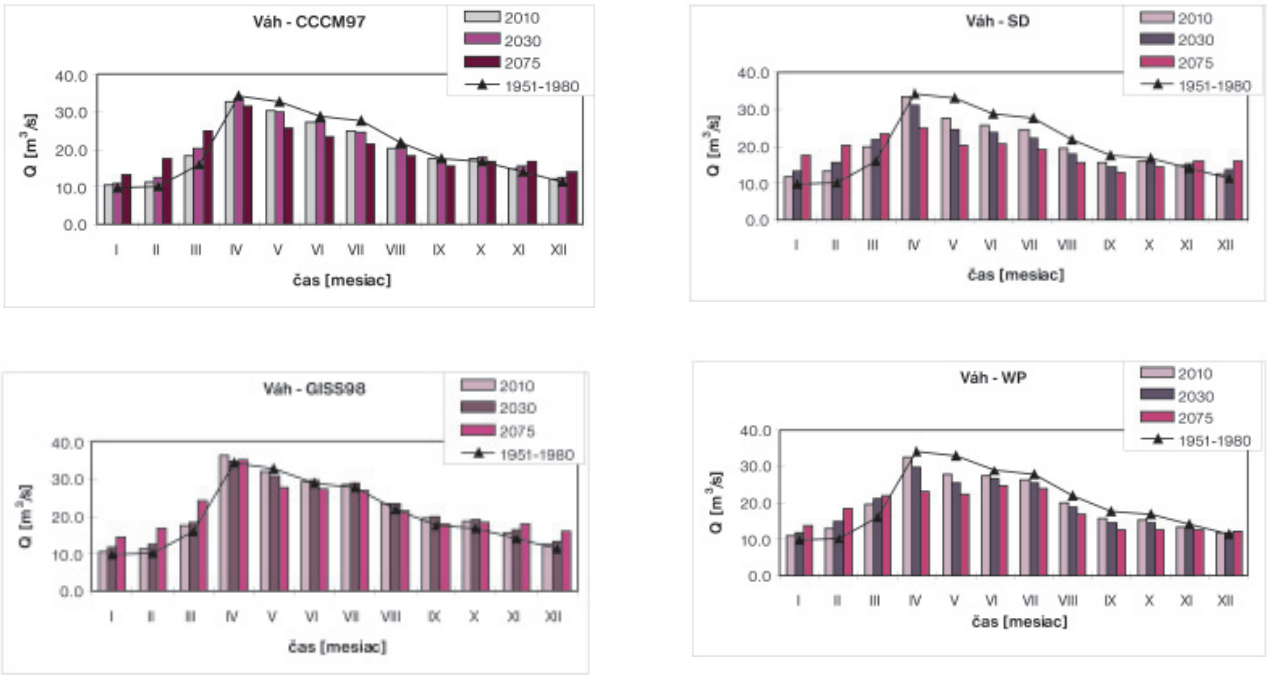
The SD scenario anticipates a decline of average annual precipitation and a growth of annual air temperature for the total territory of Slovakia in all time horizons. Based upon this scenario, more than 81 % of the surface will be in the category of -5 % - -20 % drop in runoff (time horizon 2010) and more than 87 % of the surface will be in the category -20 % - -40 % (time horizon 2030). More than 80 % of the territory of Slovakia would belong to zone of -40 % drop in 2075. The assessment of annual runoff changes with respect to altitude showed that the most significant runoff drop is obvious in the lowlands (time horizon 2010 the drop is about -20 %). The drop of runoff in the time horizon 2075 is more than -47 % compared with the default period. At the altitude above 1500 m a. s. l. the decline varies from -6 % in 2010 to -18 % in 2075 (Figure 6.13).

Figure 6.13 Spatial distribution of changes (%) of long time average annual runoff according to CCCM97 scenario



Based upon the assessment of runoff distribution, changes in long time average monthly flows are anticipated in all regions of Slovakia. In all scenarios and all horizons, the growth of winter and spring runoff and decline of summer and autumn runoff are anticipated. The most affected regions are the south and west parts of Slovakia where the long term average monthly flows might start from February (or March) to November (or December). The most significant drops (up to -70 %) are expected in period from May to July in time horizon 2075. The less affected regions are in the northern Slovakia (Figure 6.14).

Figure 6.14 Comparison of long term average monthly flows in the default period and the future horizons according to individual scenarios in the Vah River Basin (5 550 Liptovsky Mikulas)



The results should be carefully interpreted and uncertainty of methods should be taken into account. Gradual or rapid climate changes are not considered; the status of two quasi-stationary models is compared. Similarly, it is not possible to compare directly the scale of changes. It is recommended to compare the trends in the modeled changes.

6.4.1 Framework adaptation measures to mitigate the negative impacts of changes

Adaptation measures to mitigate the negative impacts of climate changes are formulated very generally. This is due to the uncertainties of impact assessment. In addition, political, social, ecological, economic and technological considerations are necessary. Currently, it is recommended to prefer decisions that decrease the risk of negative impacts of climate change and in the mean time, approaches towards sustainable development should be applied. The latter includes integrated water resources management. This is known as "no regret policy", and requires a capacity building of decision makers.

Basic measures to mitigate potential negative impact in water management deal with several areas:

- direct measures for the water demand side,
- indirect instruments affecting consumer behavior,
- institutional changes toward better water management,
- improvement of the operation of existing water management systems.

In the first area, it could be, for example, a reduction of specific water consumption per capita using technical means, reduction of losses in production and distribution of drinking water, support for the introduction of new technologies in industry, rain harvesting, construction of divided water supply systems in small residential areas and other measures.

The second area should target subsidies and taxes, charges and fines. At the same time, it will be necessary to enhance public awareness on the impacts of climate change on the quality of life in general, and on the issues of water resources and subsequent measures in particular. The information policy should be connected with education for enhanced environmental awareness of consumers with respect to water resources.

The third area concerns better water resources legislation. Current water policy does not take into account the need to prepare adaptation measures. The same problem exists in landscape and urban planning. In addition, it is necessary to assess the sustainable use of water resources for existing water reservoirs.

The fourth area includes several initiatives. It is necessary to deal with the optimization of the exploitation and management of existing water systems. The provision of water supply was seldom determined. Therefore, it would be necessary to examine the vulnerability of the existing water management systems as a whole in critical situations. The forecast trends in the hydrological regime changes indicate an increase demand to reallocate runoff with respect to individual years and during each year. It is necessary to take into account the possibility to compensate for the decline in water resources yield, especially in the lowlands of Central and East Slovakia. It is necessary to assess the possibility of the construction of retention reservoirs that would allow for the regulation of runoff.

In addition, there are measures with respect to monitoring. It is necessary to strengthen the existing systemic monitoring of water quality and water quantity in basins, including smaller ones, in order to improve the identification of water reduction and consequent strategy decisions.

The final area to be given of attention is better management. It is appropriate to implement measures that result in universal effect aimed to a permanent improvement of runoff conditions and improvement in water retention in the country.

6.5 Agricultural production in Slovakia

6.5.1 Change of phenological conditions

Increased temperatures allow for accelerating physiological processes of plants, start of phenophases, phenophases intervals, and vegetation periods. Extension of vegetation periods is forecast up to 43 days in the southern part of Slovakia in 2075 and up to 84 days in northern parts. An example is a head white cabbage with a different vegetation periods. It is forecast that early cabbages will accelerate maturity by about 31 days, late cabbage might be harvested later by 16 days; in total, the vegetation period is to be prolonged by 47 days.

6.5.2 Change of agro-climatic conditions

Change of evapotranspiration

Evapotranspiration deficit is one of the most important characteristics. It is expressed as the difference between potential and actual evapotranspirations (dE = Eo - E in mm). By the end of 2075, it is estimated that there will be an increase in dE by 126 mm in southern Slovakia, and seven times the current state in the northern part. This is an important phenomenon. It is estimated that periods of drought will start in the early months of the year and there will be a shortage of water in the soil at levels up to 400 m a. s. l.

Change of winterizing conditions

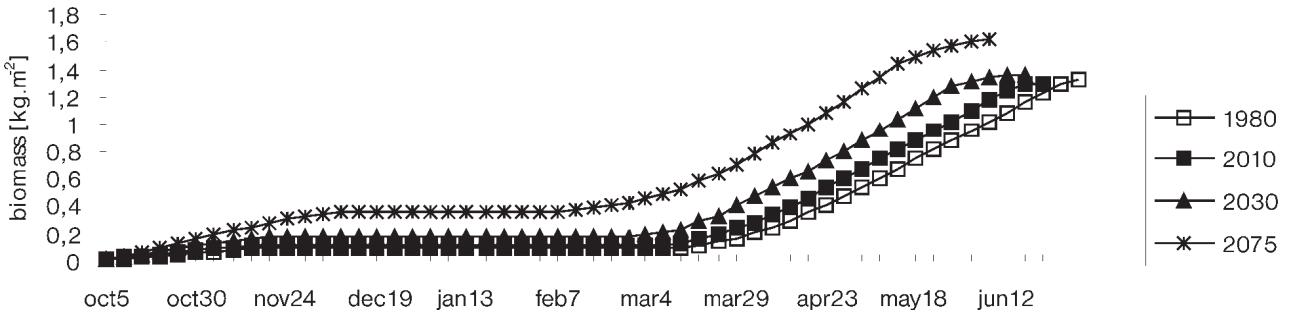
Agro-climatic analyses showed that winterizing conditions are dependent on extreme minimum temperature, height and duration of snow coverage and depth of freezing in the soil. An assessment of the potential impacts of climate change includes an assessment of the physical mechanisms that lead to gradual changes of water balance. The factors involved are reduction of snow stock, early start of positive temperature in the spring, and increase evapotranspiration totals in the winter months. According to the scenarios of the CCCM model, it is estimated that average monthly air temperatures will be positive during the whole year in the Danubian and Zahorie Lowlands from 2030. At Southern and Eastern Slovakia, these features are expected from 2075. Depression areas of the middle and north parts will have negative January temperature up to 2075. At levels above 800 m, negative monthly temperatures are estimated from December to February up to 2075.

6.5.3 Changes of agro-climatic production potential

Changes of photosynthetic active radiation directly impact the extension of the large vegetation period, or main vegetation period respectively. According to the scenario CCCM, it is estimated that increase of production potential will be by 8 % in 2010, by 19 % in 2030, and by 47 % in 2075.

An increase of annual evapotranspiration deficit by 126 mm (or 50 %) is forecast in southern lowlands parts (Hurbanovo station). At higher altitudes of northern Slovakia (climatic station Liptovsky Hradok), the forecast deficit is by 66 mm (or 111 %). According to the growth curve generated by the DSSAT3 model, the increased CO_2 concentration to the 660 ppm will cause increase in phytomass by 35 %. The shape pf the growth curves of summer wheat is also impacted by the CO_2 concentration, and temperature and humidity conditions, as well. (Figure 6.15).

Figure 6.15 Phytomass growth curve of summer wheat till 2075 simulated according to the CCCM model for Hurbanovo



6.5.4 Changes of incidence of disease, pests and weeds

Temperature is one of the most important factors influencing biological systems of pathogens and pests. It is a regulator of the intensity of production processes and thus a higher occurrence and degree of hazard. It is estimated that higher temperatures will result in increased occurrence of putrescence caused by fungi *Monilia fructigena* (attacking pome fruits), grape weevil, apple weevil, and virus diseases. Extreme winter temperatures impact pests; low temperatures in winter decrease the incidence of *Rhagoletis cerasi* and high soil humidity support the presence of lice (aphids).

6.5.5 Adaptation measures to mitigate negative impacts of climate change

Measures aimed to utilize positive and mitigate negative impacts of climate change are directed mainly to:

- Changes in crop growing technologies. It is emphasized to apply an approach of sustainable management, without extremes and natural recovery of soil fertility,
- Changes in agro-climatic division and structure of grown crops and varieties. The aim is to use natural sources of radiation and water regimes,
- Changes in cultivation programs. The effort should be given to cultivation of hybrids that are adaptable to biotic and abiotic stresses. Special attention should be paid to the division of seeds,
- Changes in crop protection. The focus should be on biological protection and application of integrated protection,
- Regulation of water regime. Existing irrigation schemes should be used for the production of vegetables and thermophile fruits. Reconstruction of drainage systems is urgent,
- New approaches in plant nutrition. The most important positive effect may be obtain by an application of organic manure in combination with industrial fertilizers. Particularly nitrogen nutrition leads to a decrease in humus in the soil,
- Regulation of water and energy regimes of vegetation by mulching. Plastic wraps and nonwoven textiles are suitable means to increase the yield of water in the soil. They might be also regulators of the energy regime and consequently increased biological activity of the soil,
- New approached in the regulation of weeds. Application of herbicides should be limited.

Measures with respect to water and wind erosion:

- increase the share of fodder crop in arable land,
- grassing of shallow soil,
- upgrade of protective forest belts,
- adjustment of structure and compactness of the soil.

Public awareness and information:

Seminars, conference and public media are effective means to increase public awareness and dissemination of information on climate change.

6.6. Forest ecosystems and forest management

6.6.1 Change of bioclimatic conditions of forest communities

Changes in bioclimatic areas were investigated by the support of two indices (IT, IQ). These represent the most important climatic factors with respect to forest communities (Fischlin, A., Bugmann, H., Gyalistras, D., 1995). An index of average annual air temperature (IT) was defined as follows:

$$IT = (Topt. - T)/(0.5*dT)$$

where:

Topt. - *is the value of average annual air temperature that is optimal for a given wood,*
T - *is the average annual air temperature in the locality of occurrence of a given wood,*
dT - *is amplitude of average annual air temperature for natural areal of a given wood in the western Carpathian mountains..*

The index IT reaches the value -1 at the lower bound of natural occurrence, the value 0 in the middle of the areal (temperature optimum) and the value +1 at the upper bound of natural occurrence.

Similarly, the index of water balance was defined (IQ):

$$IQ = (Q - Qopt.)/0.5*dQ$$

where the meaning of symbols is analogous to those applied in case of air temperature. The value Q represents the difference of annual precipitation totals and evaporation from the forests determined according to the method (Tomlain, J. 1996).

Assessment of indices calculated for the current climate (1951-1980) and for forecast climate change according to the CCCM-prep (Lapin, M., Melo, M., Damborská, I., Gera, M, Faško, P., 2000) was done under the assumption that the impact of climate factors follows the Gauss division (Otto, H. J., 1993, Vinš, B. et al., 1996) (Table 6.3).

Table 6.3 Relative scale of indices of average annual air temperate in relationship to forest woods

Assessment of conditions	IT
Existence limit at lower bound	less than -2,0
Ecological pesimum at lower bound	<-2,0,-1,0>
Impaired conditions are lower bound	(-1,0,-0,6>
Ecological optimum	(-0,6,+0,6)
Impaired conditions at upper bound	<+0,6,+1,0)
Ecological pesimum at upper bound	<+1,0,+2,0)
Existence limit at upper bound	more than +2,0

The assessment was carried out for the total surface of Slovak forests for three selected woods: spruce, fir and beech. Based upon the results, spruce and fir are not in compliance with the bioclimatic demands. IT index of 3-5 is forecast (conditions of climate change) at 71 % of spruce surface, 82 % of fir surface and 32 % of beech surface. The IQ index signals the biggest changes for beech at its lower bound.

6.6.2. Climate change modeling of water balance of vegetation levels

Climatic water balance (CWB) is defined as the difference between precipitation (P) and potential evapotranspiration (PE). PE is defined as maximum potential evaporation in given metrological conditions from sufficiently humid soil and vegetation (Ďurský, J., Škvarenina, J., 2001). It characterizes the upper bound of evapotranspiration, if it is not limited to a shortage of soil moisture. Table 6.4 shows the results of water balance during the main vegetation period (March - September) (current and forecast conditions according to CCCM and CCCMprep) (Lapin, M., Melo, M., Damborská, I., Gera, M, Faško, P., 2000). It could be stated, that already current climatic conditions, potential evapotranspiration is higher than total precipitation in vegetation period (1.-4. vegetation levels). Forest communities of 1. db, 2. bk-db, 3.db-bk and partly 4. Bk too vs intake water from winter storage in the soil. The modeled conditions of climate change will significantly increase the water deficit in the vegetation period. Increasing the air temperature and decreasing total precipitation in the warm period lead to a decrease of relative air humidity. This will result in less favorable conditions for high forest and expansion of xerotherm shrub vegetation and steppe vegetation forms. German authors forecast that favorable conditions will be for hornbeam, linden, and acacia at altitudes of 2.-3. vs.

Beech (4. vegetation level) has a sufficient water balance. In 2075, bioclimatic conditions will lead to starving of beech forests. Future climatic conditions will limit presence of spruce in 4. vegetation level, as well.

The fir-beech 5 vegetation level is characterized by a positive water balance, mainly in the northern parts of Slovakia. The CCCM scenario estimates that spring and fall dry periods will dominate in 2075. The paper (Thomasius, H. 1991) emphasizes the difficulties in spruce cultivation in the future, as current precipitation is less than 800 mm and average temperature over 7 °C.

Water balance is sufficient also for the 6. vegetation level (sm-jd-bk). Climate change will reduce the excess of moisture in summer and fall months. It is estimated that the change will lead to the reduction of the spruce in this vegetation level.

Spruce of 7. vegetation level will have a sufficient supply of precipitation in the future as well. The atmospheric warming will lead to an increased potential evapotranspiration. Reduction of precipitation in continental areas (f.e. south-east Tatras) will prevail in early autumn months. These climatic conditions will suit spruce and pines, as well. Similar results in the Alp areas are expected also in Bavaria (Rehfuess, K. E., 1999). Higher biomass production is expected in the 7. vegetation level.

Global climate change will not impact the water balance of 8. and 9. alp vegetation levels. According the dynamic GAP model, increased wood varieties and decreased mountain pines are forecast in this zone (Minďáš, J., Lapin, M., Škvarenina, J., 1996). Limiting factors are the nutrition of soil and toxic pollutants (acid deposition, heavy metals, photo oxidants).

Table 6.4 Water balance of vegetation levels in a main vegetation period (April-Sept.)

Vegetation level	Meteorological station	Vegetation period (March – September) (P-Eo)* (mm)	
		Current climate: 1951-1980	Climatic scenario CCCM in 2075
1. Oak	Hurbanovo	-299	-430
2. Beech – Oak	Myjava	-140	-255
3. Oak – beech	Kamenica n. C.	-76	-196
4. Beech	Plaveč	-7	-129
5. Fir – beech	Červený Kláštor	+65	-48
6. Spruce-fir-beech	Oravská Lesná	+301	+167
7. Spruce	Tatranská Javorina	+498	+342
8. Mountain pine	Skalnaté Pleso	+666	+517
9. Alp			

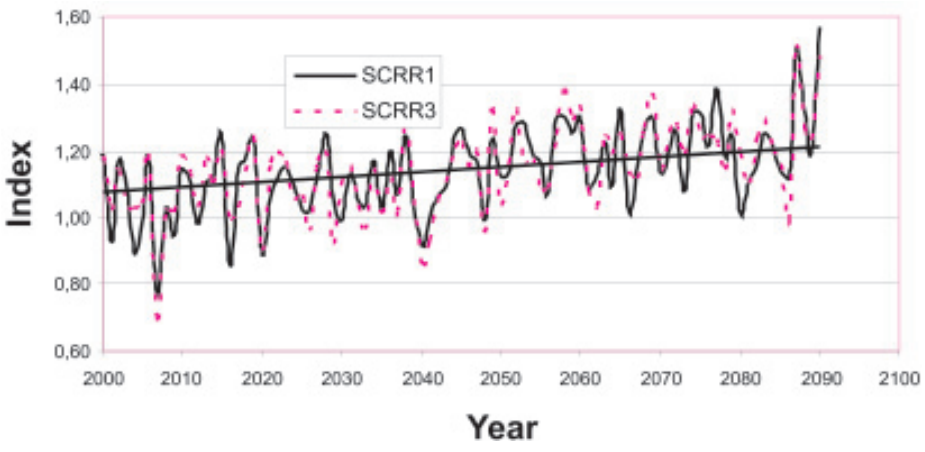
* P - precipitation, Eo - potential evapotranspiration

6.6.3. Changes in the growth process of forests according to dendro-climatic models - a case study

The dendro-climatic model is an empiric models based upon the statistical assessment of the relationships between time series and monthly climatic characteristics. The linear regression model is applied to selected tree system. Input variables are average monthly temperatures (T1....T14) and monthly precipitation totals (Z1.....Z14) from July of the previous year to August of current year, totally 18 climatic variables. The advantage of this approach is that growth reaction to climatic factors is estimated regardless of physiological processes to growth response. However, the model does not allow the assessment of growth at the cell level; the general responses (such as the width of annual ring) are only the evidence of changes.

The dendro climatic model was applied for the region of upper Orava and the scenario CCCMprep. - RR1. The statistical model was derived from the data for 1901- 1990 and estimated indices were calculated for each individual tree for 2001 - 2090. Relative yields (increment) for each scenario are shown in Figure 6.16. Interpretation of results is that future increment will be bigger and identical for each applied scenario (CCCMprep - RR1, CCCPprep - RR3). It means that an increased increment is not dependent on increased temperatures, but is impacted by different levels of precipitation.

Figure 6.16 Estimated relative increment of spruce according to SCRRI (CCCMprep -RR1) and SCRR3 (CCCMprep -RR3) models



The frequency analysis shows that 19.2 % of trees will negatively react to climate change (reduction in increment) and 80.8 % of trees will be positively impacted. Almost 46 % of trees would manifest positive changes. 11.5 % of trees will have significantly negative responses to climate change, 34.6 % of trees will not be impacted and 53.9 % of trees will positively react to the climate change.

The next step was to observe the reaction yield of spruce in mountain areas in Poland and Babia Hora and the relationship to the sea level. Average indices of yield for each tree were calculated for the period of 2060-2090. The research shows that climate change will impact the coverage at the upper bound of the forest. Dentro climatic models showed that:

- future yield will increase and it is identical at two precipitation rates (CCCMprep -RR1 a CCCMprep -RR3) applied,
- the decisive factor for the growth process is the air temperature,
- 11.5 % of trees will be negatively impacted, 34.6 % of trees will be neutral to climate change, and 53.9 % of trees will positively react to climate change (95 % of statistical reliability),
- trees of upper bound of forest will be impacted.

6.6.4. Synthesis of results based upon the modeled estimates

The results achieved allow for general statements and perspectives of forest growth in the western Carpathian Mountains. The results are presented in Table 6.5.

Table 6.5 Summary results of the assessment of forest growth in West Carpathian mountains according to climate change models

Forest communities	Holdridge model	Forest Gap Model	Analysis of bioclimatic areals	Analysis of climate water balance
1.-3. Vegetation level	• Absence of conditions of SM, JD • Conditions for „Balkan type“ forests	• Extinction of spruce and fir communities • Begining of xerothemr forests	• Extinction of spruce and fir communities • Deterioration of beech conditions	• Deficit of precipitation for spruce, fir, beech
4.-6. Vegetation level	• Decrease in SM, JD occurrence • Conditions for mixed forests of moderate zone	• Extinction of SM, JD • Development of mixed communities of beech and deciduous trees	• General decline of coniferous trees (SM) • Favorable bioclimatic conditions for beech (5.-6.vs) • Conditions for oak trees	• Sufficient precipitation for SM, JD only at the north regions of 6. vs • Favorable water balance for beech
7.-8. Vegetation level	• Conditions for mixed forests , shift to upper bound of forest	• Development of mixed communities SM-JD-BK, shift to upper bound of forest	• Decrease of SM, surface reduction, shift to upper bound of forest	• Sufficient precipitation for existence of SM

6.6.5. Climate change and harmful factors in forests of Slovakia

Forests in uplands (1. - 3. vegetation levels)

Forests in uplands (1. - 3. vegetation levels) will be impacted by drought. It is estimated that oak trees will be prevalent in steppe communities. Fire disasters will attack shrubbery. The paradox is, that bank coverage and lowland forests will be exposed to floods. Some species of fungi will be generated and grown (*Dothistroma septospora*). It is forecast that oaks, sweet chestnut and beech will be impacted by *Phytophthora cinnamomi* a *P. cambivora*. Due to an increased stress of woods, fungi attacking oak (*Ceratocystis, Ophiostoma*) and acer (*Verticillium*) will occur. Cancer might occur in poplars (*Cryptodiaporthe populea*) (Jankovský, L., Cudlín, P., 2002).

Some parasites might occur in deciduous trees due to dry and warm weather. In southern regions, invasive incests are forecast. The most risk comes from species of grasshopper, butterfly and aphids.

Middle and mountain levels (4.-6. vegetation level)

Middle and mountain levels (4.-6. vegetation level) will be impacted by snow and hoarfrost. A deficit in precipitation will impact spruce. Aggressive *Armillaria spp*. might cause calamite in spruce. Similarly, the increased occurrence of root putrefaction will dominate (*Heterobasidion annosum* and *Stereum sanguinolentum*) (Jankovský, L., Cudlín, P., 2002). Insects will penetrate to the middle forest levels.

High mountains forests (7. and 8. vegetation levels)

High mountain forest will be impacted by a precipitation deficit that will result in weak spruce communities. This will make them vulnerable to windstorms and intensive rains. Climatic extremes will weaken mountain pines. Aggressive incests will easily penetrate to impaired spruce communities. Winter deviation in weather will weaken wood that will be very sensitive to insects.

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7. Review of climate change research

Research and scientific projects in the last 10 years were implemented mainly in following institutions: SHMU, the Department of Metrology and Climatology of the Faculty of Mathematics, Physics and Informatics of the University Komenskeho, the Geophysical Institute and the Institute of Hydrology of Slovak Academy of Science, Department of Water Management and Landscape of the Slovak Technical University, Slovak Agricultural University in Nitra, Technical University in Zvolen, The Forest Research Institute in Zvolen, Hydro-melioration, Bratislava, the Water Research Institute, the Faculty of Natural Sciences and other institutions.

The National Climate Program of the Slovak Republic

The NCP is carried out under the SHMU. However, from 2002, the Ministry of Environment did not allocate any financial sources to the NCP. Thus, the projects under the NCP are limited to monitoring of climate change and overview of outcomes of other projects.

The projects of VEGA grant

Totally 8 projects were supported by the grant agency VEGA in the period of 2001-2005. These projects were managed by following institutions:

- Department of metrology and climatology of the Faculty of Mathematics, Physics and Informatics (UC); Analysis of change and variability of climate, scenarios of climate change for Slovakia, changes in ground ozone,
- Department of Water Management at the Faculty of Construction (STU); Scenarios and potential impacts of climate change in hydrology and water management
- Institute of Hydrology (SAV); Scenarios and potential impacts of climate change in hydrology and water management focused on soil water in lowlands and mountains areas
- Slovak Agriculture University in Nitra; Assessment of risks of climate change on production conditions of selected fruit trees and agricultural crops, climate change and drought - impacts and background for sustainable agriculture, production and quality
- Technical University Zvolen; Adaptation and mitigation measures for forest ecosystems, impacts of change in atmosphere and climate change in forest ecosystems.

Other VEGA projects also partially deal with the climate change issues.

The projects of APVT (Agency for Science and Technique)

Following projects are conducted in 2003-2005:

- No. APVT-51-006502: Scenarios of changes of selected components of hydrosphere and biosphere in Slovakia due to climate change, Institute of Hydrology SAV,
- No. APVT-51-017804: Forecasting of impact of change on the use of landscape on quantity and quality of water for integrated water resources management, Institute of Hydrology SAV,
- No. APVT 51-044802: Impact of drought on water regime and biodiversity in lowlands of Slovakia, Institute of Hydrology SAV,
- No. APVT-27-009304. Reaction of diversity of forest fytocenoze on change of climate conditions in Slovakia, Forest Research Institute, Zvolen,
- No. APVT-27-023304: Research of water balance of forest ecosystems with respect to anticipated climate changes, Forest Research Institute, Zvolen,
- No. APVT-27-037702: Research of supply and balance change of carbon in mountain landscape, Department of Metrology and Climatology of the Faculty of Mathematics, Physics and Informatics of the UK.

Other APVT projects also partially deal with the climate change issues.

State Program of Research and Development

Under the state program of R&D, the project Climate change and its impacts on development of the society: is under the development (2003 -2005, Hydromelioration company). Under this project, the phase E01 is carried our: Assessment of regional scenarios of the climate change.

International projects

Under the International hydrological program of UNESCO, the Institute of Hydrology SAV cooperates at the project Catchment Hydrological and Biogeochemical Processes in Changing Environment, (under the project Flow Regimes from International Experimental and Network Data). Under the 5th Framework Program of the EU, the Technical University Zvolen cooperates in two projects: WARM project (Wildland - urban Area Fire Risk Management) and CARBOMONT (Effects of land-use changes on sources, sinks and fluxes of carbon in European mountain areas).

8. Education and enhancement of public awareness

Legal framework in the Slovak Republic with respect to collection, assessment and release of environmental information to the public is covered by the Act 211/2000 Coll. on the Free Access to Information, Act 205/2000 Coll. on Collection, Storage and Dissemination of Information, Act 17/1992 Coll. on the Environment, Act 478/2002 on Air Protection, and Act 572/2004 Coll. on Tradable Permits. These regulations provide for dissemination of information to the public. Similarly, other documents such as the National Environmental Action Plans I, II and III and the Concept of Environmental Education are devoted to this issue. The Ministry of Education has developed the National Education Program - Millennium that involves principles of sustainable development and create a space to implement these issues in the long term education.

Education and public awareness activities with respect to climate change are not legally and institutionally supported; however, there are many examples of projects and programs of several institutions dealing with the issue of climate change. The main institution governed by the Ministry of Environment is the Slovak Environmental Agency - SEA (www.sazp.sk). It is a partner institution to the European Environmental Agency (www.eea.eu.int) and includes centers of environmental education.

The National Action Plan for Health and the Environment for 2006 - 2010 (NEHAP) governed by the Ministry of Health also deals with the climate change issues. The recommendations of the WHO are available at the web page of the Institute of Public Health (www.uzvsr.sk)

An increase of public awareness was significantly improved by new information technologies and Internet. The SEA operates web portals on environmental monitoring - Information System of Monitoring (www.iszp.sk) and Enviroportal - information system on environmental impact assessment (www.enviroportal.sk). These systems are built based on the Act 261/1995 Coll. on the State Information System and establish the condition to provide actual and full information on the environment to each individuals. Based upon the Information System of Environmental Departments, environmental impact assessment belongs to one of nine subsystems. There is information generated by the Ministry of Environment, district and regional environmental offices and the Slovak Environmental Agency. The system requires the automation of related activities.

Process of release of information regarding of climate change is under the responsibility of National Focal Point at the Ministry of Environment (www.enviro.gov.sk). Supporting activities are carried out by the SHMI (www.shmu.sk) and other governmental agencies. The web page of the Ministry of Environment contains also the Third National Communication Report (in the Slovak language), the complex national report on the GHG emissions inventory (NIR 2005) and the National Allocation Plan for the trading with GHG emissions and emission quotas in the European Community.

8.1. Publications

Publications, periodic journals and expert papers dealing with the climate change and air protection are listed as follows:

- State of the Environment in the Slovak Republic Report - developed and annually published by the MoE, http://www.sazp.sk/slovak/periodika/sprava/index.html,
- Report on the air quality and share of individual sources of pollution in the Slovak Republic - developed and annually published by the SHMU, department of Air Quality http://oko.shmu.sk/,
- Thematic Assessment on capacity self-assessment of the UNFCCC, developed under auspices of the MoE, MoA under the UNDP/GEF program in 2004 - report published at www.vupu.sk in Slovak and English version,
- Enviromagazín - journal issued by the SEA from 1996 in Slovak language,
- Meteorological magazine - specialized journal issued by the SHMU in the area of metrology, climatology, air pollution and other related sciences from 1998 in English, Slovak and Czech languages,
- Životné prostredie (Environment) - the revue for theory and creation of the environment issued by the Institute of Landscape Ecology of the SAV from 1967. It provides for monothematic editions and is published at http://www.fns.uniba.sk/zp/casopisy/zp/.

8.2 Conferences, workshops, seminars

Annually, several conferences, workshops and seminars are organized to support the activities in the area of climate change and air protection:

- 1. Conference Envirofórum 2005 - the first time organized by the SEA and the MoE. The conference was attended by experts including public administration, self-government, scientific organizations, universities, and private companies dealing with operation of information systems and users,
- Conference Air Protection - annually organized from 1985 under the Slovak Metrology Association auspices and relates to air protection, new industrial technologies to improving air protection,
- Seminars organized at the occasion of the World Metrological Day and the World Water Day - annually organized by the SHMU including the contest of junior researchers.

8.3 Festivals, media

- Envirofilm - international festival of films, TV programs, and video programs on environmental protection www.envirofilm.sk.
- Ekotopfilm - the oldest ecologically focused film festival at the world that includes the archive of more than thousand of films, regularly organized from 1974, www.ekotopfilm.sk.
- Regular publishing in Slovak periodicals: www.pravda.sk, www.tyzden.sk, SME, Hospodarske noviny, Trend.

8.4. Other activities

Information role is carried out by the P&R department of the Ministry of Environment that provides information to the public.

High quality activities are carried out by the Advisory and Information Centers of the Slovak Energy Agency (SEA - established by the Ministry of Economy by the Decision 63/1999, www.sea.gov.sk). These centers provide information, expert advisory activities in the area of energy management, promotion of effective use of energy and use of renewable sources. The SEA is accredited to organize short term courses and training similar to those in the EU. It is also accredited to organize the specialized four-semester course on Industrial Energy and Water Management in Banska Bystrica.

Non-governmental organizations are also involved in education and public awareness, such as Association of Environmental Education Organizations Spirala. Today, it groups 12 NGOs. In Slovakia, several international NGOs are active.

In the context of voluntary environmental instruments currently applied in enterprises are ecological symbols (eco-labelling of environmentally sound products according Act 469/2002 Coll. on Environmental Labelling of Products) and voluntary participation of small and medium enterprises in emission trading and emission quotas (according to Act 572/2004 Coll.).

Table P.1.3.1 Total aggregated trends of emissions and sinks of GHGs in Slovakia in 1990-2003 according sectors and gases

Emisie GHGs	1990*	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2 ekvivalent (Tg)														
Net CO_2 emissions/sinks	57,019	48,637	44,269	41,158	39,153	41,158	41,961	43,250	41,712	40,978	37,703	37,337	36,975	37,934
CO_2 (without LULUCF)	59,446	52,113	48,397	45,424	42,441	43,841	44,389	44,662	43,649	42,630	40,148	42,603	42,254	42,817
CH_4	6,343	5,901	5,527	5,113	5,047	5,192	5,250	4,959	4,681	4,623	4,555	4,548	4,677	4,709
N_2O	6,047	5,173	4,401	3,872	4,051	4,180	4,243	4,285	3,986	3,831	3,819	4,040	3,861	3,946
HFCs	0,000	0,000	0,000	0,000	0,003	0,025	0,045	0,070	0,044	0,066	0,078	0,083	0,104	0,134
PFCs	0,271	0,267	0,249	0,056	0,132	0,114	0,035	0,033	0,024	0,014	0,012	0,011	0,011	0,021
SF_6	0,000	0,000	0,000	0,000	0,009	0,010	0,011	0,011	0,012	0,013	0,013	0,013	0,014	0,015
Total (with net CO_2)	69,680	59,978	54,446	50,299	48,396	50,678	51,545	52,609	50,459	49,525	46,181	46,033	45,643	46,759
Total (without LULUCF)	72,107	63,455	58,574	54,565	51,683	53,361	53,973	54,021	52,396	51,177	48,625	51,299	50,922	51,641
IPCC sectors	**1990***	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
CO_2 equivalent (Tg)														
Energy	57,675	51,142	47,354	44,473	41,463	42,762	43,360	43,570	41,891	40,766	38,703	41,101	40,649	41,445
Industrial Processes	4,264	3,371	3,348	3,036	3,358	3,557	3,601	3,749	4,366	4,474	3,909	4,107	3,993	3,938
Use of solvents	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Agriculture	8,062	6,895	5,871	5,134	4,936	5,102	4,893	4,759	4,330	4,101	4,138	4,219	4,135	4,017
LULUCF	-2,409	-3,462	-4,117	-4,254	-3,277	-2,672	-2,415	-1,398	-1,923	-1,636	-2,428	-5,249	-5,262	-4,864
Waste	2,088	2,032	1,989	1,909	1,916	1,929	2,106	1,930	1,796	1,821	1,858	1,855	2,127	2,223

Emissions determined as 15.4.2005
* Base year for the Kyoto commitment
LULUCF = Land-use, Land-use Change and Forestry; GHGs = Greenhouse Gases

1 Aggregated GHG emissions expressed as the equivalent of CO_2, calculated by GWP100 (Global warming potential - methane GWP=21, N2O GWP=310, F-gases GWP=140-23 900)

Table P.1.3.2 Total trends of emissions and sinks of CO_2 v Slovakia in 1990-2003 according to sectors

Categories	1990*	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
							CO_2 (Gg)							
1. Energy	**55 962**	**49 487**	**45 731**	**42 907**	**39 802**	**41 062**	**41 628**	**41 803**	**40 089**	**39 010**	**36 947**	**39 270**	**38 866**	**39 692**
A. Combustion of fuel (RA)	55 962	49 487	45 731	42 907	39 802	41 062	41 628	41 803	40 089	39 010	36 947	39 270	38 866	39 692
1. Energy industry	50 890	45 206	41 785	39 017	35 682	36 685	37 186	37 196	35 136	34 191	32 628	34 377	33 276	34 549
3. Transport	5 071	4 281	3 946	3 891	4 120	4 378	4 442	4 607	4 953	4 819	4 319	4 893	5 590	5 143
2. Industrial processes	**3 484,06**	**2 626,75**	**2 665,67**	**2 516,64**	**2 639,23**	**2 778,76**	**2 761,22**	**2 858,98**	**3 560,21**	**3 619,76**	**3 102,19**	**3 197,97**	**3 245,23**	**2 984,34**
A. Mineral products	2 942,48	2 134,13	2 206,23	2 068,93	2 187,20	2 341,61	2 249,56	2 331,17	3 032,41	3 052,40	2 522,11	2 590,16	2 596,33	2 281,76
C. Metal production	541,58	492,62	459,44	447,72	452,03	437,15	511,66	527,82	527,80	567,36	580,08	607,81	648,90	702,58
5. LULUCF	**-2 407**	**-3 504**	**-4 151**	**-4 284**	**-3 317**	**-2 696**	**-2 422**	**-1 402**	**-1 939**	**-1 636**	**-2 403**	**-5 225**	**-5 243**	**-4 833**
A. Forest	-4 454	-5 482	-6 056	-6 135	-5 205	-4 399	-3 968	-2 717	-3 130	-2 800	-4 318	-5 551	-5 641	-5 156
1. Forest/Forest	-4 454	-5 482	-6 056	-6 135	-5 205	-4 399	-3 968	-2 717	-3 130	-2 800	-4 318	-5 551	-5 641	-5 156
B. Soils	3 287	3 211	3 495	3 457	2 725	2 063	2 063	3 226	1 798	1 711	4 394	1 002	1 174	1 416
1. Soils/Soils	3 287	3 211	3 495	3 457	2 725	2 063	2 063	3 226	1 798	1 711	4 394	1 002	1 174	1 416
C. Meadows	536	396	373	0,00	163	256	93	-50	70	-126	-797	-880	-874	-1 363
1. Meadows/meadows	536	396	373	0,00	163	256	93	-50	70	-126	-797	-880	-874	-1 363
F. Other landscape	-1 775	-1 629	-1 962	-1 606	-999	-615	-609	-1 861	-677	-420	-1 682	204	98	269
1. Landscape/other landscape	-1 775	-1 629	-1 962	-1 606	-999	-615	-609	-1 861	-677	-420	-1 682	204	98	269
6. Waste	**IE**	**IE**	**IE**	**IE**	**IE**	**IE**	**IE**	**IE**	**IE**	**IE**	**98**	**135**	**143**	**140**
C. Waste incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	98	135	143	140
Total emissions / Sinks	**57 019**	**48 637**	**44 269**	**41 158**	**39 154**	**41 158**	**41 961**	**43 250**	**41 712**	**40 978**	**37 703**	**37 337**	**36 975**	**37 934**
Total emissions	**59 446**	**52 113**	**48 397**	**45 424**	**42 441**	**43 841**	**44 389**	**44 662**	**43 649**	**42 630**	**40 148**	**42 603**	**42 254**	**42 817**
International reserves	NE	NE	NE	NE	37	38	44	39	36	37	37	35	37	48
Aviation transport	NE	NE	NE	NE	37	38	44	39	36	37	37	35	37	48
Combustion of biomass	1 686	1 382	1 253	720	717	326	316	349	303	269	263	417	508	555

Emissions determined as 15.4.2005

* Base year for the Kyoto commitment

RA = Reference Approach; NE = Not Estimated; IE = Included Elsewhere; LULUCF = Land-use, Land-use Change and Forestry

Table P.1.3.3 Total trends of CH_4 emissions in Slovakia in 1990-2003 according to sectors

Categories	NE1990*	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CH_4 (Gg)														
Total emissions	**302,05**	**281,02**	**263,18**	**243,48**	**240,32**	**247,22**	**249,99**	**236,16**	**222,89**	**220,16**	**216,93**	**216,58**	**222,72**	**224,25**
1. Energy sector	69,09	68,08	67,64	65,39	67,40	68,64	69,59	70,23	72,23	70,23	71,10	73,17	70,27	68,64
A. Combustion of fuel (RA)	17,43	14,94	13,46	11,69	10,90	9,81	9,78	9,64	9,05	8,74	8,22	11,98	10,83	12,33
1. Energy industry	16,39	13,99	12,53	10,69	9,83	8,66	8,61	8,41	7,74	7,45	7,08	10,72	9,45	11,13
3. Transport	1,04	0,95	0,93	1,00	1,08	1,14	1,18	1,24	1,31	1,29	1,13	1,27	1,38	1,21
B. Fugitive emissions	51,66	53,13	54,18	53,70	56,50	58,83	59,80	60,59	63,18	61,49	62,88	61,19	59,44	56,31
1. Extraction of coal	27,20	28,83	29,93	28,61	29,91	29,70	30,08	30,61	31,17	29,50	28,82	26,33	25,69	21,11
2. Oil and natural gas	24,46	24,31	24,24	25,09	26,58	29,13	29,73	29,98	32,01	31,99	34,06	34,86	33,74	35,20
4. Agriculture	**133,81**	**116,58**	**101,13**	**87,30**	**81,89**	**86,85**	**80,25**	**74,09**	**65,21**	**63,15**	**61,81**	**61,90**	**59,11**	**57,01**
A. Enteric fermentation	116,25	100,26	86,31	73,68	68,98	73,60	67,65	62,53	55,00	53,28	52,30	52,38	49,37	47,75
B. Animal waste handling	17,56	16,32	14,82	13,62	12,91	13,25	12,60	11,56	10,21	9,87	9,51	9,53	9,74	9,26
5. LULUCF	**0,70**	**0,57**	**0,46**	**0,48**	**0,41**	**0,46**	**0,51**	**0,54**	**0,53**	**0,61**	**0,67**	**0,68**	**0,66**	**0,73**
A. Forests	0,70	0,57	0,46	0,48	0,41	0,46	0,51	0,54	0,53	0,61	0,67	0,68	0,66	0,73
1. Forests /forests	0,70	0,57	0,46	0,48	0,41	0,46	0,51	0,54	0,53	0,61	0,67	0,68	0,66	0,73
6. Waste	**98,46**	**95,79**	**93,96**	**90,31**	**90,63**	**91,27**	**99,64**	**91,29**	**84,92**	**86,18**	**83,35**	**80,83**	**92,68**	**97,86**
A. Solid waste landfills	50,27	50,27	50,27	50,27	50,27	50,89	59,60	50,99	45,81	46,54	48,26	45,41	57,18	65,76
B. Waste water	48,19	45,52	43,69	40,04	40,36	40,38	40,04	40,31	39,11	39,64	35,09	35,42	35,50	32,11
International reserves	NE	NE	NE	NE	0,77	0,77	0,91	0,81	0,74	0,75	0,76	0,72	0,75	0,98
Aviation transport	NE	NE	NE	NE	0,77	0,77	0,91	0,81	0,74	0,75	0,76	0,72	0,75	0,98

Emissions determined as 15.4.2005

* Base year for the Kyoto commitment

LULUCF = Land-use, Land-use Change and Forestry; RA = Reference Approach; NE = Not Estimated

Table P.1.3.4 Total trends of N_2O emissions in Slovakia in 1990-2003 according to sectors

Categories	1990*	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
							N_2O (Gg)							
Total emissions	**19,51**	**16,69**	**14,20**	**12,49**	**13,07**	**13,48**	**13,69**	**13,82**	**12,86**	**12,36**	**12,32**	**13,03**	**12,46**	**12,73**
1. Energy sector	**0,85**	**0,73**	**0,65**	**0,62**	**0,79**	**0,83**	**0,87**	**0,94**	**0,92**	**0,91**	**0,85**	**0,95**	**0,99**	**1,00**
A. Combustion of fuel (RA)	0,85	0,73	0,65	0,62	0,79	0,83	0,87	0,94	0,92	0,91	0,85	0,95	0,99	1,00
1. Energy industry	0,60	0,52	0,46	0,43	0,40	0,39	0,39	0,38	0,35	0,33	0,32	0,34	0,33	0,35
3. Transport	0,25	0,21	0,19	0,19	0,40	0,44	0,48	0,56	0,57	0,57	0,53	0,61	0,67	0,65
2. Industrial processes	**1,64**	**1,54**	**1,40**	**1,17**	**1,85**	**2,03**	**2,42**	**2,50**	**2,34**	**2,46**	**2,27**	**2,58**	**2,00**	**2,53**
B. Chemical industry	1,64	1,54	1,40	1,17	1,85	2,03	2,42	2,50	2,34	2,46	2,27	2,58	2,00	2,53
4. Agriculture	**16,94**	**14,34**	**12,09**	**10,65**	**10,38**	**10,57**	**10,35**	**10,33**	**9,55**	**8,95**	**9,16**	**9,42**	**9,33**	**9,09**
B. Animal waste handling	3,53	3,20	2,76	2,40	2,24	2,36	2,18	2,00	1,76	1,66	1,62	1,63	1,55	1,50
D. Agriculture soil	13,41	11,14	9,33	8,25	8,13	8,22	8,17	8,33	7,79	7,29	7,54	7,79	7,78	7,59
5. LULUCF	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**
A. Forest	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
1. forest/forest	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
6. Waste	**0,06**	**0,07**	**0,05**	**0,04**	**0,04**	**0,04**	**0,04**	**0,04**	**0,04**	**0,04**	**0,03**	**0,07**	**0,12**	**0,09**
B. Waste water	0,06	0,07	0,05	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,03	0,06	0,11	0,08
C. Incineration of waste	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	0,01	0,01	0,01
International reserves	NE	NE	NE	NE	0,10	0,10	0,12	0,11	0,10	0,10	0,10	0,10	0,10	0,13
Aviation transport	NE	NE	NE	NE	0,10	0,10	0,12	0,11	0,10	0,10	0,10	0,10	0,10	0,13

Emissions determined as 15.4.2005

* Base year for the Kyoto commitment

LULUCF = Land-use, Land-use Change and Forestry; RA = Reference Approach; NE = Not Estimated; IE = Included Elsewhere

Table P.1.3.5 Total trends of PFCs, HFCs a SF_6 emissions in Slovakia in 1990-2003 according to sectors

Categories	1990*	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
							CO_2 ekvivalent (Gg)							
Total emissions of HFCs	0,00	0,00	0,00	0,00	2,91	24,52	44,86	69,83	43,58	66,01	78,30	83,23	103,74	133,83
HFC-23						0,000001	0,000073	0,00007	0,00005	0,00005	0,00005	0,00006	0,00004	0,00008
HFC-32							0,000019	0,00011	0,00007	0,00010	0,00032	0,00058	0,00120	0,00192
HFC-125						0,000009	0,000084	0,00026	0,00043	0,00076	0,00191	0,00337	0,00576	0,00814
HFC-134a					0,00001	0,01098	0,02545	0,04180	0,02918	0,04443	0,04773	0,04288	0,04741	0,06043
HFC-152a							0,00000	0,00014	0,00032	0,00061	0,00083	0,00101	0,00120	0,00138
HFC-143a							0,00012	0,00031	0,00046	0,00080	0,00192	0,00348	0,00550	0,00738
HFC-227ea					0,00100	0,00352	0,00352	0,00439	0,00071	0,00080	0,00080	0,00080	0,00044	0,00023
HFC-236fa											0,00005	0,00022	0,00038	0,00022
Total emissions of PFCs	271,37	271,37	267,12	249,03	155,82	132,26	113,90	35,15	33,19	23,81	13,93	11,65	11,43	11,41
CF4	0,036598	0,036000	0,033500	0,021000	0,017800	0,015400	0,004700	0,00454	0,00324	0,00193	0,00157	0,00154	0,00154	0,00281
C_2F_6	0,003640	0,003600	0,003400	0,002100	0,001800	0,001500	0,000500	0,00040	0,00030	0,00015	0,00015	0,00015	0,00015	0,00028
Total emissions of SF_6	0,03	0,03	0,04	0,06	9,27	9,91	10,76	11,34	12,24	12,68	13,11	13,48	14,42	15,03
SF_6	0,000001	0,000001	0,000002	0,000003	0,000388	0,000415	0,000450	0,00047	0,00051	0,00053	0,00055	0,00056	0,00060	0,00063

Emissions determined as 15.4.2005

* Base year for the Kyoto commitment

P.2.5 Annex to chapter 5 - projections and assessment of impact of measures

P.2.5.1 Projection method for emissions from combustion and transformation of fuels

Methods used

WASP IV - Wien Automatic System Planning Package, developed by the IAEA for a long-term planning of electricity networks and investments. The recent version of the model WASP-IV allows the development of optimal economic development plans of the electricity network including investment costs, cost of unspent energy and reliability of electricity supply. The technique of linear programs allows designing the operation with respect to external limitations such as emission quotas, disposability of fuels.

Advantages and disadvantages of the WASP program:

- is designed only for sources of electricity within the systemic Energy sector,
- allows good analysis of close national systems (energy island). It does not reflect new conditions regarding to an open energy market,
- allows to assess the relationship between sources and loads in electricity network on-line or aggregated. Input data for individual years and time periods could be adjusted (peak, load, minimum),
- operates in the mode of leas cost method,
- takes into account all criteria and external limitations,
- does not allow modeling of combined production of electricity and heat,
- does not allow modeling of consumption of several fuels for one source. Virtual fuels that represented mixed fuels were inserted.

BALANCE - the program is a component of ENPEP programs. The recent version in Windows represents the simulation of the market with energy for individual segments of the total energy network. The program iterates the optimum of final consumption supply in individual energy network segments taking into account production costs of an each energy medium.

Advantages and disadvantages of the BALANCE program:

- it is simulation rather than optimization program. Based upon the expert judgment, the program simulates possible behavior of the energy system. Sensitivity and lag factors are inserted. Also, application of price knots allows simulation of economic measures (subsidies, price regulation). Application of sensitivity factor of >15 and lag factor = 1 allows the solution at the minimum cost that approximate an optimum,
- allows to insert emissions factors for individual knots including emission charges or carbon tax. It does not allow determination of emission quotas for parts or a total energy system,
- the system works as "short-sighted" that means to seek the balance from year to year without the consideration to prices changes in the following years,
- friendly use outputs in excel,
- simple graphic module allows to insert and control the structure of energy system and provides numerical and graphical illustration of energy balance and emissions in individual knots,
- modeling of electricity network is simplified; it does not allow modeling of difference curves of electricity loads for individual years (only the whole period). Contrary to the WASP model, it is possible to simulate a combine electricity production and heat as mixed fuels.

MESSAGE - it is an optimization model with a linear programming. The Program seeks an optimal solution for selected periods. The model is flexible and allows seeking a minimum optimal function for whatever parameters (not only the energy systems). The mathematical description is complex. The optimization function seeks minimum costs to meet demands for final consumption supply from primary and imported energy sources. The model also allows inserting certain constraints that simulate the regulation of the system based upon the source limits, price regulation and emission quotas impact. The electricity network creates an integrated part and curves of load could be adjusted for individual periods. It also supports modeling of combined electricity and heat production.

Advantages and disadvantages of MESSAGE model

- flexible instrument, seeking an optimal solution at the lowest costs for the whole period,
- it requires a careful and appropriate consideration of all limits of economic, local and environmental characters and limits with respect to availability of sources,
- the model provides for large options with respect to the implementation of emission quotas and pollution changes and taxes,
- processes with a combined production of electricity and hear might be precisely modeled with respect to different load curves,
- simple transfer of data to excel, that allows easy preparation of input data and user friendly interpretation of output data,
- The MESSAGE model is still under the construction. The manual still refers to the original version. The program poses certain software errors. The author of this reports presented these problems at the expert meeting in IAEA in June 2005.

P.2.5.2 Basic macroeconomic assumptions

Sector Industrial Processes

Driving force of the final consumption is an annual growth of value added in individual sectors and industrial branches.

The VAs are data of the EU indicators except of annual growth rate of VA of metal production. The following indicators were used:

AGR of VA	2000/2005	2005/2010	2010/2015	2015/2020	2020/2025	2025/2030
Iron and steel in %	1.40	1.90	1.90	1.90	2.10	2.00

It is a branch that significantly contributes to the CO_2 generation. The final consumption in the industry was divided into the following energy media:

- Direct fuel consumption in technologies - based upon the consultations with the Ministry of Economy, linear relationship between VA and final consumption was applied,

Table P.2.5.2.2 Input data for calculation of heat consumption in individual houses

Year	2000	2005	2010	2015	2020
Total	871 202	915 541	976 172	1 015 789	1 054 606
Old houses	740 745	740 745	669 575	605 243	547 091
New houses	130 457	174 796	306 597	410 546	507 515
Heating total (TJ)	67 861	70 598	72 900	74 134	75 415
Old houses (TJ)	59 734	59 734	53 995	48 807	44 118
New houses (TJ)	8 127	10 864	18 905	25 327	31 297
TJ/1000 flats					
Old houses	80.6	80.6	80.6	80.6	80.6
New houses	62.3	61.4	60.5	59.6	58.7
Warm water total (TJ)	12 491	13 183	14 237	14 952	15 646
Old houses (TJ)	10 453	10 453	9 449	8 541	7 721
New houses (TJ)	2 037	2 729	4 788	6 411	7 925
TJ/1000 flats					
Old houses	14.1	14.1	14.1	14.1	14.1
New houses	15.6	15.6	15.6	15.6	15.6
Consumption total (TJ)	80 351	83 781	87 136	89 086	91 060
Old houses(TJ)	70 188	70 188	63 444	57 348	51 838
New houses (TJ)	10 164	13 594	23 692	31 738	39 222

- Heat consumption produced in heat plants - the VA per unit will increase by 1 % per year. This assumption includes an elastic relationship,
- Electricity production in companies' power plants is proportional to heat cogeneration.

The amount of carbon trapped in products was separately calculated.

Supply of heat from centralized sources and individual heating systems

Annual growth (or decline) rate was based on data from the Study of economic efficiency, supported by the World Bank. The results were adjusted according to new demographic data. The following tables were used to calculate annual growth rate.

Table P.2.5.2.1 Annual growth rate of VA and number of inhabitants

Annual growth rate	2000/2005	2005/2010	2010/2015	2015/2020	2020/2025	2025/2030
In %						
Gross domestic product – GDP	4.10	5.30	4.40	4.40	4.40	4.40
Household consumption	3.20	4.20	5.28	5.57	5.17	4.94
Value added - VA	4.24	4.38	4.93	5.21	5.12	4.88
VA industry total, of which:	3.78	4.03	4.69	5.12	5.15	4.77
Of which						
VA - metal production	3.10	3.90	3.80	3.60	3.70	3.60
VA - chem. industry total	5.81	5.59	5.59	5.79	5.40	4.90
Of which						
VA - production of inorganic fertilizers	1.55	3.10	2.86	2.96	2.84	2.89
VA - petro-chemistry	5.86	5.65	5.15	4.86	4.11	3.46
VA - other chem. production	5.54	6.38	6.50	6.39	5.79	5.14
VA - pharmaceutical/cosmetics	10.48	6.99	7.06	7.33	6.75	5.99
VA – non-metal materials	3.40	4.37	4.67	4.77	4.55	4.09
Of which						
Cement and auxiliary products	2.96	4.63	5.12	4.87	4.41	3.73
Ceramics	2.63	3.99	4.47	4.41	4.47	3.95
Glass production	3.04	4.40	4.13	4.56	4.62	4.12
Other non-metal materials	5.92	4.28	4.90	5.01	4.84	5.00
VA Paper, cellulose and press production	1.92	4.05	4.76	5.34	5.01	4.51
Of which						
Paper and cellulose production	-3.60	0.77	1.46	1.69	1.76	1.80
Publishing	5.82	5.65	6.03	6.47	5.82	5.09
VA food industry	1.61	2.81	4.65	5.00	4.88	4.32
VA textile and leather industry	3.42	3.11	3.20	3.38	3.53	2.90
VA engineering production	4.50	4.40	4.99	5.55	5.73	5.42
VA other industry	5.17	4.08	4.59	4.97	5.05	4.62
VA construction	4.61	3.53	7.42	6.71	5.24	4.95
VA Services and trade	5.13	4.87	5.16	5.39	5.31	5.08
Of which						
Commercial services	5.28	5.15	5.79	6.14	5.71	5.41
Non-commercial services	5.26	4.77	4.77	4.80	4.95	4.82
Trade	4.96	4.73	4.95	5.19	5.20	4.98
VA agriculture	2.23	2.64	3.31	3.31	3.07	2.74
VA energy	-1.27	0.81	1.45	1.93	2.29	2.42
Households	-0.01	-0.07	-0.11	-0.19	-0.30	0.00

Table P.2.5.2.3 Input data for calculation of heat consumption in flats without supply from SCZT

Year	2000	2005	2010	2015	2020
Old houses	15 183	15 183	13 724	12 406	11 215
New houses	53 472	65 889	88 531	113 677	137 166
Heating total	TJ				
Old houses	564	564	510	461	417
New houses	1 787	2 186	2 884	3 669	4 421
Total	2 351	2 750	3 394	4 130	4 838
	kwh/m²/year				
Old houses	123	123	123	123	123
New houses	103.6	97.1	91.0	85.3	80.0
Warm water	TJ				
Old houses	238	238	215	194	176
New houses	855	1 054	1 416	1 819	2 195
Total	1 094	1 292	1 632	2 013	2 370
	kwh/m²year				
Old houses	51.9	51.9	51.9	51.9	51.9
New houses	49.6	49.6	49.6	49.6	49.6
Total consumption of heat (TJ)	3 444	4 042	5 026	6 143	7 208
Old houses (TJ)	802	802	725	655	592
New houses (TJ)	2 642	3 240	4 301	5 488	6 615

Table P.2.5.2.4 Input data for calculation of consumption of heat in flats supplied from SCZT

Year	2000	2005	2010	2015	2020
Old houses	634 381	634 381	573 430	518 335	468 533
New houses	145 598	179 407	241 058	309 530	373 488
Heating total	TJ				
Old houses	23 568	23 568	21 303	19 257	17 406
New houses	4 865	5 953	7 853	9 990	12 038
Total	28 433	29 520	29 157	29 247	29 444
	kwh/m²/year				
Old houses	123	123	123	123	123
New houses	103.6	97.1	91.0	85.3	80.0
Warm water	*TJ*				
Old houses	9 944	9 944	8 989	8 125	7 345
New houses	2 329	2 870	3 857	4 952	5 975
Total	12 274	12 815	12 846	13 078	13 320
	kwh/m²/year				
Old houses	51.9	51.9	51.9	51.9	51.9
New houses	49.6	49.6	49.6	49.6	49.6
Total consumption of heat (TJ)	40 707	42 335	42 003	42 324	42 764
Old houses (TJ)	33 512	33 512	30 292	27 382	24 751
New houses (TJ)	7 195	8 823	11 710	14 942	18 013

Production of electricity from systemic power plants

The data of SE, a.s. were used. The completion of the nuclear power plant in Mochovce is not considered. After the termination of the blocks in the Nuclear Power plant Bohunice, the introduction of fossil fuels was considered.

Table P.2.5.2.5 The projections of production in SE, a.s.

		Fuel	2005	2010	2015	2020
Total JE		Nuclei	17 050	12 550	12 900	12 900
Total EVO 1		black coal	2 200	2 050	2 000	2 000
	Block 1, 2	black coal	700	700	700	700
	Block 3, 4	black coal	150	0	0	0
	Block 5, 6	black coal	1 350	1 350	1 300	1 300
Total EVO 2	Block 21-26	Gas	50	200	200	200
	Block 1, 2	Brown coal	1 010	1 200	1 200	1 200
	Block 3, 4	Brown coal	710	0	0	0
Total ENO B		Brown coal	1 720	1 200	1 200	1 200
ENO A		Brown coal	205	160	200	200
Total ENO		Brown coal	1 925	1 360	1 400	1 400
Total TE			4 175	3 610	3 600	3 600
Total VE		Water	4 439	4 490	4 503	4 519
ENO B - fluid.	Block 125 MW	Brown coal		670	670	670
EVO 1 - fluid.	Block 125 MW	Black coal			625	625
EVO 1 - fluid.	Block 125 MW	Black coal			625	625
EVO - PPC	400 MW	Gas		1 200	2 145	2 145
EVO15	ST 32 MW	Gas		176	176	176
EVO16	ST 32 MW	Gas		100	176	176
New TE total			0	2 146	4 417	4 417
New VE total		Water	0	3	140	140
TOTAL SE, a.s. incl. EBO V1 a EGA			25 664	22 799	25 560	25 576

ENO - Power plant Nováky,
TE - heat plants,
VE - hydropower plants,
JE - nuclear plants

P.2.5.3 Basic assumptions for projections of GHG emissions in sector Industrial Processes

N_2O emissions from production of nitric acid

In Slovakia, nitric acid is produced in the companies Duslo, a.s. Šaľa and holding Chemko Strážske. Emissions of NO_x and N_2O are produced in the production of nitric acid. In 1999, Duslo, a.s. Šaľa that produces 320 000 tons of nitric acid annually, has introduced a modern technology. The new technology has reduced by half the NO_x emissions. On the other hand, from 1996, a selective catalytic reduction of NO_x gases introduced in 1996 might slightly increase the N_2O emissions. Simple model of modeling was applied in the projections of emissions. It was based on production volumes and emission factors determined for individual type of technologies. Measures aimed to reduce emissions were applied as well. Estimated levels of productions are shown in table P.2.5.3.1.

Table P.2.5.3.1 Estimated production of HNO_3

Year	Duslo, a.s.	Chemko
	t HNO_3	
2005	415 000	57 000
2010	485 000	75 000
2015	555 000	95 000
2020	600 000	120 000
2025	600 000	120 000
2030	600 000	120 000

Assumptions and methods of GHG projections in Agriculture sector

The sources of data used for the projections in agriculture are the Green reports of the Ministry of Agriculture, and limits of agriculture production according to the common agriculture polity for Slovakia. The data are shown in the table. The level of CH_4 emissions is determined by number of livestock.

Table P.2.5.3.2 Number of livestock according to categories in thousand of pieces

Source	Year	1990	1995	2000	2005*	2010*	2015*	2020*	2025*	2030*
Cattle	Dairy	549	355	243	197	139	116	104	99	96
	Other	1 014	628	404	383	250	209	198	188	188
Total		1 563	983	646	580	389	325	302	287	284
Pigs	Sows	180	160	131	85	77	73	69	66	62
Total		2 521	2 076	1 488	1 105	1 450	1 445	1 440	1 435	1 430
Sheep and ram		600	428	348	325	335	335	335	335	335
Goat		25	25	51	38	40	40	40	40	40
Poultry total	Layers	8 134	7 625	5 846	6 170	6 050	6 050	6 050	6 050	6 050
	Broilers	7 833	5 235	6 080	6 450	6 450	6 450	6 450	6 450	6 450
	Other	511	522	520	500	500	500	500	500	500
Horses		14	10	10	9	9	9	9	9	9

The N_2O emissions are also influenced from the other N-inputs, how is depicted in the following table.

Table P.2.5.3.3 Sources of nitrogen for emissions of N_2O and NH_3 in tons until 2030

Source:	Year	1990	1995	2000	2005*	2010*	2015*	2020*	2025*	2030*
Synthetic fertilizers		222 255	69 587	72 653	80 000	130 000	150 000	170 000	190 000	210 000
Animal waste	Total	176 851	124 164	88 972	75 921	69 546	65 058	63 251	62 169	61 808
	Pasture	21 253	14 032	10 271	9 009	7 327	6 681	6 402	6 259	6 209
	Solid	106 092	70 477	49 086	43 155	34 292	30 745	29 378	28 564	28 343
	Liquid	49 506	39 655	29 615	23 757	27 927	27 632	27 470	27 345	27 256
Crop residue	Total	179 485	175 673	180 870	173 787	176 262	179 935	181 987	182 923	184 004
	N - fix.	39 239	32 415	24 068	9 590	9 952	1 334	9 743	9 152	9 152
	Other	140 246	143 258	156 802	164 197	166 310	169 601	172 244	173 771	174 853
Biological fixation		6 770	5 985	4 394	2 142	2 236	2 340	2 210	2 080	2 080

* estimate

The method of projections of GHG in waste management

Emissions of CH_4

The methane is produced as the result of anaerobic decomposition at landfills. The methane is released into the atmosphere or it might be capped or incinerated. It is estimated that 5 - 20 % of methane emitted into the atmosphere comes from landfilling. The following table shows estimates on quantity of biologically degradable waste and the increase of incinerated or recovered waste until 2025.

Estimated methane emissions until 2025 were calculated based upon the IPCC method. Based upon the measures, the following parameters were changed according to following assumptions:

- DOC - a coefficient that express the share of biologically degradable carbon (municipal waste and selected waste from industry and agriculture),
- R - amount of methane generated in landfill that was incinerated or recovered.

The increase of 5 %, 10 %, 15 %, 20 % and 25 % was used fro waste from industry and agriculture for the time horizons of 2005, 2010, 2015, 2020 and 2025 (the parameter MSWT x MSWF according to the IPCC method). The calculated amount of waste was used for the calculation in table P.2.5.3.5. Other parameters according to the IPCC methods were not changes.

Table P.2.5.3.4 Assumptions of the reduction of biologically degradable waste and the increase of waste incineration or landfill gas recovery

	Year	Estimated share of biologically degradable waste compared to 2003 [%]	Estimated share of incineration or gas recovery compared to 2003 [%]
Basic scenario	2005	100	0
	2010	100	0
	2015	100	0
	2020	100	0
	2025	100	0
Scenario with low effect of measures	2005	100	5
	2010	95	10
	2015	90	15
	2020	85	20
	2025	80	25
Scenario with medium effect of measures	2005	70	5
	2010	65	15
	2015	60	25
	2020	55	35
	2025	50	45
Scenario with high effect of measures	2005	75	10
	2010	60	25
	2015	50	40
	2020	35	55
	2025	25	70

Table P.2.5.3.5 Estimated amount of selected waste from industry and agriculture in 2005, 2010, 2015, 2020 a 2025

Year	Value of the parameter MSWT x MSWF for selected waste from industry and agriculture [Gg]
2005	227.47
2010	238.26
2015	249.09
2020	259.92
2025	270.75

Table P.2.5.3.6 Estimated methane emissions from landfills until 2025

	Estimated CH_4 emissions [Gg CH_4]				
Year	**2005**	**2010**	**2015**	**2020**	**2025**
Base status of emission in 2003 = 65.76 Gg CH_4					
Basic scenario	66.73	67.70	68.90	69.63	70.60
Scenario with low effect of measures	63.40	58.84	54.42	50.13	45.99
Scenario with medium effect of measures	50.17	43.73	37.57	31.68	26.06
Scenario with high effect of measures	49.62	36.85	27.27	14.38	7.71

Municipal and industrial wastewater contain a high share of organic mater. The release of methane and nitrogen oxides occurs in anaerobic treatment and sludge processing. It is estimated that wastewater contribute to global emissions by 8-11 %. It is estimated, that the population of Slovakia will slightly decline in a time horizon to 2025. Projections are based on assumption of connection of inhabitants to sewage system in target years of 2005, 2010 and 2015. The data of Water Research Institute were applied. The data for 2020 and 2025 were estimated. In addition, it was estimated that recovery of bio-gas generated in anaerobic

sludge digestion will increase. In the case of industrial wastewater, the assumption of a 25 % increase of organic load in 2025 was considered. However, it is assumed that base available techniques application will lead to reduction of pollution of wastewater. Projections considered an increase of organic matter in waste water from the industry by 20 %.

Table P.2.5.3.7 Estimated changes in methane emissions until 2025 compared to 2003

	Changes compared to 2003 [Gg CH_4]				
Year	2005	2010	2015	2020	2025
Base status of emission in 2003 = 65.76 Gg CH_4					
Basic scenario	+0.97	+1.94	+3.14	+3.87	+ 4.84
Scenario with low effect of measures	-2.36	-6.92	-11.34	-15.63	-19.77
Scenario with medium effect of measures	-15.59	-22.03	-28.19	-34.08	-39.70
Scenario with high effect of measures	-16.14	-28.91	-38.49	-51.38	-58.05

Table P.2.5.3.8 Quantitative estimates of projections of methane emissions from wastewater

	year	No. of inh. [thous.]	Share of inhabitants connected to sewage system[%]	Estimated share of utilized gas from sludge digestion[%]
Basic scenario	2005	5377	56	20
	2010	5359	56	20
	2015	5329	56	20
	2020	5278	56	20
	2025	5199	56	20
Scenario with low effect of measures	2005	5377	57	20
	2010	5359	58	25
	2015	5329	59	30
	2020	5278	60	40
	2025	5199	65	45
Scenario with medium effect of measures	2005	5377	58	25
	2010	5359	60	30
	2015	5329	65	35
	2020	5278	70	40
	2025	5199	75	45
Scenario with high effect of measures	2005	5377	59	30
	2010	5359	65	35
	2015	5329	75	40
	2020	5278	80	45
	2025	5199	85	50

Table P.2.5.3.9 Assessment of effect of measures on methane emissions from wastewater treatment

	Estimated methane emissions [Gg CH_4]				
Year	2005	2010	2015	2020	2025
Base status of emission in 2003 = 25.92 Gg CH_4					
Basic scenario	25.91	25.82	25.68	25.43	25.05
Scenario with low effect of measures	25.58	24.26	23.56	21.73	18.05
Scenario with medium effect of measures	24.35	22.74	20.20	17.69	15.21
Scenario with high effect of measures	23.13	20.32	16.37	14.00	11.66

Table P.2.5.3.10 Estimated changes of methane emissions until 2025 compared to 2003

	Change of methane emissions by effect of measure compared to 2003 [Gg CH_4]				
Year	2005	2010	2015	2020	2025
Base status of emission in 2003 = 25.92 Gg CH_4					
Basic scenario	-0.01	-0.10	-0.24	-0.49	-0.87
Scenario with low effect of measures	-0.34	-1.66	-2.36	-4.19	-7.87
Scenario with medium effect of measures	-1.57	-3.18	-5.72	-8.23	-10.71
Scenario with high effect of measures	-2.79	-5.60	-9.55	-11.92	-14.26

N_2O emissions from wastewater

The IPCC, CORINAIR or ISI methods could be used for calculations of N_2O emissions from wastewater treatment. The ISI method was applied. It assumes that the wastewater treatment without the nitrogen removal does not emit any N_2O. Therefore, the calculations take into consideration only WWTP that include denitrification level.

Recent development in Slovakia shows the gradual increase of WWTPs that apply tertiary treatment. This is due to the fact that according to EU Directive 91/271, agglomerations of more than 10 000 PE must be equipped by advanced treatment in so called sensitive areas. The sensitive areas are those in which rivers are impaired by eutrophication. However, the increase of WWTP with nutrient removal will increase the generation of N_2O. Two scenarios were considered:

- basic scenario: amount of WWTP that include nitrogen removal will not increase,
- scenario with a high effect of measures: amount of wastewater that undertake nitrogen removal will gradually increase by 2025. The ISI method is based on the number of inhabitants connected to WWTP. This is illustrated in table P.2.5.3.11.

Table P.2.5.3.11 Estimated PE connected to WWTP with nitrogen removal until 2025

Year	PE
2005	250 000
2010	450 000
2015	600 000
2020	650 000
2025	700 000

Number of PE in 2000 is equivalent to number of PE in a base year of 1998

In the case of industrial wastewater, it is not estimated significant change. In recent years, the increase of industrial WWTP was documented, however, concentrations of nitrogen in wastewater is low. The highest nitrogen concentrations are in Duslo, a.s. Šaľa and Chemko Strážske companies. Currently, there are not available any data of trends in the development in other companies. The table P.2.5.3.12 shows estimated N_2O emissions, the table P.2.5.3.13 illustrates changes in emissions compared to a base year of 2003.

Table P.2.5.3.12 Estimated N_2O emissions in the time horizon by 2025

	Estimated N_2O emissions from wastewater [kg N_2O]				
Year	2005	2010	2015	2020	2025
Base status of emission in 2003 = 50 707 kg N_2O					
Basic scenario	50 707	50 707	50 707	50 707	50 707
Scenario with high effect of measures	50 707	70 012	76 447	78 592	80 737

Table P.2.5.3.13 Estimated changes of N_2O emissions compared to 2003

	Estimated changed of N20 emissions from waste water [kg N_2O]				
Year	2005	2010	2015	2020	2025
Base status of emission in 2003 = 50 707 kg N_2O					
Basic scenario	0	0	0	0	0
Scenario with high effect of measures	0	+19 305	+25 740	+27 885	+30 030

P.3.7 Annex to chapter 7 - overview of research oriented to climate change

P.3.7.1 TU Zvolen, Forestry Research Institute Zvolen, Hydromeliorácie

Project:	WARM project (Wildland – urban Area Fire Risk Management) part of 5th Framework program for science and research. Research of forest fires in Europe
Implementer:	Technická univerzita Zvolen
Duration:	2002-2004
Focus:	Forest fires and climate change

Project:	CARBOMONT (Effects of land-use changes on sources, sinks and fluxes of carbon in European mountain areas) – part of 5th Framework program for science and research
Implementer:	Technická univerzita Zvolen
Duration:	2002-2004
Focus:	Emissions of greenhouse gases

Project:	Adaptation strategy of forest ecosystem to anticipated climate change in conditions of immision load. Science Grant Scheme of the Ministry of Education, No. 1/9265/02
Implementer:	Technická univerzita Zvolen
Duration:	2002-2004
Focus:	Adaptation measures

Project:	Changing composition of the atmosphere, anticipated climate change, impact on forest ecosystems. Science Grant Scheme of the Ministry of Education and Slovak Academy of Sciences, Final report, No. 1/6060/99
Implementer:	Technická univerzita Zvolen
Duration:	1999-2001
Focus:	Impact of climate change

Project:	Analysis of impacts of climate change on forest ecosystems of Western Carpathian Mountains and proposal of adaptation and mitigation measures. Science Grant Scheme of the Ministry of Education, No: 1/2382/05
Implementer:	Technická univerzita Zvolen
Duration:	1999-2001
Focus:	Impact of climate change

Project:	Climate change and impacts on the development of the society – project under the state scientific and research program: Actual issues of society development
Implementer:	Hydromeliorácie, š.p. Bratislava
Duration:	2003-2005
Focus:	Impacts of climate change

Project:	Reaction of diversity of forest phytocenoze to changes in edaficko-climatic conditions of Slovakia Project APVT-27-009304
Implementer:	Lesnícky výskumný ústav Zvolen
Duration:	2005-2007
Focus:	Impacts of climate change on biodiversity

Project:	Investigation of reserve and balance changes of carbon in mountain landscape Project APVT-27-037702
Implementer:	Lesnícky výskumný ústav Zvolen
Duration:	2004-2006
Focus:	GHG emissions

Project:	Impact of global climate change on the forests of Slovakia Project of the Ministry of Agriculture
Implementer:	Lesnícky výskumný ústav Zvolen
Duration:	2003-2007
Focus:	Impact of climate change

P.3.7.2 Institute of Hydrology of SAV

INTERNATIONAL PROJECTS

- **MHP UNESCO 1.1** Flow Regimes from International Experimental and Network Data, Subproject 5: Catchment Hydrological and Biogeochemical Processes in Changing Environment,
- cooperation: International hydrological program of UNESCO, Paris, France and 6 cooperation countries in Europe,
- Guarantor: RNDr. Ladislav Holko, CSc. (international coordinator),
- Focus: Experimental hydrological research and mathematic modeling of hydrological processes in small basins
- Duration until 2006.
- **MVTS 51-98-9350-00/2002:** Flood regime of rivers in the Danube basin,
- Guarantor: RNDr. Pavol Miklánek, CSc.,
- Duration: 2003-2007,
- Number of cooperative organizations: 9,
- Slovak-Czech project 185/099: Cadmium transport in a structure soil under conditions of climate warming,
- Guarantor: Ing. Ľubomír Lichner, CSc.,
- Duration: 1.1.2002-31.12.2003,
- Cooperative organizations: Fakulta stavební ČVUT Praha.

APVT PROJECTS:

- **APVT 51-006502:** Assessment of climate change impact on selected components of the hydrosphere and biosphere in Slovakia,
- Guarantor: RNDr. Pavla Pekárová, CSc.,
- Duration: august 2002-November 2005,
- Cooperative organizations:
  - Department of Water Management of Landscape, Slovak technical university, Bratislava,
  - Department of metrology and climatology, Faculty of mathematics, physics and informatics UK, Bratislava,
  - Slovak Hydrometeorological Institute, Bratislava,
  - Institute of Landscape Ecology SAV, Bratislava.
- **APVT 51-044802:** Impact of the drought on water regime and biodiversity of lowland regions in Slovakia and design of counter-measures,
- Guarantor: RNDr. Július Šútor, DrSc.,
- Duration: January 2004 - December 2006,
- Cooperative organizations:
  - Department of Hydrotechnics, Slovak technical university, Bratislava,
  - Department of Ecology, Slovak Agriculture University, Nitra,
  - County research institute of agro-ecology, Michalovce.

VEGA PROJECTS

- **VEGA 2/6090/99:** The influence of global changes of environment on water storage in the zone of aeration of soils,
- Guarantor: RNDr. Vlasta Štekauerová, CSc.,
- Duration: 1999-2001,
- Cooperative organizations: none.

- **VEGA 2/7149/20:** Changes of hydrological processes in mountain regions in interaction with changing environment
- Guarantor: RNDr. Zdeněk Kostka, PhD.,
- Duration: 2000-2002,
- Cooperative organizations: none.
- **VEGA 2/2016/22:** Parametrization of the extreme runoff formation processes in the Slovak basins in conditions of the non-stationarity of the hydrological system,
- Guarantor: RNDr. Pavol Miklánek, CSc.,
- Duration: 2002-2004,
- Cooperative organizations: KVHK SvF STU Bratislava.
- **VEGA 2/2003/2:** The influence of extreme meteorological phenomena on soil water regime of Slovakia lowland areas,
- Guarantor: RNDr. Vlasta Štekauerová, CSc.,
- Duration: 2002-2004,
- Cooperative organizations: none.
- **VEGA č. 2/3032/23:** Soil water repellency and its consequences on water flow in soil,
- Guarantor Ing. Ľubomír Lichner, CSc.,
- Duration: 2003-2005,
- Cooperative organizations: none.
- **VEGA 2/3018/2:** Quantification of water balance of heavy soils in the East Slovakian Lowland and prognosis of their changes under extreme meteorological conditions,
- Guarantor: Ing. Milan Gomboš, CSc.,
- Duration: 2003-2005,
- Cooperative organizations: none.

P.3.7.3 Agriculture University Nitra

- **VEGA 1/1313/04:** Assessment of risks due to anticipated climate change on production conditions of Apple (*Malus domestica*) apricot (*Armeniaca vulgaris*) and peach (*Persica vulgaris MILL*.) in Slovakia and project of climate change and drought - impact and backgroudn for agriculture, production and quality,
- Assessment of risks due to anticipated climate change on production conditions of pepper (*Capsicum annum L*.) and melon (*Citrulus lanatus MILL*.) in Slovakia.

Report on Demonstrable Progress of the Slovak Republic to Achieve Commitments under the Kyoto Protocol

Ministry of the Environment of the Slovak Republic
Slovak Hydrometeorological Institute, Bratislava

Bratislava, November 2005

Contens

Introduction

The Kyoto Protocol entered into force on the 16th February 2005 after fulfilment of condition stated in Article 25, that means 90th day following the ratification by at least 55 countries, among them have to be included countries of Annex I contributing at least by 55 % to the total 1990 carbon dioxide emissions. Slovakia presents its Report on Demonstrable Progress according to the Article 3.2 in consistency with the Fourth National Communication of the Slovak Republic on Climate Change and the following the Decisions 22/CP.7 and 25/CP.8. This report provides for the comprehensive analyses of undertaken steps and measures which are critical prerequisites to fulfil systemically the UNFCCC and KP commitments.

Afer the Kyoto Protocol coming into force, except for urgent needs to change existing strategic objectives towards the sustainable meeting of reduction targets for the first and the second KP commitment period, decisive enhancement of monitoring and reporting obligations for parameters selected to be qualified in the demonstrable progress report has been recognised. The scope of presented report closely follows the relevant COP Decisions and principles of Decision No. 280/2004/EC of the European Parliament and of the Council Concerning a Mechanism for Monitoring Community GHG emissions and for Implementing the Kyoto Protocol.

1. National reference frame to meet commitments under the UNFCCC and KP

1.1 Political and institutional framework

The UNFCCC came into force in Slovakia on the 23rd November 1994 (1). The First National Communication of the Slovak Republic on Climate Change was published in May 1995 (2) providing comprehensive information on policy and measures which had been adopted to mitigate adverse impacts of climate change. The Second National Communication followed in June 1997 (3), Third in November 2001 (4). While the first two reports are available only as hard copies, the third one is also available on the web page of the Ministry of Environment (www.enviro.gov.sk). The process and related capacity development is formally promoted by the Strategy of SR on Climate Change (6). Slovakia ratified the Kyoto Protocol in May 2002. The adopted reduction commitment of SR for the period 2008 - 2012, quantified in Annex B to the Kyoto Protocol is equal to 92 % of the total national emissions of greenhouse gasses in 1990 multiplied by five. In the Strategy of SR for Achieving the Commitments under of the Kyoto Protocol (5), the total quantity determined for the first target period (2008 - 2012) is reduced by an additional 5 %, but not proportionally for all sectors. It is intended to create a reduction reserve that would allow compensation of uneven economic development or other possible changes with potential impact on the GHG emissions' generation.

The National Focal Point (NFP) at the Air Protection Department of the Ministry of Environment SR is the key expert and legal guarantor for the achievement of commitments and requirements of the UNFCCC and KP. In addition to the NFP, also the Ministry of Economy SR, the Ministry of Agriculture SR, the Ministry of Construction and Regional Development SR and the Ministry of Transport, Post and Telecommunication SR contribute to the mitigation of climate change impacts at all levels of the process. No separate state administration has been established to address only climate change, but the field has been incorporated into the state administration for air protection represented by the Ministry of Environment SR (MŽP SR), the Ministry of Transport (MDPT SR) and the Slovak Environmental Inspection, District and Regional Offices and municipalities. Non-governmental organisations (NGOs), academic institutions and interest groups are involved in the process of development and approval of interdisciplinary and strategic materials. Implementing agencies, scientific and research institutions, including laboratories, supervisory bodies, consulting companies and experts also play important roles in the process. The role of the mass media and schools, supported by NGOs and civic associations, is very important in the dissemination of environmental information.

Climate change issue has become a priority of the Slovak Government. It is reflected in all conceptual documents of affected sectors and strategic objectives. In the Program Declaration the Slovak Government 2002 *"...has pledged to apply the principles of sustainable development through a developing policy emphasizing balanced economic, social and environmental dimensions. The Slovak Government feels the shared responsibility with EU countries in dealing with global problems of air protection, ozone layer protection and climate change and it will support an increased share of renewable energy resources and control of technologies. The government will participate in the emission trade together with developed countries in order to achieve the commitments under the Kyoto Protocol on the reduction of greenhouse gas emissions..."*.

The overview of the institutions and their competence for the climate change are listed in the table P.1 in Annex.

1.2 Strategy and conceptual framework

The Strategy of SR to Achieve Commitments under the Kyoto Protocol

The Strategy towards the Kyoto Protocol commitments (5) is the comprehensive document that the Slovak Government has taken note on it in 2002. It defines objectives in three time horizons:

Short-term (up 2002):

- to ratify the Kyoto Protocol by 2002.

Medium-term (2003-2007):

- to reach by the end of 2005 the development of GHG emissions that will clearly allow to achieve the Kyoto Protocol commitments,
- to complete the National Inventory System (NIS) in compliance with the requirements of the Art. 5 KP, Decision 20/CP.7, and Decision 296/1999/EC by the end of 2005.

Long-term (2008-2020):

- to reduce GHG emissions in 2008-2012 by 8 % compared to the reference year 1990, aggregate emissions may not exceed 333.6 mil. tons in five year period,
- to establish prerequisites to reduce further 5 % of the GHG emissions in the second target period (Art.3 (13) of the KP),
- to control the GHG emissions development so that stabilisation after the year 2015 could be achieved gradually.

The document defines also the policy to meet the reduction goals for energy sector, transportation, agriculture, forest and water management as well as education and public awareness. It also identifies priority areas to strengthen capacities to meet the objectives of the UNFCCC and KP. Proposals to adaptation measures were not the subject of the document due to their specific character. The short-term objective to ratify the KP was fulfiled on May 31, 2002. Currently, the completion of the NIS is the priority task under the responsibility of the Ministry of the Environment and the SHMU.

Action Plan of Fulfilment of the Kyoto Protocol Commitments of the UNFCCC

Next to the mentioned Strategy document (6) it has been developed the proposal of *Action Plan of Fulfilment of the Kyoto Protocol Commitments of the UNFCCC* that has thoroughly analysed direct and indirect measures in view of their GHG reduction potential, invenstment intensity and the time horizon to be implemented.

The analysis has focused on the energy sector, namely on the fossil fuel combustion and transformation, which significantly contributes to the total CO_2 emissions, but which also represents the largest room to implement mitigation measures. The following measures were evaluated:

Measures on the energy demand side

- improvement of the thermal characteristics of building in residential sector,
- shifting from individual road transport to the public mode.

Measures on the energy supply side

- utilisation of combined cycles with electricity and heat cogeneration in public power plants,
- utilisation of combined cycles with electricity and heat cogeneration in industrial power plants,
- biomass utilisation in the industrial power plants,
- biomass utilisation in the central district heating system,
- utilisation of geothermal energy in the central district heating system,
- biomass utilisation for individual heating,
- utilisation of solar energy for heating and hot water sypplying.

Total estimated CO_2 mitigation potential of measures from the Action Plan represents average annual decrease in emissions during the first KP commitment period by 9 % related to the without measure scenario.

Principles for Tranding with the GHG Emission Reductions

Except for above mentioned documents, the Ministry of the Environment has adopted and at the web site published Principles for Trading with the GHG Emission Reductions (7) for period until the trading with CO_2 emission quotas will be established (i.e. for years 2002-2004, or 2005 eventually). According to the adopted strategy it is allowed to trade with GHG emission reduction at the entity level only in case that there have been clearly identified projects generating emission reduction in sufficient volume. The reason is to ensure environmental benefits and integrity so, that the volume of transfer would not be higher than occured emission reduction. Trade procedure, conditions and criteria of transfers as well as selected types of environmentally sound projects (switching from fossil fuels to renewable energy source, decrease in fossil fuel consumption, switching to the less carbon intensive fuel type) are defined in these principles too.

Proposal of Energy Policy of the Slovak Republic

The objective to increase energy efficiency was declared in the proposal of the Energy Policy in 2005. The proposal (4) is under the public discussion and is placed at the web page: www.economy.gov.sk. The document represents the analytical set of data on technical, economic and market potentials of energy savings for individual sectors. It includes possibilities to finance energy saving projects. Based upon the background study, the main areas of active policy will be oriented to the sectors of industry, transport and housing.

Detailed overview of further strategic and concept documents in the relevant sectors are presented in the Chapter 4 of the Fourth National Communication of the SR on Climate Change.

1.3 Legislative arrangements

Following is the overview of adopted national legislative and regulation measures aimed directly or indirectly on the reduction of GHG emissions. There has not been adopted any direct legislative measure in Slovakia focused on GHG emission reduction until the year 2004. Neverthless, some of previously applied indirect measures proved significant decreasing of GHG emissions as by side effect, namely the Act on Air Protection, measures to support wider use of renewables and some energy efficiency increasing and energy saving measures.

Act 478/2002 on Air Protection

Type of measure - regulatory and economic

The Act governs rights and obligations of legal and physical persons with respect to the release of polluting substances to the air. It also stipulates the quality objectives, responsibilities of authorities and liabilities with respect to violation of obligations. According to the Act, each operator of the pollution source is obliged to pay progressively increasing charges (coefficients are defined for each year) depending on the amount and type of polluting substances emitted to the air. The pollution charges for the CO_2 emissions are not established.

Act 572/2004 on Trade with Emission Quotas and its implementing Decree 711/2004

Type of measure - regulatory and economic

The Act was adopted in 2004 and transposed the requirements of the Directive 2003/87/EC. This Directive deals with the scheme of trading with emission quotas of GHG emissions. The Act stipulates rights of all stakeholders that participate at the scheme. It also stipulates the system of trading, the scope and comptences of the national authorities. Selected activities fall under the Decision 2004/156/EC that provides for the rules of monitoring and reporting obligations.

Act 587/2004 on Environmental Fund

Type of measure - economic, indirect

The Environmental Fund was established by the Ministry of Environment. The income of the Fund is generated from pollution charges from large and medium pollution sources, penalties for the violation of the legal provisions and other sources. The financial means could be provided for the activities aimed to achieve the objectives of the state environmental policy, support of the research or public awareness.

Act 656/2004 on Energy and Act 657/2004 on Heat Energy

Type of measure - regulatory

These acts support the implementation of the EU legislation after the joining the common European market. The Act on energy sector stipulates conditions for entrepreneurship and business in electro-energy sector, gas industry. It also provides for rights and obligations of stakeholders in this market and supervision of the national authorities. The Act on heat energy sector similarly provides for provisions with respect to heat energy business.

Act 276/2001 on Regulation of Network Branches

Type of measure - regulatory

The Act was adopted in 2001 and regulates legal, economic and organization procedures of the energy regulation. The Act provides for extent, conditions and procedures of regulation, competencies of the National Office for Regulation of Network Branches. The Office supervises the activities that are subject of regulations and functioning of the market at the monopoly conditions of sale.

Directive 2002/91/EC on Energy Economy of Production (energy efficiency) in Buildings

Type of measure - regulatory

The Act on Energy Economy in Buildings is under the preparation.

The Act is under the preparation in order to transpose the Directive 2002/91/EC that aims to improve energy efficiency in buildings. The sector of households and buildings represent more than 40 % share on the final consumption of energy in the EU. The directive defines measures that lead to improvement of parameters of buildings, methods of integrated standards of energy consumption in buildings, recommends temperatures and climate conditions in pubic buildings. The Directive requires regular inspections of cooling and heating systems. A platform of the program Intelligence Energy 2003-2006 contributed to the preparation of the Directive. Also the cooperation and experience with the CEN were applied.

Directive 2003/54/EC on Common Rules of Internal Market with Electricity and Directive 2003/55/EC on Common Rules of Internal Market with Gas

Type of measure - regulatory, economic

The aim of market liberalization is to create competitive conditions even at the existence of natural monopolies. These Directives require that all dealers in energy sector met the obligations with respect to economic interests. These obligations include safety and reliability of the system and network, quality of electricity supply and high energy efficiency and the environmental protection.

Directive 2001/77/EC on Support of Electricity Generated from Renewable Resources

Type of measure - regulatory

According to this Directive, producers of electricity from renewable energy resources will be granted by green certificates. It will also provide for stabile prices of the electricity generated from renewable resources. The Directive includes support programs and rules for business (flexible depreciation of investments). Slovakia declared an indicative objective of 19 % share production of the electricity from renewable resources in 2010. However, current Slovak legislation does not provide for the obligation to buy the electricity generated from renewable resources, thus, it is anticipated to amend this provision.

Directive 2004/8/EC on Support of Co-generation, and the Directive (under the preparation) on Energy Efficiency of Final Utilization of Energy and Energy Services

Type of measure - regulatory

Directive 2004/8/EC on the Promotion of Cogeneration based on a useful heat demand in the internal energy market represent the link to relevant EU legislation (amends the Directive 92/42/EHC). The target is to duplicate the energy saving at the same time with the increasing the energy production from co-generation from 11 % in 1998 to the 18 % to the 2010.

The Slovak Office for Standards, Metrology and Testing is responsible for the implementation of legal regulations with respect to energy consumption and compulsory labelling of appliances.

Regulations of the Slovak Government to the Directive 92/75/EC on Energy Labelling

Regulation No.:	Type of appliances
177/2002	Noise labelling
178/2002	Wasching machines
188/2002	Lights
193/2002	Electric cylinder dryiers
199/2002	Electric refrigerators, freezers and their combination
210/2002	Combination of washing maschines and dryiers
211/2002	Washer-up
231/2003	Air conditioning units
379/2004	Amendment to the Regulation No.: 199/2002

Directive 2001/81/EC on National Emission Ceiling, Regulation 60/2003 on Establishment of National Emission Caps and Emission Quotas

Type of measure - regulatory

These regulations provide for national emission ceiling of pollution substances (sulphur oxides, nitrogen oxides, ammonium and non-methane volatile organic compounds) and emission quotas of SO_2 till 2010.

Act 220/2004 on Protection and Utilization of Agriculture Soil

Type of measure - regulatory

The Act stipulates measures for the protection of properties and functions of agricultural soil with the aim of sustainable management of the soil. It is a framework legal instrument to protect ecological and genetically important elements of the soil. It deals with the measures aimed to protect the soil against degradation, erosion and risks substances.

Act 555/2004 on Manures

Type of measure - regulatory

The Act 136/2000 on manures was replaced by the Act 555/2004 in September 2004. The Act stipules requirements of the application of Manures, substrates and other substances, including registration, storage and use of manures and chemicals. It also provides for certification procedures.

Act 415/2002 on Ecological Agriculture and Production of Bio- foods

Type of measure - regulatory

Amends Act 224/1998

The Act aims to support ecological agriculture. The measures to be implemented till 2010 are set out to support eco-farming projects.

Act 326/2005 on Forests

Type of measure - regulatory, economic

It is a framework legislation to protect forests and forest management. It aims to sustainable wood logging in order to avoid overexploitation of woods.

Act 238/1991 on Waste

Type of measure - regulatory

Amended Act 223/2001 on Waste is the basic legislation in the area of waste management. According to this Act, each generator of waste is obliged to utilize waste generated as a source of secondary raw material or energy. Landfilling is the final level of the waste disposal. The Act stipules basic rules and obligations of legal and physical persons with respect to generation and minimization of waste.

2. Trends in, and projections of, the national GHG emissions

The process of greenhouse gases inventory according the UNFCCC requirements is realized in Slovakia from 1995, from 2000 in the CRF. Next year inventory will be provided in the new CRF Reporter program for the whole time series 1990-2004 according to the COPs Decisions (18/CP.8 about reporting and 13/CP.9 about reporting in the LULUCF sector). Air Protection Department at the Ministry of the Environment (MZP) of the Slovak Republic is the national focal point to the UNFCCC. MZP is granting and supervising development and maintenance of national emission inventories on annual bases. The complete CRF with the emission inventory are reported to the Secretariat of the UN FCCC by 15 of April annually (8). After review process from the external expert is published Centralized Review on the web page http://unfccc.int/program/mis/ghg/indrev2003.html.

The inseparable part of the emission inventory is the National Inventory Report, which is prepared from 2003 annually (9).

The emissions of GHGs in the Slovak republic were estimated in compliance with the methods provided in IPCC 1996 Revised Guidelines and Good Practice Guidance (GPG 2000), CORINAIR (2003), COPERT III (2002) and the national methodology in important categories. In accordance of these methodologies are used the emission factors: IPCC default, national specific, from literature.

The emission balance is reported in the seven basic IPCC sectors (Annex I, KP), spits into the subsectors:

- Energy (Combustion processes, Transport, Fugitive emissions),
- Industrial Processes (Industrial technologies, F-gases),
- Solvents and Solvent Use,
- Agriculture,
- Land Use, Land Use Change and Forestry,
- Waste,
- Other.

The inventory process has not been certified (for example according to ISO 9001) and the quality system (QA/QC) has not been implemented. The quality system according to IPCC requires:

- transparency (is kept, NIR),
- consistency (good, re-calculations since 1990 in case of change),
- comparability (default EFs according to IPCC, in case of absence EFs comparison with the Czech Republic),
- completeness (expert estimation about 95 %), accuracy (not yet sufficiently assessed),
- use of good practice (according to the Good Practice Guidance, 2000).

The uncertainties of emission factors are not assessed consistently and usually expert estimates are used.

In the table P.2 of the Annex are listed the inventory and projections of greenhouse gas emissions, preparation of national communications, action plans and evaluation of policy effects and measures - current institutional framework of the Slovak Republic.

2.1 Trends of aggregated GHG emissions

In accordance with the generally expected results, the aggregated emission of GHGs in year 2003 moderately increased comparing with the year 2002 about more than 700 Gg without LULUCF (app. 1 %). There is the significant decreasing of aggregated emissions against the base year (1990) about approximately 20 463 Gg, that means the decreasing by about 30 %. The total national emission in the current year 2003 was estimated to be 51 641.44 Gg without LULUCF sector and the net GHG emission was 46 758.80 Gg including the LULUCF.

The Slovak Republic reported the national Emission from energy sector based on reference approach data in 2003 to be 41 444.84 Gg including the transport emissions (5 370 Gg), which represent decrease by about 28 % comparing to the base year. The total emissions from Industry sector in 2003 were estimated to be 3 938.28 Gg (decrease by about 8 % comparing to the base year), the emissions from Agriculture sector were estimated to be 4 016.58 Gg (decrease by about 50 % related to the base year), the emissions from Waste sector were estimated to be 2 223.23 Gg (no decrease was registered due to including emissions from the waste incineration since the year 2000). The emissions from Solvent Use and other sectors were estimated to be 0 Gg, the total sinks from LULUCF were estimated to be -4 864.12 Gg.

A major share of aggregated emission by sectors is covered with the Energy sector by about 80 %, the Industry sector covers about 8 %, the Agricultural sector about 8 % and the Waste sector about 4 % (figure 2.1). The major share of aggregated emission by gases covers CO_2 emissions by about 83 %, CH_4 emissions by about 9.1 %, N_2O emissions by about 7.6 % and F-gases emissions by about 0.3 % (figure 2.2).

Figure 2.1 The aggregated GHG emissions by sectors in 2003

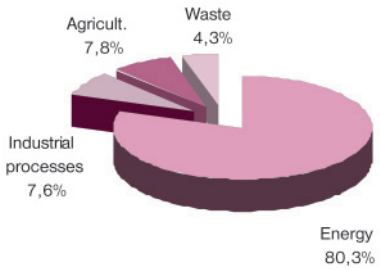
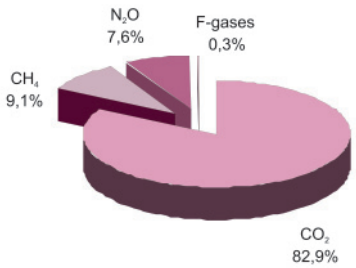


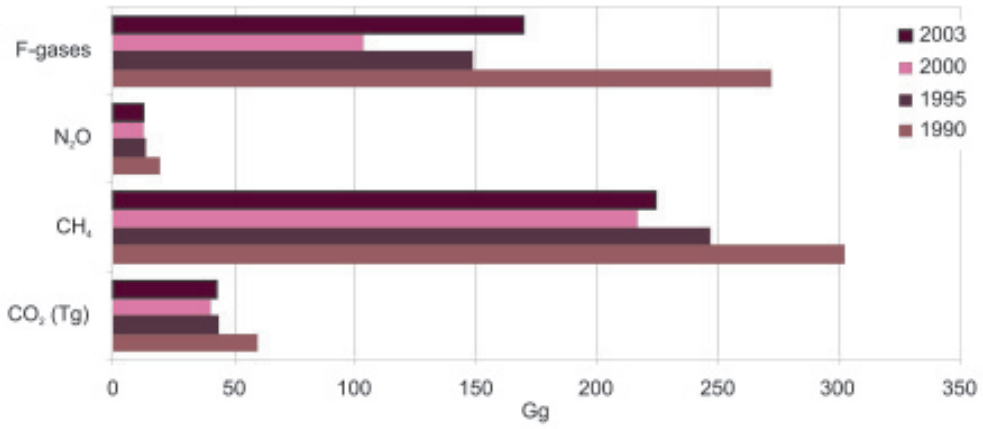
Figure 2.2 The aggregated GHG emissions by gases in 2003



2.2 GHG emissions' trends by gases

The total anthropogenic emissions of carbon dioxide decreased relating to the base year (1990) by about 28 % without LULUCF and represented in current year 42 816.85 Gg without LULUCF. The total anthropogenic emissions of methane reached in the 2003 over 224 Gg and increased relating the previous year about 2.4 Gg. The significant increasing of CH_4 emissions from waste management caused this effect. On the other hand, the total anthropogenic emissions remarked the 26 % decreasing comparable with the base year (1990). The total emissions of N_2O decreased relating the previous year to 12.73 Gg and increased relating the previous year about 0.3 Gg. The total decreasing comparable with the base year presents 35 %. The total emissions of F-gases represented 169.73 Gg and are increased comparable with the previous year's inventory by about 40 Gg, but beside the base year (1990) shows a more than 50 % decreasing (13 % beside 1995), caused by decreasing a consumption of perfluoro-carbons (figure 2.3).

Figure 2.3 The GHG emissions' trends by gas in 1990, 1995, 2000 and 2003

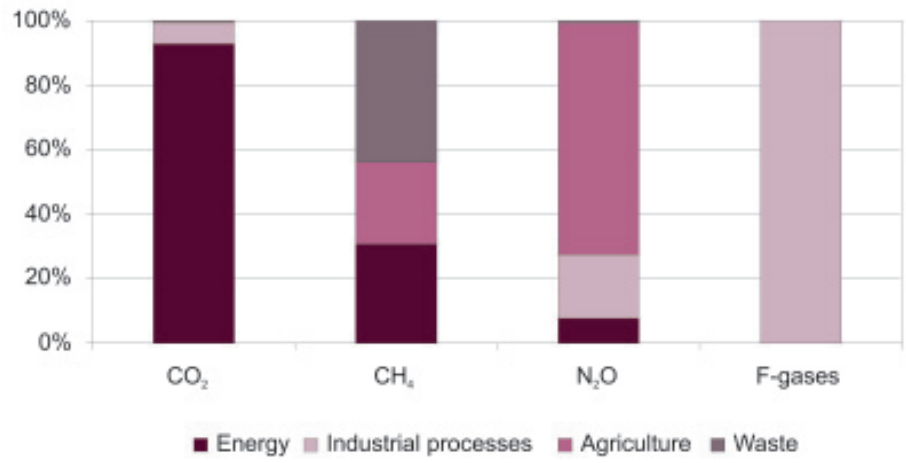


* Total anthropogenic emissions of CO_2 are in Tg

2.3 GHG emissions' trends by sources

The major share of CO_2 emissions is from Energy sector (fuel combustion, transport) with more than 92 % from the total carbon dioxide emissions in last 2003 inventory. More than 40 % of CH_4 emissions produces Waste sector (SWDS), more than 70 % of N_2O emissions produces Agricultural sector (fermentation) and 100 % F-gases emissions come from Industry sector as depicted on figure 2.4.

Figure 2.4 The emission trends by source in 2003



2.4 Emissions' trends of indirect greenhouse gases and SO_2

The total anthropogenic emission of NO_x was estimated to 98.06 Gg and the major share was produced by Energy sector. The total emission of CO was estimated to 308.18 Gg and the major share of emissions was produced by Energy sector. The emission of NMVOC was estimated to 82.24 Gg per year 2003 and the major share was produced by Energy, Industry and Solvent-use sectors. The emissions of SO_2 were estimated to 106.10 Gg per year 2003 and the major share of emissions was produced by Energy sector.

2.5 Projections of GHG emissions and their trends

Projections of greenhouse gas emissions are prepared specifically within the preparation of the national communications on climate change and also irregularly relevant to the decision making processes. The preparation in countries with economy in transition to the market type is complicated by ongoing changes and uncertainties of future economy development that are usually accompanying restructuring and reforms. Therefore, it is not possible simply extrapolate historical input data for modeling purposes. The projections also contain the quantification of the reduction effect of approved or planned measures. Slovakia is one of the countries which is regularly quantifying and issuing data on achvied and proposed reduction impact of policy and measures in cross years. The actual projections of total aggregated emissions were calculated for relevant IPCC sectors in three scenarios: without, with and with additional measures. Results of calculations and modelling are shown in table 2.1.

Projections of aggregated GHG emissions in 2000-2015 are shown in figure 2.5. The trends clearly indicate that the Kyoto Protocol reduction objective will be fulfiled in the time horizon by 2010 even for the reference without measure scenario. According to current projections further reduction of emissions during the post-Kyoto period will be complicated to achieve even for the scenario with additional measures. Therefore adoption of specific strategy and measures in next years will be necessary to compensate proposed economic growth.

Decrease in GHG emissions as indicated in figure 2.6 occurred due to entire number of impacts and processes linked with the transformation of economy. As the most decisive reasons in relation with the followed subject we can consider: gradual decrease in energy intensity since 1993; higher share of services in the GDP generation; higher share of gas fuels in the economy; structural changes in industry and the decrease of energy consumption in energy intensive sectors (without metallurgy), as well as in less energy intensive industries; and the impact of legislative measures influencing directly or indirectly the generation of greenhouse gas emissions. As it has been already mentioned, meeting of the KP reduction target during the first commitment period seems to be feasible for all three sceanarios whereas the specific strategy is necessary for further the post-Kyoto reduction goals.

3. Evaluation of reduction potential for domestic policy and measures

In the following section is presented the overview of the projected reduction potential for selected domestic policy and measures in the cross years structured according to the IPCC sectors and gases (tables 3.1-3.5).

Table 2.1 Projections of aggregated GHG emissions (Gg CO_2 equivalent)

Scenarios	1990*	2003	2005	2010	2015	2020	2025
Energy	57 676	38 651	39 637	46 670	52 405	58 402	65 023
- of which transport	5 169	5 371	5 649	6 350	6 821	7 017	6 991
Industrial processes	4 264	3 938	4 188	5 178	6 350	7 649	9 048
Agriculture	7 860	4 015	2 772	2 763	2 744	2 828	2 941
LULUCF	-2 345	-4 815	2 116	-424	-536	-1 040	-1 669
Waste	2 098	2 223	2 243	2 271	2 307	2 334	2 365
Without measures	69 553	44 013	50 956	56 458	63 270	70 172	77 707
Energy	57 676	38 651	39 637	45 850	51 507	57 399	63 898
- of which transport	5 169	5371	5649	6 350	6 821	7 017	6 991
Industrial processes	4 264	3 938	4 178	5 169	6 336	7 634	9 033
Agriculture	7 860	4 015	2 772	2 687	2 637	2 690	2 772
LULUCF	-2 345	-4 815	2 116	-424	-536	-1 040	-1 669
Waste	2 098	2 223	2 166	2 056	1 958	1 839	1 687
With measures	69 553	44 013	50 870	55 336	61 902	68 522	75 721
Energy	57 676	38 651	39 637	45 050	50 602	56 435	62 882
- of which transport	5 169	5 371	5 649	6 027	6 471	6 655	6 631
Industrial processes	4 264	3 938	4 151	5 042	6 059	6 502	7 889
Agriculture	7 860	4 015	2754	2 333	2 129	2 032	1 989
LULUCF	-2 345	-4 815	2 107	-490	-635	-1 228	-1 891
Waste	2 098	2 223	1 856	1 700	1 527	1 360	1 202
With additional measures	69 553	44 013	50 505	53 634	59 682	65 102	72 071

Figure 2.5 Projections of aggregated GHG emissions

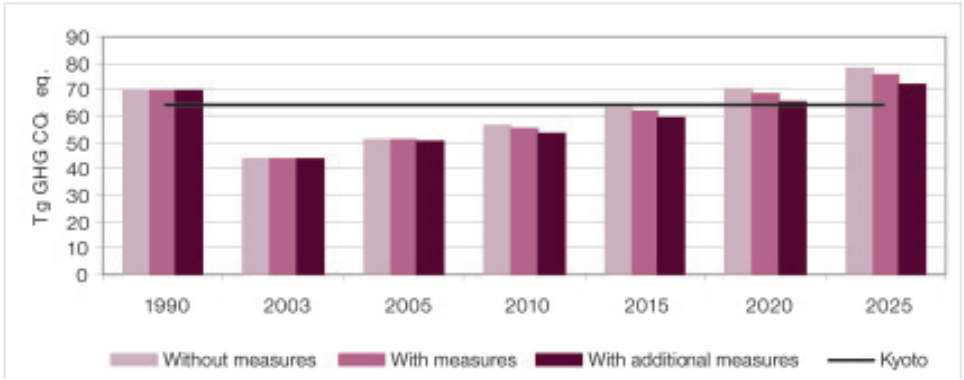


Figure 2.6 Trends of total aggregated emissions of GHGs with the projections to the 2010.

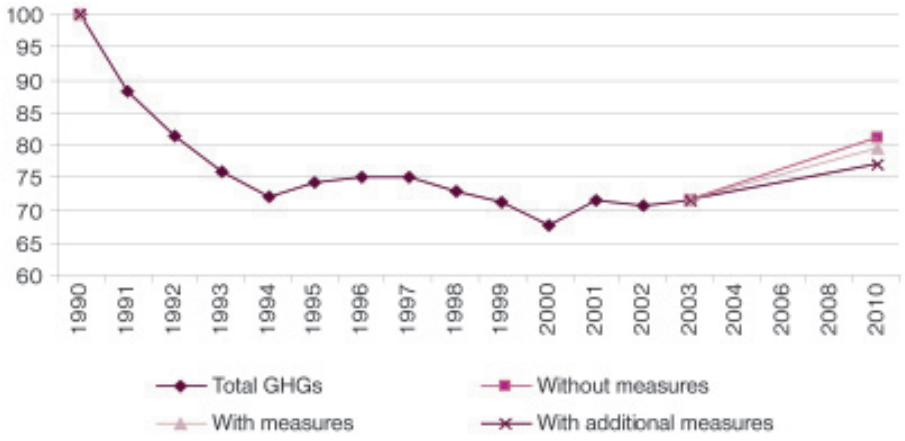


Table 3.1 Impact and characteristics of measures in the Energy sector (including transport)

Measure	Type of measure	Status	Applied in scenario	IPCC sector	Year	2010	2015	2020	2025
					gas	GHG CO_2 eq.			
Act 572/2004	Regulatory economic	I	with measures	1.A*	CO_2	838	920	1 029	1 156
					CH_4	-6	-7	-8	-9
					N_2O	-12	-15	-18	-21
					sum	820	898	1 003	1 125
Directive 2001/77/ES	Regulatory	I	with additional measures	1.A.1.a	CO_2	476	476	476	476
					CH_4	0	0	0	0
					N_2O	1	1	1	1
					Sum	477	477	477	477
Directive 2001/91/ES	Regulatory	I	with additional measures	1.A.4.b	CO_2	0	74	118	168
					CH_4	0	5	8	11
					N_2O	0	0	0	0
					sum	0	79	126	179
Directive 2003/30/ES	Regulatory	S	with additional measures	1.A.3.b	CO_2	324	350	361	361
					CH_4	0	0	0	0
					N_2O	0	0	0	0
					sum	324	350	361	361

* except 1.A.4.b and 1.A.3

Table 3.2 Impact and characteristics of measures in the Industrial Processes sector

Measure	Type of measure	Status	Applied in scenario	Sector	Year	2010	2015	2020	2025
					Gas	GHG CO_2 eq.			
Modernization of production of HNO_3	regulatory, technical	S	With measures	2.B.2	N_2O	4	6	5	6
New technology of emission sinks	regulatory, technical	S	With additional measures	2.B.2	N_2O	128	997	997	997
Reduction of releases in compliance with the EU legislation	regulatory	I	With additional measures	2.F	HFCs	0.123	0.145	0.129	0.129
	regulatory	I	With additional measures	2.F	SF_6	0.004	0.004	0.006	0.006

Table 3.3 Impact of measures to reduce GHG emissions in the Agriculture sector

Measure	Type of measure	Status	Applied in scenario	Sector	Year	2010	2015	2020	2025
					Gas	GHG CO_2 eq.			
Disposal of animal waste	Regulatory	I	With additional measures	4.B	CH_4	47	78	105	108
			With measures		N_2O	77	107	138	169
			With additional measures			0	65	44	39
New manures	Regulatory	I	With measures	4.C	N_2O	307	430	552	675

Table 3.4 Impact of measures to increase sinks and reduce GHG emissions in Land Use, Land use Change and Forestry

Measure	Type of measure	Status	Applied in scenario	Sector	Year	2010	2015	2020	2025
					Gas	GHG CO_2 eq.			
Afforestation and increased protection against fires	Regulatory economic	I	With additional measures	5.A	CO_2	39.19	62.16	120.62	149.76
					CH_4	0.84	1.05	1.05	1.05
					N_2O	0.62	0.62	0.62	0.62
				5.B	CO_2	9.45	13.23	24.57	26.46
				5.C	CO_2	12.60	17.64	32.76	35.28
				5.C	CO_2	3.15	4.41	8.19	8.82

Table 3.5 Impact of measures to reduce GHG emissions in the Waste sector

Measure	Type of measure	Status	Applied in scenario	Sector	Year	2010	2015	2020	2025
					Gas	GHG CO_2 eq.			
Measures in waste disposal	regulatory	I	With measures	6.A	CH_4	186.06	304.08	409.50	516.81
			With additional measures		CH_4	6.66	7.43	8.14	8.79
Municipal waste waters	regulatory	S	With measures	6.B.2	CH_4	32.76	44.52	77.70	147.00
					N_2O	-5.98	-7.98	-8.64	-9.31
Industrial waste waters	regulatory	S	With measures	6.B.1	CH_4	6.51	13.44	21.00	28.98
					N_2O	-3.61	-4.81	-5.21	-5.61

I - policy and measures have been already implemented
S - adopted, approved policy or measures
P - planned, prepared policy/measures

4. Activities and programmes to achieve the commitments under the Article 10 and 11 of the KP

4.1 Activities under Article 10 a) - programmes to improve quality of input data for emission inventory

Even though there are not available any fosuced programmes for improving quality of the emission data at the present time, the considerable effort and the financial instruments are spent for the building of the National Inventory System according to the Article 5 of the KP and the Decision 20/CP.7 COP, annually. Some examples from the quality management affort are listed in the following section.

Energy sector - category energy industry

Two IPCC methods are prescribed for the determination of emissions from fuel combustion of stationary sources. The Statistic Office of SR inserts National energy balance every year, which is base for calculation of reference approach (RA) (top down). The reference approach determines the apparent consumption of individual types of fuels (primary, secondary and biomass) for which inventory is prepared. The sectoral approach (SA) (bottom up) is based on National Emission Inventory System (NEIS),

the database of stationary sources, which collects the data of fuels consumption from the major sources of air pollution in the Slovak Republic. Reference and sectoral approach are estimated on fully independent data sets, whereby obtained differences are negligible. The difference between the top down and the bottom up energy balance estimates the uncertainty level. Slovakia is using reference approach as a national total emission estimate of CO_2, while consistent data series since 1990 exist only for this approach. The carbon emission factors (t C/TJ) are estimated for individual fuels type based on international methodology (IPCC, OECD, IAEA) and national measurements (expert judgment). The national emission factors are not in use for this time, but Slovakia will accentuate the determination of most important national emission factors. The values of fraction of carbon oxidized were changed followed the recommendation of Commission Decision 2004/156/EC (0.995 for liquid and gaseous fuels, 0.99 for solid fuels). Slovakia is preparing the deep revision of national energy balance from 1990-2003. The base problem is to change inventory methodology from the reference approach (the national energetic total from 1990) to the sectoral one (now only informative character). The revision will impact fuels base, NCV and emission factors in base year 1990 in accordance with the new inputs from operators of the most important plants. The revision was started this year and will be developed in co-operation with the Profing Ltd. company.

Energy sector - category transport

The transportation sector is in the last years not negligible source of emissions of all GHGs and indirect pollutants too. The emissions from this sector have increasing tendency every year and are the key source in level and trend assessment for calculation of uncertainty management. The emissions from road transport were calculated by using COPERT III method. The emissions from international bunkers from aviation were improved in the last year and the expert's judgment was used in this estimation.

Energy sector - category fugitive emissions

The important source of methane emissions in national GHGs inventory are fugitive emissions from coal mining & handling and oil & natural gas distribution as a key sources categories in uncertainty estimation. The Slovak inventory team in co-operation with Profing, Ltd. provided the revision of emissions and emission factors for underground mining and handling during the last year 2004 due to inconsistent emission factors. These ones used until now were suitable mainly for hard coal underground mines. The important reason for this opinion is an occurrence of brown coal underground mines with mainly non-gaseous system. Emission factors according to the IEA - CIAB - the published values for mining were assigned according to the depth of the mines (10). The fugitive emissions from transport and distribution of NG were calculated using new emissions factor refined EF (CH_4) for tier 1, based on North America data - IPCC Good Practice Guidelines, Table 2-16. The fugitive emissions of methane were recalculated from transport and distribution of natural gas activities during 1990-2003.

Industrial Processes - category CO_2, CH_4 a N_2O emissions

The Industrial sector in Slovakia is a source of CO_2, CH_4, N_2O, NO_X, CO, NM VOC, SO_2, CF_4, C_2F_6, and SF_6 pollution. Even though the emissions of CO_2 and N_2O are reported in this sector only, because of problematic estimation of this emissions and hardseparation of industrial sources and fuel combustion sources from each other in industrial processes. The emissions of CO_2 occurring by manufacture of glass, ammonium production and iron & steel production are included in the sectoral approach for Energy sector - manufacturing industries and in the reference approach in the balance of fossil fuel combustion. The situation is complicated by the confidentiality aspects of adopted legislation (which is like protecting the large installations against the publicity of activity data). The national EFs are available only for several industrial processes (cement and lime production, limestone and dolomite use and the magnesite production).

Sector Land Use, Land Use Change and Forestry (LULUCF)

According to the COP Decision 13/CP.9 for reporting in LULUCF sector was adopted new methodology and reporting tables. GHG emissions and sinks were recalculated for the time series 1990-2004 in the consistency with new requirements.

Waste sector

Production of CH_4 and N_2O emissions from waste disposal and wastewater treatment activities is balanced. The IPCC methodology and Good Practice Guidelines were used to estimate of methane emissions from waste and wastewater treatment. Emissions of nitrous oxide from wastewater were calculated by using IPCC and ISI methodologies. Database of Centre of Waste Service and Environmental Management in Bratislava and database of Wastewater on the SHMU have been used as a source of input data GHG emissions from the Waste sector are the key source and concerning to the actual EFs there are estimated with the high uncertainty level.

4.2 Activities under Article 10 b) - national and regional programmes to reduce GHG emissions

4.2.1 Programmes and activities in air quality

Although air quality management programmes are focused on limitation of basic pollutants, they contribute to decrease GHG emissions in relatively high share. There are actually 18 air quality management areas in 2 agglomerations and 8 specially followed zones due to air quality in the Slovak Republic at present. Exceeding daily limit values for PM10 is higher than 35-times per year in all these 18 air quality management areas. Exceeding of daily limit value for sulphur dioxide has occurred in the district of Prievidza, exceeding of limit values for nitrogen oxide has occurred in Bratislava - capital of Slovakia. Both areas belong to the air quality management areas. For all these areas have been developed programmes on air quality management with clearly specified measures for individual sources to improve local air quality. All programmes are published at the internet web page of the Ministry of the Environment (www.enviro.gov.sk). In addition, an action plans containing short time measures, that must be immediately realized at specified areas with the highest risk of exceeding the limit values for PM10, in order to minimize risk and reduce the duration of its occurrence were prepared in all 14 air quality management areas. Programmes and plans were developed according to the Act No. 478/2002 on Air Protection as amended and Decree of the Ministry of Environment of the Slovak Republic No. 705/2002 on Air Quality. EU Directives 1999/96/EC, 2002/3/EC, 1999/30/EC and 2000/69/EC were transposed by this act and decree.

4.2.2 Programmes on climate change

National programme on reduction of GHG emissions in Slovakia

According to the Article 2 of Decision No. 280/2004/EC is the Slovak Ministry of the Environment currently developing project No. 836 to prepare proposal of national programme relating to the limitation and reduction of all GHG emissions under the UNFCCC and KP commitments. Substantive part of prepared proposal should be also the definition of procedure and parameters for transparent and accurate monitoring of the actual and projected progress in emission reduction. This program shall include information on:

- definition and detailed analyses of areas and parameters which significantly determine fulfilment of the UNFCCC and KP targets at the national level,
- proposals of measures to "adjust" trajectories of GHG emissions so that fulfilment of more stringent reduction commitments during the post Kyoto period is feasible even in conditions of accelerated economy growth,
- proposal of methodology to monitor and evaluate progress of country in limitation and/or reduction of GHG emissions.

Program to enhance rational consumption of fuels and energy in transport

The program comprises set of technical and administrative measures aimed to reduce consumption of fuels. The measures are grouped as follows:

- acceleration of public transport,
- reduction of specific consumption in individual transport,
- endorse regulations to transpose strategic objectives of energy saving,
- technical measures of vehicle stock in the public transport,
- enhancement of bicycle and walk transport,
- awareness raising and information dissemination.

Waste management program

Waste management program till 2005 (6) was adopted in 2002. It involves objectives to be achieved by 2005 in municipal waste disposal as follows:

- to reach 35 % share of municipal waste recovery, 15 % share of energy recovery of municipal waste, and 50 % of landfilling,
- to reduce landfilling of biologically degradable municipal waste by 30 % of the reference year 2000,
- to reduce incineration of biologically degradable municipal waste by 10 % of the reference year 2000,
- to reach 35 % share of composting of biologically degradable municipal waste.

Legal framework in the waste management is covered by the Act 223/2001 on Waste and its implementing regulation 283/2001. An important economic instrument is the Recycling Fund that was established to collect financial sources and allocate them to projects dealing with collection, recovery and waste processing. There are two ways of allocating money: either through funding projects on waste recycling (non-obligatory) or through subsidies to municipalities (obligatory) to cover 95 % of the costs concerning separate collection and recovery of municipal waste.

Other programmes with impact on GHG emission reduction

No direct piece of legislation to motivate energy savings and use of renewable energy sources has been in place until the membership of Slovakia in EU. There were available only limited financial sources from the state budget at the relevant ministries (economy, environment, building and regional development) to support these types of projects. Currently some financial sources from the EU Structural Funds can be used to support these activities in limited scope based on assessment criteria for selection. Official information sources can be found at www.enviro.gov.sk, www.economy.gov.sk as well as www.sea.gov.sk.

4.3 Activities under Article 10 c) - support for transfer of environmentally sound technologies

Position of Slovakia has been changed in the last years not only due to political and economical changes but also from view of international aid and the transfer of environmental technologies, including the soft types. After the membership in OECD and EU, Slovakia has been moved from the position of acceptor of international aid and acceptor/importer of technologies of different ages and different technical and technological level at the 90th of last century, to the position of donor. The creation of significantly larger room for the changed direction of technology transfer and their applications at the third markets relates with the development of new instruments like Official Development Aid (ODA). Further significant changes are associated with legislative and economic pressure on the quality and environmental impacts of installed and imported technologies. Due to legal requirements in the fields of air pollution and waste management, as well as the prices of input materials and energy, the old and obsolete technologies has become economically ineffective. Together with growing market of environmentally sound technologies in Slovakia, the potential of export - transfer of progressive technologies from Slovakia is also growing (e.g. in material and energy recovery of biomass and renewable sources). Ongoing process of industry restructuring, icreased share of foreign investments as well actual development of energy prices at the global market result in changes of business group behaviour towards higher utilisation of voluntary measures.

In this regard the most important instruments are:

- ecological symbols, eco-labelling of environmentally suitable products (EVV) according to Act No. 469/2002 on Environmental Labelling of Products; Decree No. 258/2003 and related regulations for environmental assessment of products and awarding the eco-labels,
- voluntary participation of small and medium enterprises in emission trading.

Less addressed instruments are:

- Eco-Management and Audit Scheme - EMAS (Act No. 468/2002 and implementing regulation - ordinance of MŽP SR No. 90/2004),
- Energy audits,
- Life Cycle Assessment (LCA),
- Green procurement (in Slovakia almost unknown).

The definition and the application of Best available technologies (BAT) is the specific field. They are primarily defined by the Act on Integrated Pollution Prevention and Control (IPPC), but also by legal regulations of air protection, waste management and wastewater treatment contain the requirements for BAT[1)]. There is missing comprehensive approach[2)] at the systemic level to support transfer of environmentally sound technologies except for large pollution sources covered by the Act 245/2003 on IPPC.

4.4 Activities under Article 10 d) - scientific and technical research, participation in international and intergovernmental efforts and networks on climate change

National funds for activities in the field of climate change are only limited. Consequently a number of actions can be realised only within the bilateral and multilateral cooperation with financial support from international funds. As regards the issue of climate change, following activities are important: the US Country Studies Program (13), Study on Slovak Strategy for GHG Reduction (14) and ongoing project UNDP "National Capacity Needs Self-Assessment related to Environmental Management of Global Conventions" and participation in "Danube regional project UNDP/GEF". In frame of the 5th Framework Programme EU on Research and Science is actually developed international "WARM project (Wildland - urban Area Fire Risk Management)" focused on the forest ecosystems and land forest fires. Further research project named "CARBOMONT (Effects of land-use changes on sources, sinks and fluxes of carbon in European mountain areas)" is aimed at the GHG emissions and sinks inventory in the forest ecosystems. In the frame of the International hydrologic programme UNESCO 1.1 Flow Regimes from International Experimental and Network Data is developed the subproject "Catchment Hydrological and Biogeochemical Processes in Changing Environment" on the Institute of Hydrology Slovak Acedemy of Sciences. The slovak-czech part of this project is focudes on the transport of cadmium in the soils infuenced by climate change.

1 Act no. 245/2003 on IPPC
2 Act no. 478/2002 on BATNEEC

4.5 Activities under Article 10 e) - capacity building enforcement

In May 1999, the UNDP and the Secretariat of the Global Environment Facility launched the Capacity Development Initiative. Based on this initiative, in January 2004, a project entitled "National capacity needs self-assessment related to environmental management of global conventions" (NCSA Project) was approved for the Slovak Republic. The objective of the NCSA project was to determine priority needs for capacity development in Slovakia in order to extend the country capacity to meet its commitments to Rio conventions. One of the project outputs with parameters for evaluation of achieved progress was The Thematic Assessment Report of Capacity Development Needs for the UNFCCC (15). Stocktaking of available capacities as well as proposals and recommendations for their development have been focused at the priority areas identified in the Slovak Strategy for meeting the Kyoto commitments (5).

4.5.1 Capacity framework to implement the KP flexible mechanisms

Findings from the stocktaking analysis on capacities at systemic, institutional and individual level to implement the KP flexible mechanisms in Slovakia are presented in Table P.3 of Annex. Table gives main available assets, needs but also presents existing constrains for full and sustainable implementing of these tools.

4.5.2 Capacity framework for National Inventory System pursuant to Article 5 of KP and decision 20/CP.7

Setting up a National Inventory System of emissions in compliance with the Kyoto Protocol and Council Decision 280/2004/EC is the priority of capacity development in Slovakia at all levels identified also as a middle-term objective (2003-2007) of the Strategy of SR. The basic characteristics of the capacity building the NIS are follows:

- to define a National Inventory System (institutions, competences), which will group the experts from all sectors according to IPCC (NFP, SNE, scientific institutions, universities, research institutes, private sector, non-governmental organisations, Statistical Office...),
- to establish an independent working unit entitled the Single National Entity (SNE - according to a COP recommendation), which will coordinate the NIS and have competencies and responsibilities stipulated by law. The SNE will be controlled directly by NFP (MŽP SR), including financial resources,
- the SNE should interlink all stakeholders at the horizontal level with regard to expert, financial, legal and information issues. The SNE should also be responsible for achieving the commitments under the UNFCCC and KP in the field of reporting, assessment and providing information to all stakeholders, administration of national databases (NEIS, IPPC - air, NEC Directive, EPER), implementation of QA/QC process, accreditation and certification, organisation of "cross-country" meetings and communication with international organisations,
- to appoint experts or organisations for each IPCC sector or gas, and explicitly determine their responsibilities; to appoint a team for the work on national communications, modelling and projections of emissions (RAINS, CAFE) in the sense of keeping consistency, reproducibility and transparency,
- to obtain dedicated continuous finances from the State budget for achieving the commitments under the UNFCCC and KP on annual basis and in a sufficient amount (according to actual needs and analysis),
- to determine the competencies of the NIS and the operators of polluting sources, with regard to the dissemination of information.

Actually is under development (already prepared Terms of Reference and allocated financial resources) project of the Slovak Ministry of the Environment aimed at proposal of national integrated system of inventory and projections of GHG emissions. The project will be carried out in two phases - after the first phase focused on methodological and organisational aspects will in the second one the project aimed at proposal and implementation of required QA/QC parameters and procedures for GHG emission inventory.

4.5.3 Capacity framework for national registry

Dexia Banka Slovensko, a.s., has been designated by the Ministry of Environmnet as an administrator of the National Registry of Emission Quotas of the Slovak Republic according to the Act No. 572/2004 on Trading with Emission Quotas and fully in agreement with the Regulation No. 2216/2004 EC on Normalised Registry Sytems (http://co2.dexia.sk.).

National registry of emission quotas is normalised electronical dbase established and operated mandatory by member states under the EU emission trading scheme to record issuing, transfers and holding of emission quotas for all obligatory, voluntary and other participants. It is web-based transparent information tool with individual accounts for all the National allocation plan installations, member state account as well as accounts of other participating subjects. The Slovak national registry of emission quotas is utilising the software SERINGAS based on licence contract with the French company Caisse des Dépots et Consignations (CDC).

According to the adopted agreement will this national registry serve during the first commitment period also for recording of emission unit transfers under the KP flexible mechanisms. After necessary modifications will this system register also all transfers of SO_2 emission quotas for domestic trade system since the year 2007.

4.5.4 Capacity framework to support education and training of scientists, technicians and managers

There is no specific document (conceptual, action plan or programme) in Slovakia that contains a strategy and measures to achieve the commitments under UNFCCC and KP in training of scientists, technicians and managers. Limited financial resources of individual sectors allocated for education and training activities of managers (pursuant to the Act on state administration) are used for the relevant priorities. Climate change has not been the topic of any specific training course. But training courses and registration of experts (ST EN 17024 and ST EN 13313) were organised for the field of cooling and air-conditioning techniques (F-gases) in accordance with Act No. 76/1998 on the Protection of Ozone Layer of the Earth. SEA organises short-term courses to get authorisation for business activities in energy sectors according to Act No. 70/1998 on Energy. Finances from the state budget have not been allocated for this activity and costs are covered only by the fees of participants. However, further resources are needed to equip the training centres. The Slovak Hydrometeorological Institute and the Slovak Meteorological Society organise seminars on the occasion of the World Meteorological Day and World Water Day and the annual international conference Air Protection (in 2003 it was the 18th Conference). In addition to the representatives of authorised implementing organisations, lecturers from academic institutions, officers (particularly for legislation), experts and technicians also including those from the private sector participate in the process. There is no earmarked systematic and institutional support of the process that would guarantee its sustainability. The ongoing decrease of teachers could be a future risk.

4.5.5 Capacity framework to support education and public awareness on climate change

No complex strategy or programme for education and public awareness on climate change is available. There are a large number of documents addressing environmental training, education and the increase of public awareness in general, which also contain incentives related to this commitment. The document Strategy, Principles and Priorities of the State Environmental Policy (16) presents a middle-term objective (2000-2010) to create a comprehensive school and non-school system of environmental education. Similarly, other documents such as the National Environmental Action Plan I (NEAP), NEAPII and the National Strategy for Sustainable Development (NSTUR) (17), create conditions allowing for the development of environmental public awareness through the activities of expert organisations in the environmental sector. According to a measure of NEAP I the Concept of Environmental Education was developed. Backup documents include the curriculum: Environmental education at primary and secondary schools (Environmental minimum). The Ministry of Education SR has prepared a document the National Programme of Education - Millennium, also covering the principles of sustainable development into the process of lifelong education. Both governmental and non-governmental organisations participate in the process. Even without any specific legislative and institutional promotion education and public awareness on climate change is implemented through a number of activities.

4.5.6 Dissemination of information on climate change, public participation in the decision making process

The Constitution of the Slovak Republic contains a section on basic rights and freedom, including "the right to protecting the environment and cultural heritage". Article 45[3)] of this section stipulates that "everybody has the right to timely and comprehensive information on the status of environment and on causes and effects of this status". Legislative framework of SR, which stipulates procedures, collection, evaluation and dissemination of environmental information, including information on climate change, consists of the following acts:

- Act No. 211/2000 on Free Access to Information,
- Act No. 205/2004 on the Collection, Registration and Dissemination of Environmental Information[4)],
- Act No. 17/1992 on the Environment[5)],
- Act No. 478/2002 on Air Protection,
- Act No. 245/2003 on Integrated Pollution and Prevention Control (IPPC).

Furthermore, official documents are being prepared and published that contain updated information and data on air protection. The right of public to environmental information is stipulated also by the EU Directives and related international conventions[6)]. The process of providing information on climate change has not been institutionalised. The responsibility for the activities in this field lies with the NFP of MŽP SR, practical outputs are provided by SHMÚ and SAŽP and other implementing agencies. Activities of the institutions are not coordinated. Many of them are realized through the Internet. However, a specific information portal on climate change, with interlinks to relevant national and international web pages, is currently available at the official web page of

3 Constitutional Act of the National Council of SR No. 462/2002
4 Pursuant to article 33, M•P SR is obliged to publish annually the Report on the status of the environment in SR
5 Pursuant to article 29, M•P SR is obliged to release information on air quality and the share of individual sources on the pollution through the authorised organisation.
6 Council Directive 90/313/ES on the freedom access to the information on environment, the Convention on trans-boundary environmental impact assessment (Espoo Convention), the Convention on the trans-boundary effects of industrial accidents (Helsinki Convention), Council Directive 96/82/EC on the control of major accidents hazards involving dangerous substances (Seveso II) and Council Directive 96/61/EC on IPPC in articles 15 and 17.

MŽP SR (www.enviro.gov.sk). This information link provides for national GHG emission inventory tables too. Other relevant information on air protection and climate change are regularly released at the web page of SHMÚ (www.shmu.sk). The Slovak Republic has not yet become a Party to the Aarhus Convention. Public participation in decision-making in Slovakia is covered by above mentioned Acts and all relevant EU Directives in this regard which have been transposed[7)].

4.5.7 Activities under Article 11 - transer of financial resources and technologies to the developing countries

An organisational unit UNIDO - ITPO (Investment and Technology Promotion Office) was established in Bratislava in the years 1999-2002, from national funds and under auspices of the Ministry of Economy and the Ministry of Foreign Affairs and in cooperation with UNIDO Vienna. Its role is to promote the two-way direction of transfer of investments and technologies[8)]. ODA is realised through UNDP RBEC in Bratislava. Environmental aspects are one of the priority field of project aiming and technology transfer, but the issue of climate change is not the specific criterion of the assessment.

The Slovak Republic started official sponsor role towards the developing countries since the year 2004. Except for projects in Africa mostly oriented to the medical and food aid there have been initiated different soft projects of international co-operation and aid for countries in Balkan, former soviet republics and Mongolia. Projects are widely oriented - from the trainings for the state administrators, increase in literacy, technical projects on renewable energy sources utilisation, clean technologies and energy saving projects to the projects on capacity building for fulfilment the UNFCCC and KP targets. The list of currently developed projects with short description of project objective is presented in table below:

Name	LAMP – Landslide Monitoring Program
Project proponent	Geofyzikálny ústav Slovenskej akadémie vied
Country	Uzbekhistan
ODA budget	98 854,4 USD
Project objective	Delivery of modern measurement and technical equipment for areas with high appearance of land slides in order to improve monitoring, analysis, prediction and corrective measures

Name	Groundwater Resources for Nomadic Shepherds in Mongolia
Project proponent	E-Est, s.r.o.
Country	Mongolia
ODA budget	79 870 USD
Project objective	Development, installation and testing of three prototypes of piston pumps in existing bores and implementation of piston pump production in Mongolia

Name	Development of Infrastructure for Rapid Earthquake Data Collection and Exchange - DIRECTE 2
Project proponent	Geophysical Institute, Slovak Academy of Sciences
Country	Macedonia
ODA budget	85 932 USD
Project objective	The goal of the project is to contribute to the increase of the country preparedness to the strong earthquakes

Name	Protection without Destruction
Project proponent	Martimex, a.s.
Country	Uzbekhistan
ODA budget	99 604 USD
Project objective	Transfer of know-how in the field of application of gabion technologies and implementation of gabion production technology in Kyrgyzstan

7 Directive 85/337/EHS on the assessment of the effects of certain plans on certain private and public projects on the environment, Directive 2001/42/ES on the assessment of the effects of certain plans and programmes on the environment and Directive 2003/35/ES, providing for public participation in respect of the drawing of certain plans and programmes relating the environment.

8 Formally these activities should be managed by the Ministry of Economy, which is today focused on import of investment through the agency SARIO, without the impact of investment on climate changes.

Name	Automatic Weather Stations Network
Project proponent	Microstep-MIS, s.r.o.
Country	Bosna and Hercegovina
ODA budget	100 000 USD
Project objective	The project is focused on improvement of the quality of the weather forecasts, quality of life of the population and reduction of impacts of natural disasters through increased quality of the meteorological products. This project will result in building up Automatic Weather Stations Network.

Name	Cleaner Production & Energy Efficiency: Developing and Improving Competitiveness and Environmetnal Performance of SME's in Uzbekistan
Project proponent	Slovak Cleaner Production Centre, s.r.o.
Country	Uzbekhistan
ODA budget	92 780 USD
Project objective	Project aims at development of national capacity for Cleaner Production and Energy Efficiency. By the end of project a group of trained consultants, experts and trainers will be able to provide service in Uzbekistan. National case studies in four selected enterprises will be developed also with the aim to reduce pollution into air, water and soil and to show new approaches in the field of environmental protection

Name	Water for herdsmen and their herds in the steppe
Project proponent	E-Est, s.r.o.
Country	Mongolsia
ODA budget	99 495 USD

Name	Irrigation for Life
Project proponent	Martimex Gama, s.r.o.
Country	Uzbekhistan
ODA budget	99 177 USD

Name	Groundwater Management and its Transboundary Aspects in Kazakhstan
Project proponent	SHMÚ
Country	Kazachstan
ODA budget	100 000 USD

Name	Radiation Monitoring System
Project proponent	Centre for European and North Atlantic Affairs
Country	Kyrgystan
ODA budget	200 000 USD

Name	Support of Kazakhstan in Kyoto Protocol Ratification Process And Capacity Building
Project proponent	Profing, s.r.o.
Country	Kazachstan
ODA budget	131 901 USD

Name	National Waste Management Strategy for Uzbekistan
Project proponent	Government of Uzbekistan with the support of NZAID, EU and the Slovak Government
Country	Uzbekhistan
ODA budget	The main role of the Slovak expert in the project was to make the review of the best waste management practices worldwide and analyze how to apply them in Uzbekistan, to help create a waste inventory and to assist in the development of a pilot project to separate waste by category.

5. Conclusions

To make more comprehensive assessment of demonstrable progress of Slovakia since 1990 towards the meeting of the Kyoto Protocol commitments we applied for the categories used for evaluation of capacity frame. That means we tried to identify available assets, critical needs and potential barriers for fulfilment of given targets in consistent and sustainable way. Finally, we have defined available tools that we will use to overrun constrains and meet the critical needs.

Assets

- In accordance with the actually emission inventory by 15. April 2005, the total emissions decresing of GHGs in CO_2 equivalent is about 30 % against the base year 1990. The adopted reduction commitment of SR for the first period 2008-2012 of the KP is real to reach. The indicated reduction of emission evaluation is the result of the number of impacts and processes linked with the transformation of economy. As the most decisive reasons in relation with the followed subject we can consider: gradual decrease in energy intensity since 1993; higher share of services in the GDP generation; higher share of gas fuels in the economy; structural changes in industry and the decrease of energy consumption in energy intensive sectors (without metallurgy), as well as in less energy intensive industries; and the impact of legislative measures influencing directly or indirectly the generation of greenhouse gas emissions.
- There are available strategic documents, programmes and schemes of the state aid to support measures and activities with direct or indirect reduction potential for GHG emissions. At present are some human and financial resources concentrated also in areas which have not been carefully followed before: mostly the evaluation of unfriendly infuences the climate change on to the human health and the analysis of socio-economic effects for the environment.
- Except for relatively large number of legislative measures with positive indirect impact on GHG emission reduction, namely in the Energy sector, it was applied for the first time also the directly focused instrument to limit or reduce these emissions. Act No. 572/2004 is transposing the Directive 2003/87/EC on Emission Trading within the EU. The aim is to limit and gradually decrease production of CO_2 emissions from the most emission intensive industrial and energy sources by allocation of proper volume of emission quotas. This market oriented measure allow for installations under the EU ETS to apply for mitigation measures in the cost effective way with defined penalties for overload of allocation on one side but with possible benefit in case of further decrease of CO_2 emission allowances.
- Even though there are not available any fosuced programmes for improving quality of the emission data at the present time, the considerable effort and the financial resources are used for the building of the National Inventory System according to the Article 5 of the KP and the Decision 20/CP.7 COP and improving of GHG emission inventory annually. Emissions from fossil fuel combustion and transformation (Energy sector) are calculated according to the IPCC methodology using both independent approaches - so called "sectoral approach" - bottom up and "reference approach" top down.
- In frame of preparing The Thematic Assessment Report of Capacity Development Needs for the UNFCCC (5) were identified and ranked the most critical capacity needs for Slovakia to allow consistent and sustainable fulfilment of onligations under the UNFCCC and KP. Two of recommended capacities have already been successfully realised - creation of intersectoral group on climate change (representatives of relevant ministries) and expert group on climate change (representatives of MŽP SR, SHMU and experts for inventory and projections of GHG emissions in followed IPCC sectors.
- The Slovak Republic started official sponsor role towards the developing countries since the year 2004. Significant share on currently developed projects represents these aimed at help in development of capacities for fulfilment the UNFCCC and KP targets in former Soviet Union republics and in Balkan region.
- Concerning the actual and proposed dynamics of GDP growth in Slovakia there exist legitimate assumption that GHG emissions will increase in line with it. Due to this scenario there is necessary to prepare investment startegies and programmes that allow us to achieve permamnent distribution of GDP growth and emissions growth with the regards to the further the post-Kyoto reduction goals.
- Establish the National Inventory System according to the Article 5 of the KP, Decision 20/CP.7 of the COP and the recommendations of the NCSA project (15).
- To enhance capacities on climate change issue (human, financial and material resources) starting from the NFP down to the individual level - experts and technicians.
- To enhance activities on monitoring and evaluation of negative impacts of climate change and to reflect them in social, economical and environmental measures so that adverse effects of climate change measures on economy, health and environment will be minimalised.
- To enforce capacities for trainings, educations and public awareness increasing.

Available tools

As the most sufficient and useful tools to support progress in ongoing achieving of the UNFCCC and KP commitments we can actually consider outputs from the prepared proposal of the *National Programme on Reduction of GHG Emissions in Slovakia, otputs from the NCSA project* (15) and assumed outputs and benefits from the project on national integrated system of inventory and projections of GHG emissions in Slovakia.

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Annex

Table P.1 Implementation of policy and measures to reduce greenhouse gas emissions and to enhance removals by sinks - the current institutional framework of SR

Institution	Type	Competence and responsibility
Ministry of Environment SR NFP – Air Protection Department	State administration	- Formulation of and responsibility for the implementation of policy and measures with respect to climate change - Drafting strategy, objectives and programmes - Proposals for supporting systemic instruments to implement policy and measures – legislative, regulatory and economic measures - Monitoring and evaluation of the implementation of policy and measures – reporting to the UNFCCC Secretariat
Ministry of Environment SR – Section of Environmental Projects Implementation	State administration	- Responsibility for and coordination of the use of subsidies from national and international funds to implement environmental projects
Regional Environmental Offices	State administration – regional level	- Executing state administration in air protection at the regional level
District Environmental Offices, municipalities	State administration – local level	Executing state administration in air protection at the local level
Ministry of Economy SR	State administration	- Formulating and implementing policy and measures to reduce greenhouse gas emissions in energy production and energy consumption - Drafting strategy and objectives - Proposals for supporting systemic instruments to implement policy and measures in energy sector and industry sector– legislative, regulatory and economic measures - Providing subsidies to motivate energy savings, including small and medium entrepreneurship - Developing legislation to introduce new standards and to tighten up current ones and to introduce obligatory labelling of electric appliances - Responsibility for implementing and monitoring measures with respect to energy savings and renewable energy sources utilisation
Ministry of Agriculture SR	State administration	- Formulating and implementing policy and measures with respect to climate change in agriculture and forestry - Drafting adaptation measures for climate change - Drafting and preparing systemic instruments to implement policy and measures - Monitoring the implementation of policy and measures
Ministry of Transport, Posts and Telecommunication SR	State administration	- Formulating and implementing policy and measures to reduce greenhouse gas emissions in transportation - Drafting strategy and objectives - Drafting and preparing systemic instruments to implement policy and measures – legislative, regulating and economic measures - Responsibility for implementing and monitoring measures with respect to reducing emissions from transportation

Continuation of the Table P.1 Implementation of policy and measures to reduce greenhouse gas emissions and to enhance removals by sinks - the current institutional framework of SR

Institution - name	Type of organisation	Competences and responsibilities
Ministry of Construction and Regional Development SR	State administration	- Formulating and implementing policy and measures leading up to energy savings in housing – public buildings and households - Drafting strategy and objectives - Drafting and preparing systemic instruments to implement policy and measures in housing sector – legislative, regulating and economic measures - Responsibility for the implementation and monitoring of measures with respect to energy savings for buildings and houses
Bureau for Regulation of Power Distribution (URSO)	State administration	- Price and material regulation of power distribution sectors -Drafting and implementing systemic instruments to eliminate price subsidies of energy carriers for industry and households - Drafting and implementing systemic instruments to liberalise electricity market
Steering Committee for the Programme of Renewable Sources Development (representatives of MP, MŽP, MVRR a MDPT SR, ÚRSO and SEA)	Cross-sector committee	- Monitoring the implementation of Strategy for the utilisation of renewable energy resources and preparing Progress report on the utilisation of renewable energy sources
Slovak Environmental Agency (SAŽP)	Implementing agency of MŽP	-Support in the implementation and monitoring of policy and measures in air protection
Slovak Environmental Inspection (SIŽP)	Control body of NŽP	-Controlling the compliance with legal regulations in air protection and the IPPC regulation.
Slovak Energy Agency (SEA)its regional offices	Implementing agency of MH	-Coordinating the use of economic programmes of MH SR to support energy savings and utilisation of renewable energy resources - Mediating the use of European Fund for Regional Development (Resolution of Slovak Government No. 678 / 2002)
Bureau for Metrology and Testing SR	Implementing agency	- Ensuring the implementation of legal regulations with respect to standards for energy consumption and obligatory labelling of appliances
Self-governing regions (VÚC), Regional Advisory and Information centres (RPIC), Slovak Chamber of Commerce and Industry (SOPK), Slovak Investment and Trade Development Agency (SARIO) and National Agency for Development of Small and Medium Entrepreneurship (NARMSP)	Regional self-government, professional associations implementing agencies	- Partnership with SEA in promotion, information dissemination and technical assistance to prepare projects and applications for EU Structural Funds.
PROFING, s.r.o., SCCP, s.r.o.	Consulting companies	- Independent evaluation and verifications of projects with respect to using flexible mechanisms of the KP
LVÚ Zvolen, VÚPOP Bratislava, Lesoprojekt Zvolen	Research Institutes	- Project implementation
Non-governmental organisations and civic associations	National, regional and local levels	- Activities with respect to environmental programmes and measures supporting the activities of official institutions (e.g. ECB in energy savings a renewable energy resources utilisation)

Continuation table P.2 Inventory and projections of greenhouse gas emissions, preparation of national communications, action plans and evaluation of policy effects and measures - current institutional framework of the Slovak Republic

Institution - name	Type of organisation	Competences and responsibilities
Ministry of Environment of SR NFP – Air Protection Department	State administration	- Legislative guarantor the preparation and publication of inventory and projections of greenhouse gas emissions and national communications on climate change in compliance with the IPCC methodology and UNFCCC recommendations and COP Decisions - Responsibility for preparing action plans to mitigate greenhouse gas emissions - Responsibility for regular submitting inventory reports and national communications on climate change to the Secretariat of UNFCCC in compliance with the convention and COP Decisions - Responsibility for desk review and in-depth review of emission inventory and NS by the Secretariat of UNFCCC
Statistic Office of SR	State administration	-Collection and publication of official statistic data used for inventory and projections of greenhouse gas emissions and national communications on climate change
Customs Directorate of the Slovak Republic	State administration	-Collection and providing data on import and export of fossil fuels for emission inventory in Energy sector
Ministry of Economy SR Ministry of Agriculture SR Ministry of Transport, Posts and Telecommunication SR Ministry of Construction and Regional Development SR	State administration	- Providing documents and data for inventory and projections of greenhouse gas emissions and national communications on climate change
Slovak Hydrometeorological Institute (SHMÚ)	State contributory institution	- Pursuant to Act no. 478/2002 an authorised institution to perform annual inventories of air emissions, including greenhouse gas emissions - Preparing the inventory of greenhouse gas emissions for IPCC sectors in cooperation with external experts - Being responsible jointly with the NFP(MŽP SR) for improving the quality of the inventory in compliance with UNFCCC recommendations and COP decisions - Completing inventories in CRF - Determining emissions from combusting processes by the bottom-up method, i.e. from an operator to a sector - Preparing annual national inventory reports (NIR) - Being responsible for active communication with the Secretariat of UN FCCC with regard to annual reviews - Preparing the projections of greenhouse gas emissions in waste management and the projections of fugitive emissions of CH_4 in cooperation with external experts - Coordinating and contributing to national communications on climate change of SR
Air Quality Department (OKO)	A department of SHMU	- Ensuring all activities in relation with air quality- monitoring, measuring , evaluating and reporting air emission data in Slovakia - Operating the National Emission Inventory system (NEIS) functioning for the registration of emissions from operators of stationary sources of air pollution - Providing annual data on greenhouse gas emissions to the European Environmental Agency (EEA) through the national internet system CIRCA (Communication and Information Resource Centre Administrator)

Continuation table P.2 Inventory and projections of greenhouse gas emissions, preparation of national communications, action plans and evaluation of policy effects and measures - current institutional framework of the Slovak Republi

Institution - name	Type of organisation	Competences and responsibilities
Slovak Environmental Agency (SAŽP) Banská Bystrica	Implementing agency of MŽP	- NFP for the cooperation of Slovakia with EEA - Operating national internet system CIRCA
PROFING, s.r.o., Bratislava	Consulting company	- Cooperating in the inventory of emissions, including fugitive emissions in the IPCC Energy sector - Projections of emissions in IPCC Energy sector and total aggregated greenhouse gas emissions - Coordination and cooperation in the preparation of national communications on climate change - Preparing the action plan for CO_2 reduction in Energy sector
EFRA Zvolen Lesnícky výskumný ústav Zvolen	Research	- Inventory of greenhouse gas emissions in agriculture, forestry and landscape use - Projections of greenhouse gas emissions in agriculture, forestry and landscape use - Sector documentation for national communications from agriculture and forestry
SjF STU Bratislava	University Professional association	- Inventory of F-gas emissions - Projections of F-gas emissions - Documentation for national communications
SPU Nitra	University	- Inventory of greenhouse gas emissions in agriculture - Projections of greenhouse gas emissions in agriculture - Documentation for national communications
Žilinský vzdelávací servis, Žilina Výskumný ústav dopravný Žilina	Consulting company – Transport Research Institute	- Inventory of greenhouse gas emissions from transportation - Projections of greenhouse gas emissions from transportation - Documentation for national communications
FChPT STU Bratislava	Technical University	- Inventory of greenhouse gas emissions from industrial processes - Documentation for national communications
Detox s.r.o., Banská Bystrica Eco-Team Slovakia, s.r.o., Pezinok	Consulting companies	- Inventory of greenhouse gas emissions from solvents
Ekotoxikologické centrum, s.r.o., Ivanka pri Dunaji	Consulting company	- Inventory of greenhouse gas emissions from waste management
SPIRIT Bratislava	Consulting company	- Development and maintenance of the database system NEIS
Department of meteorology and climatology MFFUK Bratislava	University	- Collecting and preparing documents for the evaluation of expected impacts of climate change and estimating the vulnerability for national communications on climate change
Water Research Institute Bratislava Department of water and landscape of StF Slovak Technical University Bratislava Research Institute for Amelioration and Landscape Engineering Bratislava Institute of Hydrology of the Slovak Academy of Science Bratislava Forest Faculty of TU-UTVS Zvolen	Universities and research institutes	Collecting and preparing documents for national communications on climate change

Table P.3 Implementation of flexible mechanisms under the Kyoto Protocol - identified assets, needs and barriers of the capacity framework

Level	Assets	Needs	Barriers
Systemic	- The Strategy SR for achieving the commitments under KP includes also the strategy of international activities within flexible mechanisms, - Legislative support for greenhouse gas emission allowance trading has been implemented in the course of the NCSA project in Slovakia - Act No. 572/2004 -The procedure on how to submit projects JI was developed and published, along with the approval criteria of the SR which identifies the institutions and their competencies in this regard, - General principles of greenhouse gas emission savings were published, - The integration of Slovakia into the AIJ process – as the preparatory phase for the JI mechanism, - In 1998 a complex background study of the SR was developed for decision making with respect to flexible mechanisms, - The Memorandum of Understanding with the World Bank, the Dutch Prototype Carbon Fund, Austria and other countries has been signed, - The world primacy and practical experience in CO_2 emission trading according to the mechanism of Article 17 of KP.	- To strengthen the capacity of the NFP, or to establish a new one for flexible mechanisms under KP is interlinked with the EU Scheme for greenhouse gas emission allowance trading, - To create a separate information portal at the web page of MŽP SR with all available information on the flexible mechanisms according to the KP (including links to international information sources) – the topic should also be included briefly in the separate portal on climate change, - The Act on emission trading requires the establishment and operation of a national register - this means new capacity with regard to financial, material and human sources.	- The Kyoto Protocol has not yet entered in force, - The long and rather difficult process of approving rules and modalities for the flexible mechanisms of the KP, - A limited number of suitable projects in Slovakia, demands on the administration, expertise and cost of project preparation for the JI mechanism.
Institutional	- In addition to official institutions, also consulting companies and experts have been participating in the implementation, in particular with regard to independent project assessment, verification and monitoring, - The methodology developed for the assessment of project eligibility for the JI mechanism has been accepted internationally, - Slovakia participated in the first CO_2 emission trade, which is a positive incentive, - The introduction of SO_2 emission allowances at the level of districts and individual sources,	- To provide all stakeholders and the general public with comprehensive information on the use of flexible mechanisms – including legal and economical relationships, - To promote the exchange of information and practical experience from completed trades/projects. - For operators of selected sources the emission allowances of CO_2 have been specified for the period 2005-2007, as well as the legislative framework for the trading within the country, with other EU countries, or the countries in Annex B to the KP.	- Initial disbelief and lack of initiative of national operators and investors – often due to a lack of clearly presented information, - The lack of practical experience on the preparation and assessment of projects in CRF formats according to the UNFCCC – and an unwillingness of investors to accept additional (transaction) costs.
Individual	- The progressive integration of Slovakia in the process of the AIJ, JI and ET has allowed national experts to obtain necessary qualifications and international experience.	- To promote the education of new specialists and experts for flexible mechanisms of KP.	- There are not enough I resources for the education of specialists for flexible mechanisms. The experts have received the information, financial and practical experience mainly through participation in international projects. There are few qualified national experts.

9 For EU membership, the European Trading Scheme and flexible mechanisms, this instrument can represent an advantage in the implementation of Cap & Trade principles

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