THE FIFTH NATIONAL COMMUNICATION OF THE SLOVAK REPUBLIC ON CLIMATE CHANGE

under the United Nations Framework Convention
on Climate Change and Kyoto Protocol

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Introduction

Climate change caused by increasing concentration of greenhouse gas emissions in the atmosphere is one of the most serious global threats that the world has had to face up to now, although paradoxically this phenomenon has been partly resulted from anthropogenic activities. International legal instrument to tackle this problem is the UN Framework Convention on Climate Change adopted in 1992 in Rio de Janeiro. For the Slovak Republic the Convention entered in the force on 23rd November 1994.

In 2007, the Kyoto Protocol to the UN Framework Convention on Climate Change was adopted, which has been effective since 16th February 2005 after its ratification by the Russian Federation. The Protocol has introduced quantified reduction commitments for the countries of Annex 1 to the Convention to reduce aggregated GHG emissions in the period of 2008 – 2012 by 5% on average compared to their level in 1990 and it has also introduced flexible mechanisms to achieve the commitments. The Slovak Republic ratified the Kyoto Protocol on 31st May 2002 and pledged, equally as the European Community, to reduce total volume of GHG emissions by 8% in the first binding period compared to their level in 1990.

The results of the resent scientific and economic analyses indicate the urgent need to implement reduction measures, as well as adaptation measures. The time shift of their implementation increases the risk of significant and irreversible changes and might increase the costs to eliminate them. In view of the urgency and the need to solve problems of climate change, energy security and adaptation to adverse impacts of climate change, the heads of states and governments adopted a political decision regarding middle-term objectives in March 2007, as follows:

- Unilateral 20% reduction of GHG emissions by 2020 compared to 1990, or the reduction by 30% in case of achieving international convention.
- Increase of energy efficiency by 20% by 2020.
- Achieving 20% share of renewable resources on final energy consumption, including, 10% share of biofuels in gasoline and diesel oil consumption by 2020.

Integrated Climate and Energy Package is a principal, comprehensive and ambitious solution, which will influence significantly the economic development of the Slovak Republic within the middle-term horizon. By its approval in December 2009, the legal framework of the issue was distinctly strengthened. The CEP is an important impulse for more active perception of climate change and adaptation at the level of the Slovak Republic Government and general public, together with international negotiations on future cooperation of countries in this agenda after the year 2012.

Political and economic dimension of climate change and the propagation of the renewable energy resources use, which has been broadly communicated at both the international and the national levels since submitting the Fourth National Communication of the Slovak Republic on Climate Change, was the impulse to establish a new coordination structure for their solution. In August 2008, a coordination body for climate change and renewable energy resources was established at higher political level under the Resolution of Slovak Republic Government no. 416/2008 of 18th July 2009. Under the auspicious of the Ministry of Environment and the Ministry of Economy with the participation of relevant ministries, the Climate-Energy Package Committee was established at the level of state secretaries.

The accession of the Slovak Republic to the Euro zone in January 2009 was an important economic change in the assessed period. Concurrently with this change, the global economy crisis has been deepened gradually since the end of 2008, which contributed to temporary decrease in economy. So called gas crisis at the beginning of 2009 was critical with respect to energetic and economic stability of the Slovak Republic. Its impact on the generation of GHG emissions will be assessed in the future.

Based on the national emission inventory, which was submitted to the Secretary of the UNFCCC on 15th April 2009 it is obvious, that in 2007 the Slovak Republic was 35.9% below the level of emissions in 1990 without including the sinks from sector LULUCF.

The comparison of GDP trend and aggregated GHG emission trend shows that the Slovak Republic is one of a few countries, where the GDP growth does not copy the aggregated GHG emission trend, which has been relatively stable since 1997. However in the international comparison, the indicator of GHG emissions share per capita remains still high.

Projections of aggregated GHG emissions presented in the Fifth National Communication of the Slovak Republic on Climate Change for modelled scenarios show, that fulfilling the reduction target of the Slovak

Carbon intensity expressed as the rate of CO_2 emissions and GDP is another indicator of changes in monitored field. This parameter has been decreased more than three times since 1994 due to the increased share of services and structural changes in industry associated with technological changes in sectors of high energy intensity.

Projections of aggregated GHG emissions presented in the Fifth National Communication of the Slovak Republic on Climate Change for modelled scenarios show, that fulfilling the reduction target of the Slovak Republic is achievable in the first commitment period under the Kyoto Protocol also for the scenario without measures. The introduction of legislative instruments of the Climate and Energy Package should ensure fulfilling more ambitious reduction targets that will result from international negotiations within the UNFCCC and the KP.

The Fifth National Communication of the Slovak Republic on Climate Change has been prepared in the extent and structure according to the requirements and guidelines FCCC/CP/1997/7, Part II (Guidelines for the Preparation of the National Communications by Parties Included in Annex I to the Convention) in the annotated structure 2009.

02

National circumstances

This chapter includes a brief description of natural conditions, institutional arrangement, geographic, economic and climate profiles of the Slovak Republic, including actual population development. Furthermore, this chapter includes basic characteristics of those economic sectors that contribute significantly to the emissions and sinks of greenhouse gases respectively. Relevant information presented in the Fourth National Communication of the Slovak Republic on Climate Change (December 2005) have been updated and they provide a new view on climate profile of the Slovak Republic, as well as the assessment of extreme weather impacts till 2008.

2.1 INSTITUTIONAL AND LEGISLATIVE ARRANGEMENTS

In recent years, we have been witnesses of expressive change in the attitude to the perception of climate change impacts at all process levels, including decision-making sphere. Even if it is a long-term process, currently being monitored also by politicians, obviously its solution shall be shifted from explicitly environmental level to social and economic analysis in order to find solution within the strategy of sustainable development. Institutional arrangement shall be also adapted to this end.

The Ministry of Environment of the Slovak Republic (MŽP SR) is responsible for the development of a national environmental policy and measures regarding climate change and adaptation. The development of strategic documents and legal instruments in this field is also the competence of the MŽP SR.

Activities regarding climate change have been intensified in particular after the accession of the Slovak Republic to the European Union. In order to fulfil the commitments to reduce anthropogenic greenhouse gas (GHG) emissions under the Kyoto Protocol, in October 2003 the European Union adopted Directive 2003/87/EC establishing a scheme for greenhouse gas emission trading within the Community and amending Council Directive 96/61/EC concerning integrated pollution prevention and control. In 2004, the Directive was amended by Directive 2004/101/EC of the European Parliament and of the Council, allowing the interconnection between the European scheme for GHG emission trading and flexible mechanisms of the Kyoto Protocol. Directive 2003/87/EC has been transposed into the legal system of the Slovak Republic by Act 572/2004 Coll. on emission trading with CO_2 allowances. In 2005 and at the beginning of 2006, the MŽP SR prepared the amendment to Act 572/2004 Coll. on emission trading with CO_2 allowances, which transposed Directive 2004/101/EC and amended certain definitions also in relation to other European legal regulations, in particular Commission Regulation (EC) no. 2216/2004/EC for a standardised and secured system of registries.

Implementing the provisions of Act 572/2004 Coll. as amended by later regulations, the institutional framework for emission trading has been completed by setting-up the National Register of Emission Allowances (Dexia Bank Slovakia) and district environmental offices.

Further to the negotiation within the European Union about legislative proposals for the Climate and Energy Package (more details in Chapter 4) and point B.2 of Slovak Government Resolution no. 413/2008, a Commission on Climate and Energy Package (CEP) was established in August 2008. The Commission consists of the state secretaries of all concerned ministries. In addition to the co-ordination and development of the strategy for attaining the objectives of CEP in the Slovak Republic, the Commission deals also with climate change and adaptation in a broader context of fulfilling the international commitment of the Slovak Republic in this field.

Some other institutions founded by the MŽP SR, i.e. the Slovak Hydrometeorological Institute and the Slovak Environmental Agency, play an important role in the implementation of the environmental policy and legislation, too. Academic and research institutions (i.e. the Water Research Institute, the National Forest Centre in Zvolen, the Slovak University of Agriculture in Nitra, the Slovak Technical University in Bratislava, the Faculty of Mathematics, Physics and Informatic of Comenius University in Bratislava, the Slovak Academy of Sciences), non-governmental organisations and associations of interested groups (the Slovak Energy Agency, PROFING, EFRA Zvolen, the Slovak Association of Refrigeration and Air Conditions, SPIRIT, Ecosys) are involved in the process of development and implementation of policy and measures aimed to mitigate climate change impacts.

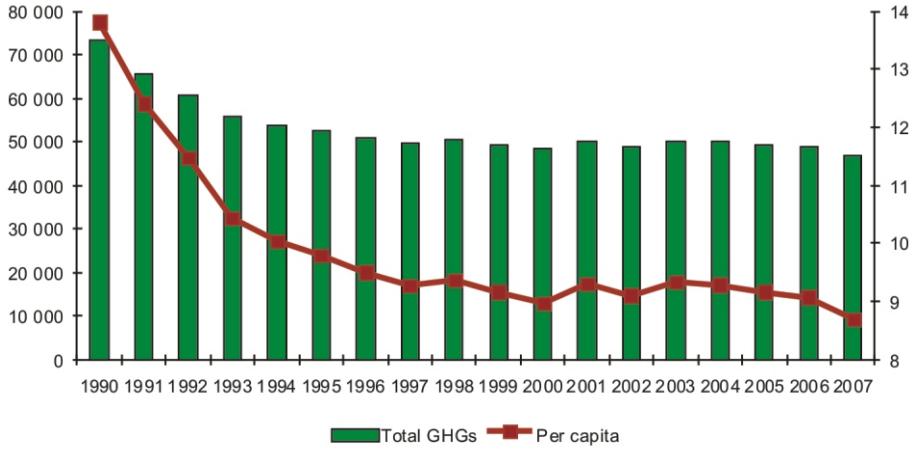
2.2 DEMOGRAPHIC PROFILE

Population of the Slovak Republic was 5.416958 millions to the date of 30th June 2009. Average residential density is 110.2 inhabitants per km^2. Besides towns, the population is concentrated in lowlands and basins, highlands and mountains are populated very sparsely. Extensive settlement and landscape exploitation have influenced essentially the original landscape structure and ecosystems. Economically active people represent 47.8% of the population. Capital city Bratislava is the biggest city in the Slovak Republic with the population of 425,540 (up to 31st December 2008).

The analysis of population, carried out by the Statistical Office of the Slovak Republic, shows downward trend in the number of born children; the situation has been slightly stabilised recently. At the same time, the average life span is longer and the share of the group over 65 years is higher, while the share of economically active people and children is lower, what can cause social problems in future.

In the context of demographic development, the decrease in emissions per capita to the level of 8.69 tons of CO_2 equivalent, i.e. below the EU-27 average, can be evaluated positively. Besides the significant economic depression in early nineties, the main reason for that are ongoing structural changes in industry, including continuous reduction in emissions.

Figure 2.1: History of aggregated GHG emissions per capita in the Slovak Republic in the period 1990 - 2007.



Source: GHG emission inventory to the date of 15th April 2009, the Statistical Office SR 2009.

2.3 GEOGRAPHICAL PROFILE

The Slovak Republic is located in Central Europe with a total area of 49,034 km^2. It belongs to naturally diversified countries; the west and north are covered by the Western Carpathian Mountains and large lowlands cover the south.

Agricultural soil covers 49.5%, forest soil 41.0%, water 1.9% and 4.7% is covered by built – up areas. The Slovak Republic is predominantly a mountainous country, 60% of its surface is over 300 m, 15% over 800 m and 1% over 1,500 m above sea level. Gerlach peak is the highest point (2,655 m above sea level) and the discharge of the Bodrog River out of the Slovak Republic is the lowest point (94 m above sea level). More than 95% of the territory is drained away by the Danube River to the Black Sea. Only a small part in the north of the country is drained away by the Poprad River and Dunajec River into basins of Polish rivers and then to the Baltic Sea. The long term average water flow in Slovak rivers is approximately 3,328 $m^3.s^{-1}$, including inflow from neighbour countries. Only 398 $m^3.s^{-1}$ (12%) of this amount springs from the country. In the Slovak Republic, 54 large water dams have been constructed with a total operating capacity of 1,890 million m^3. These dams are able to capture approximately 14% of the water originated in the territory of the Slovak Republic. The dams were constructed to generate electricity and regulate water flow to some measure. In addition, there are 198 small water reservoirs with a total capacity of 65 million m^3 that were constructed for agricultural purposes. Currently only 60 of them are in operation as the additional source of irrigation water.

The proportion of nature conservation areas in the Slovak Republic is relatively high. By the end of 2007, 9 natural parks and 14 protected areas had been declared. As regards smaller protected areas, 603 natural reservations, 290 natural monuments and 170 protected sites had been declared by the end of 2007. The total acreage of protected nature areas is 1,135,032 ha, what represent 23.1% of the total territory. Within the network of conserved areas (NATURA 2000), the Slovak Republic Government approved a national list of 38 proposed protected bird areas and 382 areas of European interest in 2003. Up to now, 21 of them have already been declared. The area of all proposed protected bird areas represents 25.2% of total territory of the Slovak Republic and in the case of areas of European interest it is 11.8%.

2.4 CLIMATE PROFILE

According to global climatologic classification, the Slovak Republic is located in the mild climate zone with precipitations equally distributed over the whole year. The Atlantic Ocean impacts the west part of the Slovak Republic and the continental influence is typical for the east part. The Mediterranean climate influences mainly the south of the central part of the Slovak Republic by higher precipitation totals in autumn. A regular rotation of four seasons is typical for the country.

During the period of 1881 – 2008, the increase in average annual air temperature by 1.6°C and the decrease in annual atmospheric precipitation totals by 3.4% on average were recorded in the Slovak Republic. The precipitation decrease was above 10% in the south of the Slovak Republic, and it was sporadically up to 3% in the north and north-east of the country. A significant decrease in relative air humidity up to 5% and a decrease in snow coverage were recorded almost throughout the country (a moderate increase in highlands). There is the evidence of gradual desertification, particularly in the south of the Slovak Republic (the increase in potential evapotranspiration and the decrease in soil moisture). However, no significant changes were occurred in sun radiation characteristics, except for temporal decrease in 1965 – 1985. Figures 2.2 and 2.3 show the ten-year average annual air temperatures and precipitation totals in comparison with the normal in period of 1901 – 1990.

Figure 2.2: Decade average annual air temperatures at Hurbanovo (as annual deviations from the normal in the period of 1901 – 1990) for year, warm half-year (TP=IV – IX) and cold half-year (CHP=X – III) in period of 1881 – 2009 (2001 – 2009 data are estimated).

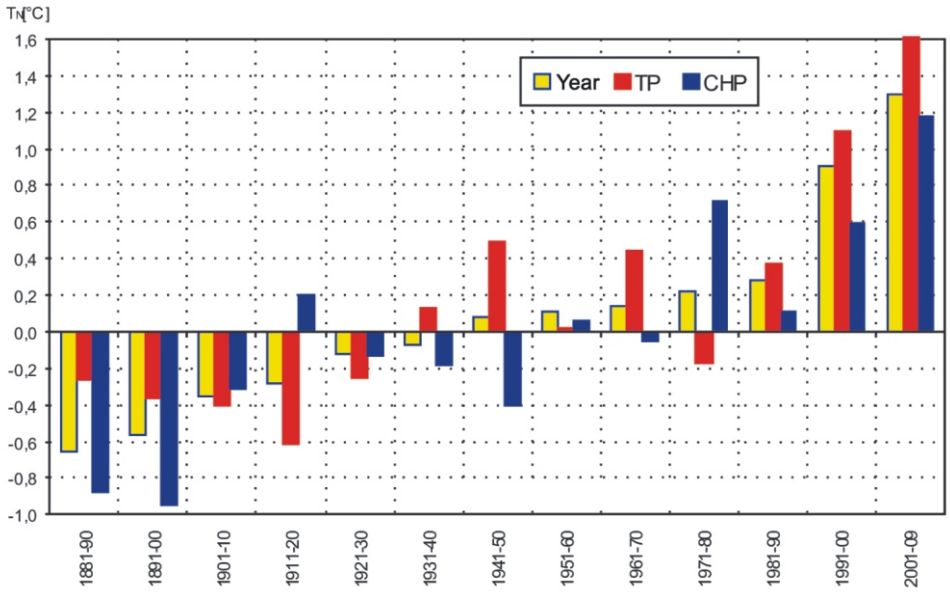
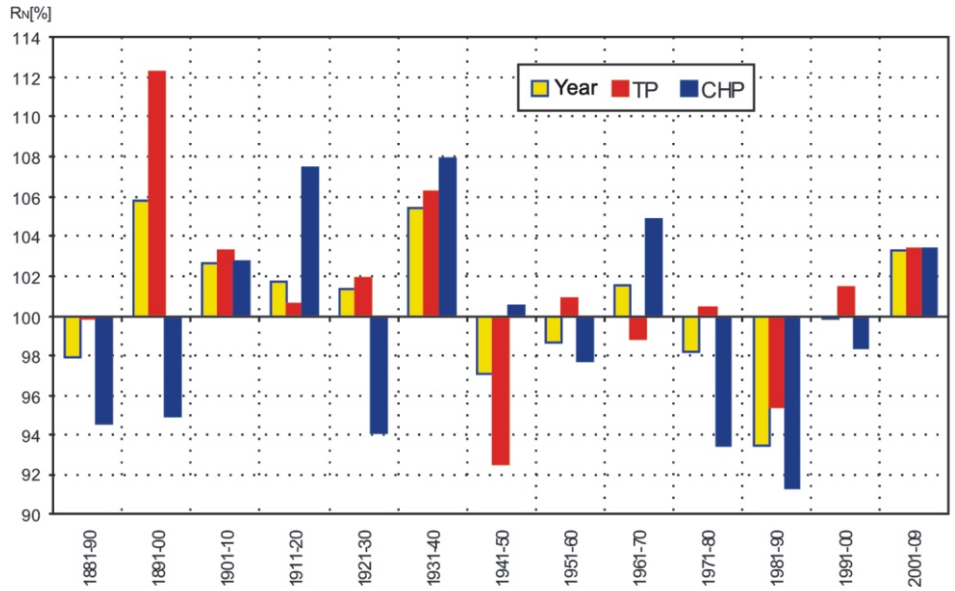


Figure 2.3: Areal averages of annual precipitation totals (percentage of normal 1901 – 1990) in the period of 1881 – 2008 calculated as double weighted average from 203 stations. Areal precipitation totals warm half-year (TP=IV - IX) and cold half-year (CHP=X - III) decreased by 30 mm within 129 years (2001 – 2009 data are estimated).



Particular attention needs to be paid to the climate change and variability, in particular to precipitation totals. Over the last 15 years, a significant increase in the occurrence of extreme daily precipitation totals has been observed. This trend had resulted in a higher risk of local floods in several localities of the Slovak Republic. On the other hand, local and regional droughts caused by long periods of relatively warm weather and small precipitation totals in some parts of a growing season, have been recorded in the period of 1989 – 2009. Particularly strong droughts were in 1990 – 1994, 2000, 2002, 2003 and 2007. Based upon the indicators of air temperature, precipitation totals, evapotranspiration, snow cover and other elements, the decade of 1991 – 2000, as well as the period of 2001 – 2009, have approached the conditions expected in about 2030 with respect to scenarios of climate change in the Slovak Republic, with the only exception of the decrease in precipitation totals in a cold half-year in the decade 1991 – 2000.

2.4.1 Evaluation of extreme weather events till 2008

Extreme weather events in relation to temperature, precipitation and air humidity have been evaluated. In the case of heat waves, we consider the days with average air temperature above 24°C and 27°C, in the case of low precipitation periods, we consider the periods of 15 and more days with precipitation totals 1 mm at the most. Concerning daily precipitation totals, we evaluated daily precipitation totals above 100 mm. The number of days of muggy weather (water vapour pressure above 18.7 hPa), and snow cover above 50 cm (above 100 cm in mountains) have been evaluated similarly. Climate change scenarios anticipate significant increase in number of certain weather extremes.

Figure 2.4 shows a number of very warm days at Hurbanovo in the period of 1951 – 2008. Daily average temperatures above 24°C are considered so high, that the air conditioning is required. Such temperature can be tolerated only with difficulties, in particular together with high absolute humidity of air. Daily averages above 27°C are sensed by people as the adverse heat wave. Such days are critical especially for children, old and ill people, in particular together with high air humidity. Since 1990 the number of these days has increased by 25% at least.

Figure 2.4: Number of days with the average air temperature of 24-27°C and above 27°C at Hurbanovo in 1951 – 2008.

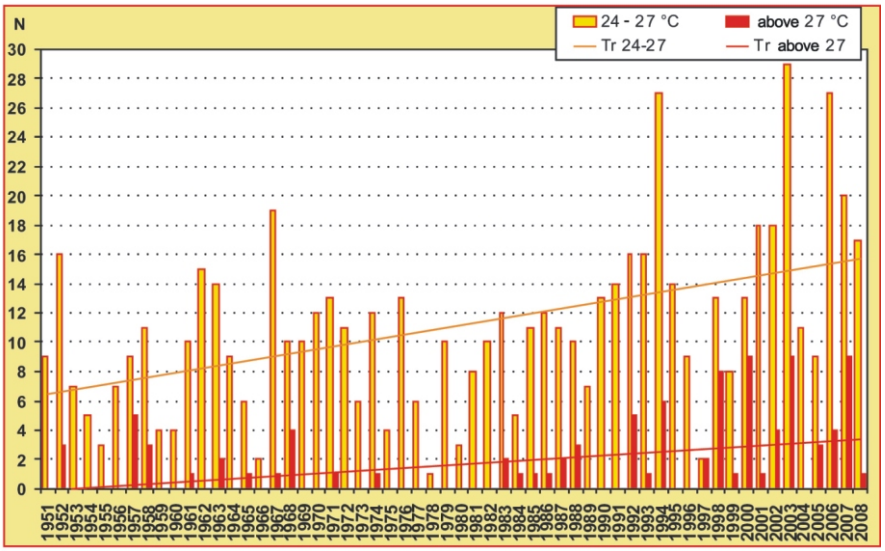
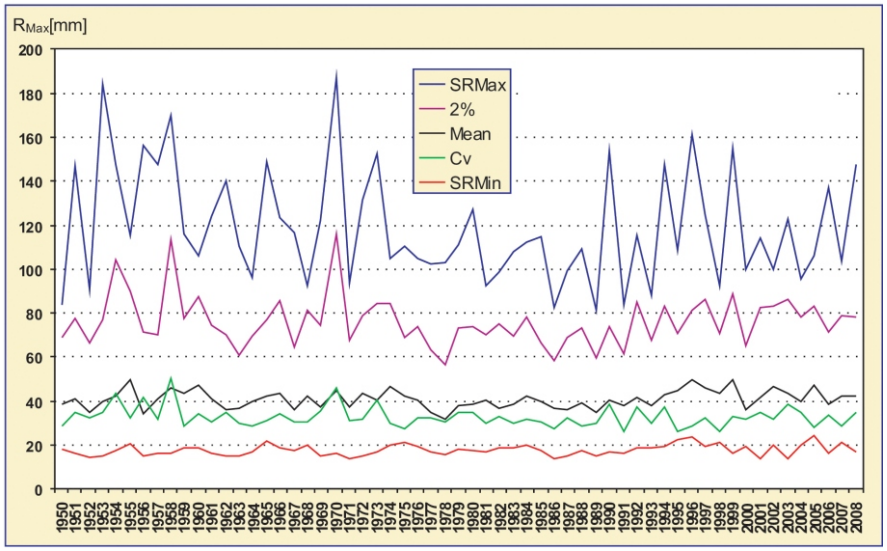


Figure 2.5 shows statistical data on annual maxima of daily precipitation totals taken from selected 557 stations in the Slovak Republic in the period of 1950 – 2008. After the transient decrease of maxima in the period of 1975 – 1989, the maxima started to increase again despite the co-increase in the number of dry days and the length of drought period. In recent days, there is an evident decrease in the number of days with cyclonal synoptic situation (in comparison with the period of 1950 – 1974), in particular during the warm season. The occurrence of high daily precipitation totals, recorded by our precipitation network, oscillates similarly (100 mm and more). In the period of 1949 – 1974, 5.8 such cases on average were recorded during 1.8 days, but in the period of 1975 – 1993 only 1.5 cases were recorded during 1.1 days, and in the period of 1994 – 2008, the number of cases increased to 3.9 during 1.9 days. The maximum, that can be hardly overcome, is 36 cases of more than 100 mm of daily precipitation totals in 29 June 1958 and 6 days with totals above 100 mm in 1997. Climate change scenarios expect the prolongation of drought periods and the increase in precipitation totals during short periods with cyclonal weather in summer.

Figure 2.5: Annual maxima of daily precipitation totals.



SR Max - maximal daily precipitation totals, 2% -in 2% (of 11) stations the precipitation totals were higher in the given year, Mean - the average of the highest daily precipitation totals at 557 stations in the given year, SR Min - the lowest of the maximal daily precipitation totals at 557 stations in the given year, Cv - variation coefficient

Simultaneously with the assessment of low precipitation periods (15 days and longer periods with precipitation totals 1 mm at maximum), changes in annual regimes of precipitation and long-term trend of annual number of days during low precipitation periods from 1901 to 2006 have been analysed. At the majority of the Slovak Republic territory, the occurrence of low precipitation periods is concentrated into spring and autumn months. In summer months, mostly in June and partially also in July, is the minimum of low precipitation periods. However, in the south of the Danube lowland the low precipitation period can be occurred with comparable probability all the year round. It is not possible at the rest of the territory due to relatively frequent occurrence of thunderstorms in summer. The frequency of precipitation deficit periods is the lowest in localities, where precipitations are more regular, namely in the north-west and the north of the Slovak Republic. Besides the frequent precipitations, also high precipitation totals are recorded in these localities. The most south regions of the Slovak Republic are represented by a meteorological station at Hurbanovo. Figure 2.6 presents the course of the number of days within low precipitations periods during the period of 1901 – 2006, recorded by this station, and it confirms the increase in drought days. Annual regime of precipitations in the most south regions of the Slovak Republic begins gradually to look like the annual regime of precipitations in the south of Europe. It means sporadic, but sometimes very intensive thunderstorm rainfalls or short-term abundant rain in summer and more rainy weather in autumn. The increase in periods of precipitation deficit in January is also very interesting. This phenomenon has been registered not only within the time line of daily precipitation totals, recorded at Hurbanovo but also in other localities of the Slovak Republic.

Figure 2.6: Number of days within low precipitation periods per year at Hurbanovo in the period of 1901 – 2006.

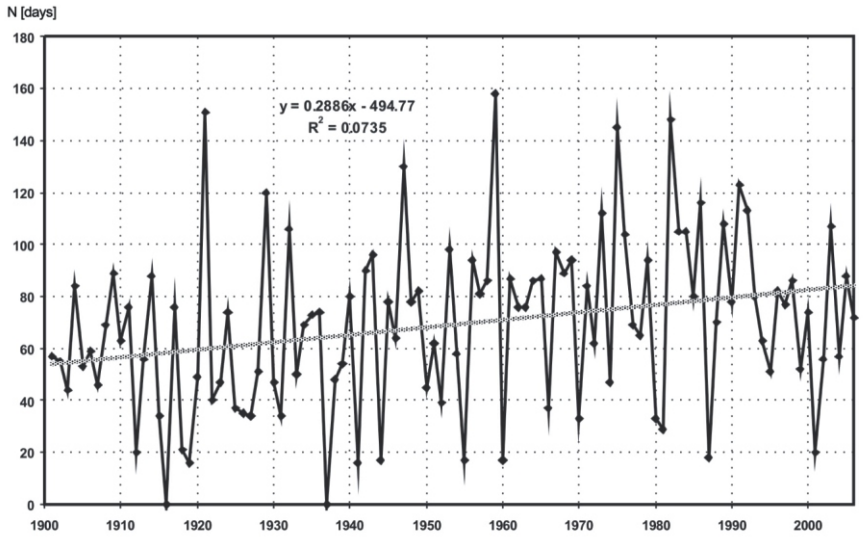


Figure 2.7 shows the results of the analysis of long-term course in the number of days with new snow cover of 20 cm and more, as well as n-day sum of new snow cover recorded by meteorological station at Oravská Lesná (winter seasons 1951/1952 – 2008/2009). Increasing trend in both characteristics of new snow cover is statistically significant within the assessed period. Increasing trend of new snow cover is similar also in other regions of the Slovak Republic. Figure 2.8 shows maximum depth of new snow cover (which was generated within 24 hours) in the period of 1981 – 2008. The increase in winter precipitations has been recorded in both the north and the south regions. Big differences between winter precipitation totals have been recorded in last two decades and this trend could continue also in future.

Figure 2.7: Number of days with new snow cover of 20 cm and more (FSC_{d20} [days]) and n-days sum of new snow cover (FSC_d [cm]) at meteorological station Oravská Lesná in the period of 1951 – 2009.

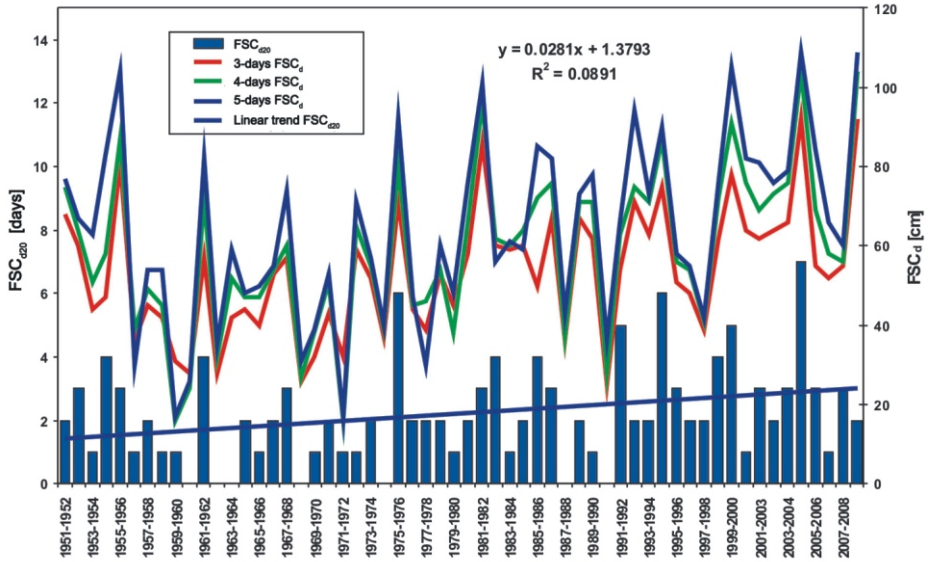
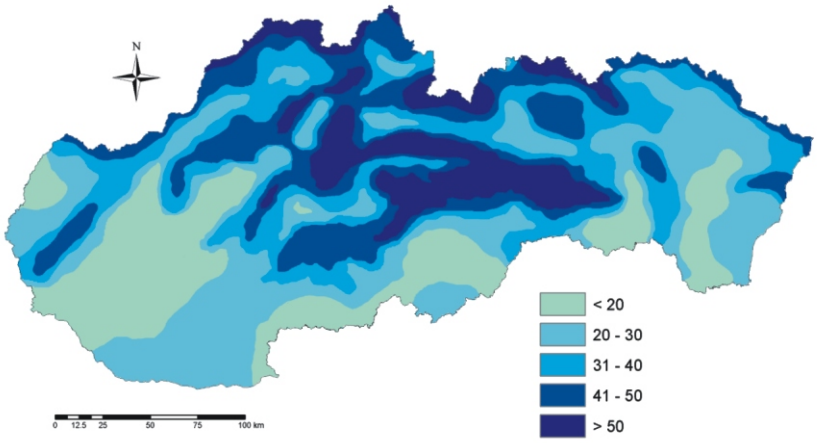


Figure 2.8: Maxima of daily depth of new snow cover [cm] in the Slovak Republic in the period of 1981 – 2008.



2.5 ECONOMIC PROFILE

Since 2006, rapid growth of the Slovak economy has been supported mainly by the rapid increase in foreign trade demand, particularly due to the increase in export capacities of automobile industry. The increased export performance of the Slovak economy has been influenced significantly by direct foreign investments implemented in recent years. Sectors of industry and construction have also contributed significantly to the dynamics of GDP growth.

Since 2000, macroeconomic development of the Slovak Republic has been influenced by changes in the structure of economy, implementation of a number of legislative and regulative measures with respect to EU membership. Moreover, extensive price liberalization was realised and within the liberalization, cross-subsidies were eliminated stepwise. The positive development continued also in 2006 and the growth of gross domestic product (GDP) at constant prices of the year 2000 reached 7.8%. Table 2.1 shows quantitative data of GDP development in the period of 2000 – 2007.

The introduction of new currency Euro (€) since the 1st January 2009 has been the most important change in economic profile of the Slovak Republic. The exchange rate was established as 30.126 SKK per 1€. Since the 1st of January 2009 to the 15th of January 2009, both currencies were used officially. Since the 16th of January Euro has become the only one legal currency in the Slovak Republic.

Table 2.1: GDP development (ESNÚ 95 methodology according to quarterly national accounts) in the period 2000 – 2007.*

Indicator	2000	2001	2002	2003	2004	2005	2006	2007
GDP constant prices in 2000 (mil. SKK)	938 755	970 685	1 016 812	1 064 956	1 119 862	1 193 169	1 294 539	1 429 471
GDP current prices (mil. SKK)	938 755	1 019 351	1 109 170	1 223 328	1 362 042	1 485 671	1 659 398	1 852 781
GDP/inhabitant constant prices in 2000 (mil. SKK)	173 822	180 432	189 040	197 986	208 053	221 479	240 121	264 826
GDP/inhabitant current prices (mil. SKK)	173 822	189 478	206 211	227 429	253 047	275 774	307 798	343 250
Rate SKK/Euro	42.6	43.3	42.7	41.5	40.0	38.6	37.2	33.8
GDP constant prices in 2000 (billion €)	22.0	22.4	23.8	25.7	28.0	30.9	34.8	42.3
GDP current prices (billion €)	22.0	23.5	26.0	29.5	34.0	38.5	44.5	54.8
GDP/inhabitant constant prices in 2000 (thousand €)	4.1	4.2	4.4	4.8	5.2	5.7	6.4	7.8
GDP/inhabitant current prices (thousand €)	4.1	4.4	4.8	5.5	6.3	7.1	8.3	10.2

*Source: Statistical Office of the Slovak Republic, set up on 18 May 2009, *ESNÚ – European System of National Accounts.*

In 2004, tax reform was implemented. Standard 19% tax has been introduced in relation to the incomes of private individuals and legal entities, as well as the value added tax.

Besides the tax reform, an improvement in the labour market has continued. Due to direct foreign investments, new jobs and working opportunities have been created. According to the selective investigation of labour forces, the average unemployment rate decreased to 9.4% in 2006. In 2005, the unemployment rate was 11.4%. In spite of recorded positive trends in unemployment at the labour market of the Slovak Republic, regional disparities persist. Problematic, so called marginal regions, from the perspective of social and economic development are concentrated mainly in the east of the country and in the south part of Central Slovakia.

The current account deficit in the balance of payments in 2006 reached 128 billion SKK and in comparison with the previous year it dropped by 2 billion SKK. The decrease was influenced mainly by the interim improvement of trade balance. Direct foreign investments, which were directed to the increase of the equity interests in companies and banks in the Slovak Republic, reached 64.3 billion SKK in 2006 (year-to-year growth by 42.1 billion SKK).

Gross international dept was 32.2 billion USD up to the 31st December 2006, what means the increase by 5.1 billion USD in the comparison with the year 2005. The development of both internal and external economic relationships are characterised by other parameters, like the inflation rate and foreign trade balance. Values of these parameters are shown in table 2.2.

Table 2.2: Selected internal and external indicators of the economic development in the period 2000 – 2007.

Indicator	2000	2001	2002	2003	2004	2005	2006	2007
Total inflation (%) (CPI)*	12.2	7.2	3.3	8.5	7.5	2.7	4.5	2.8
Foreign trade balance								
Import (CIF) (billion SKK)**	590	714	748	827	949	1 064	1 316	1 448
Export (FOB) (billion SKK)***	549	611	652	803	898	990	1 233	1 426
Balance (billion SKK)	-42	-103	-96	- 23	-50	-74	-83	-22

*Source: Statistical Office of the Slovak Republic, set up on 18th May 2009, *CPI – index of consumer prices, **CIF – import value, ***FOB – export value.*

Investments to the environment protection reached the value of 10 billions SKK in 2006, what is by 1.5 billion SKK more than in 2005. At the same time, the investments were fully covered by the state budget. Indicators are presented in table 2.3.

Table 2.3: Investments into the protection of the environment in SKK in the period 1990 – 2007.

Indicator	2000	2001	2002	2003	2004	2005	2006	2007
Investments into the protection of the environment total (mil. SKK)	3 876	5 143	8 944	5 316	7 390	8 476	10 015	8 801
-covered from the state budget (mil. SKK)	899	1 195	1 071	891	797	1 027	1 142	858
-covered from international funds (mil. SKK)	377	133	2 164	-	-	-	-	-

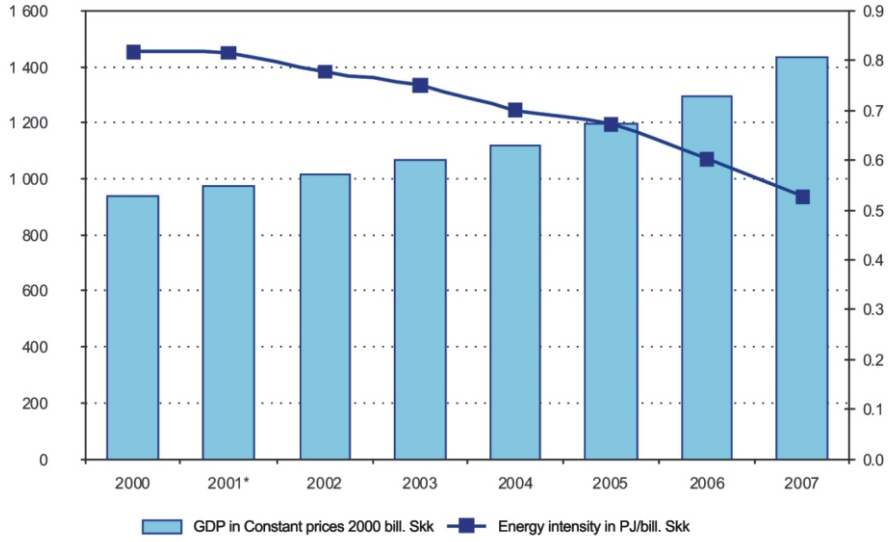
*Source: Statistical Office of the Slovak Republic, set up on 18 May 2009, *CPI – index of consumer prices, **CIF – import value, ***FOB – export value.*

2.6 SECTOR ENERGY

The decrease in the generation of emissions has resulted from a number of impacts and processes that have accompanied the transformation of the Slovak Republic into market economy. Economic recession after the year 1990 is one of the factors that have affected both historical and current development of greenhouse gas emissions. The other factors are as follows: the increase in share of gas fuels in the consumption of primary energy resources, environmental legislation concerning air protection, including charges for air pollution, structural changes in industry and related decrease in energy consumption in several energy demanding sectors, but also in other sectors.

Energy intensity (the energy efficiency of Slovak economy) is calculated as units of gross domestic consumption per unit of gross domestic product (in constant prices in 2000). Since 2000 the energy intensity has been decreasing gradually, but it is still relatively high. In 2006 the energy intensity of Slovak economy was 1.9 times higher than the EU average. Figure 2.9 shows the comparison of GDP development (left axis) and the energy intensity in the Slovak Republic in the period of 2000 – 2007.

Figure 2.9: Development of GDP and energy intensity in the Slovak Republic in the period 1990 – 2007.



*Source: Statistical Office of the Slovak Republic, set up on 18th May 2009, *ESNÚ – European System of National Accounts.*

The Slovak Republic imports nearly 90% of energetic sources (including nuclear fuel). Approximately 10% of total consumption is covered from internal sources, i.e. brown coal (6%), renewable energy sources (3% hydroelectric power station), domestic gas and oil (1%). Tables 2.4 to 2.8 illustrate changes in the structure of final consumption of fuels and energy in the Slovak Republic.

Table 2.4: Final consumption of solid fuels (PJ) in the period 2000 – 2007.

Indicator	2000	2001	2002	2003	2004	2005	2006	2007
Final consumption	59.0	36.0	36.0	29.0	33.0	26.0	29.0	31.0
of which								
Industry and construction	47.5	26.3	21.6	23.8	22.9	23.2	23.4	22.1
Agriculture	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Transport	0.8	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Commerce and services	8.5	6.4	9.0	1.5	5.3	1.1	3.3	6.5

Table 2.5: Final consumption of liquid fuels (PJ) in the period 2000 – 2007.

Indicator	2000	2001	2002	2003	2004	2005	2006	2007
Final consumption	66.0	85.0	96.0	94.0	81.0	91.0	91.0	96.0
of which								
Industry and construction	11.4	18.9	17.6	15.7	12.1	12.7	10.6	10.5
Agriculture	5.8	3.3	2.7	3.0	3.3	3.4	3.0	2.9
Transport	8.8	58.6	72.2	64.2	61.7	72.5	74.2	82.1
Commerce and services	24.1	3.4	2.7	1.9	3.4	2.5	2.2	0.4

Table 2.6: Final consumption of gas fuels (PJ) in the period 2000 – 2007.

Indicator	2000	2001	2002	2003	2004	2005	2006	2007
Final consumption	172.0	184.0	177.0	168.0	159.0	150.0	155.0	146.0
of which								
Industry and construction	88.7	67.4	69.9	59.3	53.0	57.4	58.2	59.3
Agriculture	2.0	2.0	1.9	1.3	1.8	1.7	1.3	1.1
Transport	0.4	0.1	0.1	0.2	0.2	0.3	0.2	0.8
Commerce and services	30.4	44.0	37.9	40.3	41.5	31.7	41.7	38.7

Table 2.7: Final consumption of electricity (PJ) in the period 2000 – 2007.

Indicator	2000	2001	2002	2003	2004	2005	2006	2007
Final consumption	23.0	84.0	82.0	83.0	86.0	82.0	85.0	88.0
of which								
Industry and construction	10.2	34.8	32.5	37.9	39.4	39.7	42.6	45.0
Agriculture	0.6	1.9	1.9	1.8	1.5	1.4	1.3	1.3
Transport	1.0	2.8	2.6	2.6	2.5	2.1	2.1	2.1
Commerce and services	5.3	25.9	27.2	22.3	25.7	22.1	22.6	23.5

Table 2.8: Production of electricity (TWh) in the period 2000 – 2007.

Indicator	2000	2001	2002	2003	2004	2005	2006	2007
Steam	9,30	9,83	8,99	9,64	9,33	8,98	8,78	8,03
Nuclear	16,50	17,10	17,95	17,86	10,73	17,73	18,01	15,34
Hydropower	5,10	5,05	5,48	3,67	4,21	4,74	4,56	4,59
Total	30,90	31,98	32,42	31,17	24,7	31,45	31,35	27,96

Source: Energy statistics of the Slovak Republic 2009.

In 2001, the Slovak Republic has launched restructuring and privatization processes of energy sector. 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 the SE (Slovak electricity plant), Joint Stock Company, was the division of electricity production (represented by the SE, Joint Stock Company) and electricity transmission network (represented by the SEPS, Joint Stock Company). Also the Heating Plant Košice, Joint Stock Company was established. Due to the importance and character of the SEPS (Slovak electricity transmission network) it is not envisaged to privatise this company and the state remains its owner through the National Property Fund. In 2006, the SE Joint Stock Company were privatised and changed into SE-ENEL, Joint Stock Company. Italian Company Enel SpA owns 66% of shares.

2.7 SECTOR TRANSPORT

Transport belongs to the most important components of tertiary sector that ensures the system of distribution between producers and consumers. The Slovak Republic is a very important transition country in the EU even though the natural conditions of the country are less favourably to the development of transportations (mountains, unfit rivers, poor railway interconnection in the south of the Slovak Republic). On the other hand, a favourable geographic location in the centre of Europe creates the conditions for the junction of European trade roads. The development of transport infrastructure in the Slovak Republic is very complicated due to the demands on high investments in relation to the geographic profile of the landscape. Conditions for the development of water transport are not suitable, as majority of rivers are not navigable.

Short distance passenger transport is an important part of road transport. It is the most exploited type of transport in the Slovak Republic due to a high density of roads, quality of road network and interconnection of all municipalities. In the past 10 years, road transport has expanded significantly in the transport of goods and persons. In 2007, the transport network included 364,542 km of roads of the classes I-III, including 17,883 km of motorways and roads for vehicles.

Act 135/1961 Coll. of 30th November 1961 on roads has been amended by Act 8/2009 Coll. on road traffic. The Act entered into force on 1st February 2009 together with implementing Regulation of Ministry of Interior of the Slovak Republic no. 9/2009, and abrogated Act 315/1995 Coll. on road traffic. This act regulates construction, use and protection of roads, rights and obligations of owners and administrators of roads and their users, as well as the obligations of state administration bodies and supervising bodies in relation to roads. The act has improved the safety on roads and cut down the number of accidents and victims.

Table 2.9: Number of vehicles in road transport in the period 1990, 1996 and 2000 – 2007.

Years	Passenger cars	Light duty vehicles	Heavy duty vehicles	Special vehicles	Buses	Motorcycles and mopeds	Tractors
1990	875 550	22 893	53 537	53 537	14 301	371 593	67 056
1996	1 058 425	15 262	81 816	45 430	11 321	310 537	62 810
2000	1 274 244	50 583	113 520	39 188	10 920	139 147	64 351
2001	1 292 843	57 801	114 323	36 082	10 649	139 576	63 422
2002	1 326 891	64 032	107 289	34 150	10 589	127 900	62 644
2003	1 356 185	73 978	109 046	32 033	10 568	128 009	61 690
2004	1 401 226	83 919	111 732	31 071	10 551	131 468	61 364
2005	1 303 704	91 660	105 218	22 648	9 113	136 466	46 544
2006	1 333 749	102 713	105 251	18 708	8 782	137 841	43 888
2007	1 433 926	104 439	130 231	18 983	10 468	143 617	44 098

Source: Police Force Presidium of the Slovak Republic.

The increase in consumption of gasoline and diesel oil is going on due to the increase in number of vehicles. Since 2002, also the consumption of alternative fuels has been increased due to the increasing number of buses in public transport using these fuels (CNG – compressed natural gas and LPG – liquefied petroleum gas).

Table 2.10: Fuel consumption in road transport.

Year	Petrol (t)	Oil (t)	LPG (t)	CNG (m^3)
1990	437 459	990 688		
1996	561 779	736 385	588	
2000	596 824	658 425	14 467	327 770
2001	701 760	726 375	21 787	327 770
2002	640 213	827 298	28 501	1 322 563
2003	662 876	843 626	30 483	2 566 144
2004	628 483	966 575	30 735	4 386 659
2005	699 994	1 193 996	29 965	5 530 726
2006	625 727	1 140 674	24 818	6 612 274
2007	663 467	1 380 255	21 473	7 577 187

Source: Balance of greenhouse gas emissions up to 15th April 2009.

Rail transport will be modernised with the support of EU funds. Improved quality and ecology of rail transport and the increase in passengers' number are the objectives of this modernisation.

Modernisation of rail infrastructure will result in the increase of operational speed to 160 kilometres per hour and increased safety of passengers. In 2007, the length of managed railways was 3,658 km of which the length of operated railways was 3,629 km.

Regarding the transported goods and passengers, the water transport represents only one fifth of road transport and a half of rail transport. Important ports are in Bratislava (in the middle of water route between the Black Sea and the North Sea) and in Komárno (which connects road, rail and water transport). This connection has resulted from the construction of channel Danube – Main – Rhine. The Váh water route is planned to be finished off in future in the direction from Komárno to Žilina with a later connection to the Oder through the construction of channel to Danube – Oder – Elbe, in cooperation with Austria and the Czech Republic. The length of navigable watercourses was 251 km in 2007, of which the Danube length was 172 km, the Váh length was 79 and channel length was 38 km.

There are six international airports in the Slovak Republic; the airports are in Bratislava, Košice, Piešťany, Sliač, Poprad–Tatry, and Žilina. The airports are managed by the Slovak Management of Airports, except for the airport in Žilina, where exercises with light aircrafts of the Žilina University predominate. Other smaller civil airports (Nitra, Prievidza, Ružomberok, Lučenec) are operated by aero-clubs with predominating character of sport flights.

Since 2002, air transport in the Slovak Republic has been positively affected by the penetrating enter of low cost companies, like Sky Europe Airlines, Seagle Air and Danube Wings to the Slovak market. Airports in Bratislava and Košice are the most important and the busiest airports. It is very difficult to estimate future development in air transport due to current unstable situation in this sector. Unsolved problems of privatization and capital investments into the infrastructure's development of the airports in Bratislava and Košice have adverse impacts on the development of air transport in the Slovak Republic. Currently, the extensive reconstruction and rebuilding of terminals of Bratislava airport are going on.

There was no significant decrease either in the number of passengers or in the transport capacity of goods in the period of 2004 – 2008. Only some changes in the distribution of transport capacities were recorded, i.e. the decrease in public transport. Certain recovery was apparent in air transport. Individual and cargo automobile transport are increasing permanently.

Table 2.11: Transport of passengers (in thousand of passengers) in the period 1995 and 2000 – 2007.

Indicator	1995	2000	2003	2004	2005	2006	2007
Total Passenger transport	**2 669 548**	**2 745 442**	**2 688 157**	**2 650 569**	**2 669 382**	**2 649 500**	**2 652 883**
Road	722 510	604 249	493 706	461 772	449 456	403 270	384 637
Rail	89 471	66 806	51 274	50 325	50 458	48 438	47 070
Public transport in towns	515 593	404 539	394 465	383 118	395 064	400 673	403 466
Water	138	80	321	193	134	111	122

Table 2.12: Transport of goods (thousand of tons) in the period 1995 and 2000 – 2007.*

Indicator	1995	2000	2003	2004	2005	2006	2007
Total transport of goods	**266 356**	**244 686**	**226 122**	**230 166**	**246 241**	**235 584**	**232 916**
Road	203 918	188 901	174 149	178 085	195 405	181 422	179 296
Rail	60 776	54 177	50 521	50 445	49 310	52 449	51 813
Water	1 661	1 607	1 451	1 636	1 526	1 713	1 806
Air	1.280	0.697	1.134	0.267	0.230	0.041	1.32

Source: Statistical Office of the Slovak Republic, 2009.

** In rail transport, the indicator shows the tariff weight of transported goods, for which the charge is calculated. In road transport, the indicator shows the real weight of transported goods which is transported by vehicles (including trailers). In water transport, the indicator shows the weight on the base of a consignment note in inland transport and a consignment note in international transport of goods. In air transport, the indicator shows the weight of transported goods, luggage and post, which are recorded in the "List of cargo" of the particular regular or irregular flight in inland or international air transport. In irregular transportation, where all the aircraft capacity is sold for the goods transport, only the weight of really transported goods is calculated.*

Pipeline transport is the most effective and the cheapest type of transport for crude oil and natural gas. The Slovak Republic is an important transit operator of oil and natural gas from the East to the Western Europe. Two pipelines Druzhba and Adria cross the territory of the Slovak Republic. Druzhba pipeline (the length of 506.6 km) was built in 1960 – 1965 with the aim to transport oil from former the Soviet Union to Czechoslovak refineries. Druzhba crosses the border between the Slovak Republic and Ukraine and through five pumping stations its route continues to the Czech Republic. The pipe diameter is 500 and 700 mm in the main sections. Total annual capacity is more than 20 million metric tons. The length of Adria pipeline in the Slovak Republic territory is 8.5 km and it connects with Druzhba pipeline in Tupá. The pipeline diameter is 400 mm. Annual capacity of the pipeline is 4.5 million metric tons. Adria has been built as a supplementary source of crude oil. The route from Croatia has been out of operation for a long period. As the pipeline allows reversible pumping, crude oil from Russia is transported through it to Hungary and Croatia. The demand is 5.3 million tons, what is approximately 25% of total capacity of pipeline Druzhba.

2.8 SECTOR INDUSTRY

Key solution for the modification of economy into low-carbon and energy effective model is to develop a complex strategy and adequate measures supporting innovative ecologic technologies without negative impacts on the competitiveness, social and economic development of the country. The global environmental objective can be achieved by the implementation of innovative and advanced technologies in business sphere, the improvement of conditions and the attractiveness of regions, the achievement of material and energy savings and the improvement of the effective use of energy sources. The differences between the Slovak Republic and the EU-15 in technical and innovative levels can be reduced by the increased share of secondary and renewable raw materials in industry. This measure will lead also to the increase in the competitiveness, value added, productivity and efficiency of industry.

The internal structure of Slovak industry has been stabilised after the implementation of significant changes prior to EU membership. The share of mining, distribution of electricity, gas and water has been reduced in the generation of value added and today it is comparable with other developed countries. The share of industry in GDP generation has been increased and in 2007, it reached 25% expressed in current prices of 2000.

In 2007, the industrial production indicated a moderate increase in the dynamics of growth by 2.5% in comparison with the previous year. This trend has resulted from the increased production in pulp and paper industry, production of plastics and rubber products and predominantly, in car production, with the dynamics of increase above 9%. The Slovak Republic has become a country with the highest production of cars per inhabitant in Europe. On the other hand, the decrease in domestic demand has continued in the production of chemicals, chemical products and chemical fibres, foodstuffs, beverages and tobacco products, coke, oil products and nuclear fuel.

Table 2.13: Development of value added in current prices of 2000 according economic activities (billion of SKK) in the period 2004 – 2008.

Indicator	2004	2005	2006	2007	2008
Total economy	**1 488.8**	**1 528.51**	**1 600.58**	**1 602.90**	**1 579.64**
Agriculture including fishing	69.66	69.10	74.55	73.83	72.89
Mining of raw materials	7.10	7.70	4.97	6.67	7.70
Industrial production	373.29	425.83	461.40	474.87	525.86
Production of electricity, gas, water	38.54	43.51	37.46	47.89	38.66
Construction	73.37	76.17	88.90	97.07	96.95
Commerce	187.15	197.24	205.26	192.94	206.72
Hotels, restaurant	17.59	17.38	18.44	16.80	15.79
Transport, telecom, post	110.42	98.19	95.06	80.80	84.97

Source: Statistical Office of the Slovak Republic, 2009.

High dependency of Slovak economy on primary energy resources is a limiting factor for further development of industry, together with a relatively high consumption of fossil fuels.

Energy intensity of industry in the Slovak Republic has been decreasing slowly, but it is still relatively high in comparison with the EU-15 countries. Changes in energy consumption have resulted from the structural changes in technology, but also from the cancel of price regulation of commodities (electricity, gas and heat) for both industry and households in 2004. These changes had caused that the consumption of brown coal in 2007 was only 31% of the consumption in 1990, the consumption of light fuel oil decreased by 95% and the consumption of heavy fuel oil decreased by 70%. When comparing, the production of steel increased by 28%, but the consumption of coal for the production of electricity decreased by 2.3%. Carbon intensity per cubic meter of liquid steel has improved by 5.2%.

Regarding the final consumption of energy, industry has got the highest share (including construction). The trend in the final consumption of energy in this sector shows is positive characterised by a decrease of total energy consumption. The following branches in the industrial sector contribute to fuel and energy consumption: metallurgy 32%, energy industry 32%, chemical industry 11%, pharmaceutical industry 11%, wood processing 4%, machinery 3%, textile 2%, electro-production, glass production and leather and shoemaking approximately 1% for each of them.

2.9 SECTOR WASTE MANAGEMENT

Year 2007 was the second year of the Waste Management Programme of the Slovak Republic for the period 2006 – 2010. The programme was approved on 15th February 2006 by Resolution no. 118 of the Government of the Slovak Republic. This period was focused on the support of waste recovery, either material recover,

Since 1995, the Slovak Republic has been using Regional Information System on Waste (RISO) for processing data on waste generation and waste handling. RISO provides the database for planning, updating and evaluating the fulfilment of objectives and measures of the Waste Management Programme. Statistics of municipal waste is an exception, as since 2003, this type of waste has been under control of the Statistical Office of the Slovak Republic in compliance with joint agreement of sectors. Table 2.14 shows total quantities of generated waste. Data on waste quantities put on the market are more important from the aspect of conceptual and territorial development of waste management infrastructure. According to waste act, waste generators are obliged to offer their wastes to persons (companies), who are authorised to recover or to dispose of wastes. So, the balance of wastes put on the market is the statistical basis for monitoring in waste management.

Table 2.14: Balance of waste generation and waste put on the market of the Slovak Republic in 2007.

Waste generation		Waste put on the market	
Waste category	Quantity 2007 (t)	Waste category	Quantity 2007 (t)
Hazardous waste	663 299.73	Hazardous waste	525 165.60
Other waste	14 456 137.35	Other waste	8 740 682.17
Municipal waste	1 668 648.31	Municipal waste	1 668 648.31
TOTAL	**16 788 085.39**	**TOTAL**	**10 934 469.08**

Source: Slovak Environmental Agency and Statistical Office of the Slovak Republic, 2008.

According to the sector classification of economic activities (NACE), industry is traditionally the major generator of waste with its 55% share, followed by construction with 22% share. Agriculture (7%) and commerce (4%) are also important waste generators. Total amount of waste according to NACE classification does not contain municipal waste.

In 2007, 45% of generated waste, i.e. 4,961,343 tons, was disposed of. The deposit in landfills (landfilling) predominated in waste management with 86% share. In comparison with the year 2006, the decrease in waste disposal in landfills by 1.3 million tons was recorded. Up to 31st December 2007, 151 landfills were operated in the Slovak Republic.

Deposit in landfills predominates also in handling of municipal wastes (76%). Energy recovery (7%), composting (5%) and incineration (4%) are the other important methods. Municipal waste consists of mixed municipal waste (70%), bulky waste (10%), construction waste (5%), bio-degradable waste (5%), paper and cardboard (3%). According to the Statistical Office of the Slovak Republic, the amount of components separated from municipal waste is 16 kg per inhabitant.

In 2007, 30 incinerating plants were operated in the Slovak Republic, of which 15 plants incinerated industrial waste, 18 plants incinerated healthcare waste, 2 plants incinerated municipal waste and 5 plants co-incinerated waste. Several of the plants are prepared for reconstruction or the reconstruction has already started, or the construction of new plants have replacing the closed ones is planned.

Recycling Fund was playing its role also in 2007 in conformity with the Act on Waste by supporting waste collection and waste recovery from the charges of producers and importers of 10 selected commodities.

2.10 SECTOR HOUSING, HOUSEHOLDS AND PUBLIC BUILDINGS

In 2007, housing sector and households had the second highest energy consumption, i.e. 106,059 TJ or 26% share of total energy consumption in the Slovak Republic. Tertiary sector (services) finished in the third place in energy consumption, i.e. 73,566 TJ or 18% share of total energy consumption. Heating of buildings and electricity consumption for lighting and the operation of electric equipment have reached the major share in energy consumption in service sector (approx. 3-4%). In 2007, residential and non-residential buildings reached 44% share in total energy consumption in the Slovak Republic.

In 2007, natural gas was the most used fuel in heating systems, followed with coal. Wood, as the alternative to coal or other fuels, has been introducing gradually into households, particularly into family houses. Wood is used in various forms, such as briquettes, wood pieces or pellets. In table 2.15, coal includes brown coal, hard coal, lignite and cokes.

Table 2.15: Basic energy sources used for heating (%) in the period 2000 – 2007.

Indicator	2000	2001	2002	2003	2004	2005	2006	2007
Coal	2.60	3.62	7.30	4.80	6.37	2.92	3.42	5.00
Natural gas	77.18	81.15	91.48	94.59	91.35	94.28	93.48	89.16
Wood	0.03	0.08	0.03	0.03	0.04	0.04	0.04	0.06
Other	20.19	15.15	1.19	0.58	2.24	2.76	3.07	5.77

Source: Energy statistics SR 2009.

Number of completed dwellings in the Slovak Republic has fluctuated since 2000, as well as the average floor area. An exception can be seen in 2004, when the average floor area was the highest during the period of 2002 – 2007.

Table 2.16: Number of completed apartment blocks and family houses in the period 2000 – 2007.

Indicator	2000	2001	2002	2003	2004	2005	2006	2007
Number of dwellings	12 931	10 321	14 213	13 980	12 592	14 863	14 444	16 473
Of which								
Number of dwellings in family house	N*	N*	9 095	7 589	8 575	8 707	7 657	7 897
Average floor area m^2	N*	N*	118	114	132	121	116	112
Average habitable area m^2	N*	N*	77	72	79	73	71	70

*Source: Ministry of Construction and Regional Development of the Slovak Republic, *Not available.*

Employment is an important issue that relates to housing sector. Number of registered employees in housing sector has been increased since 2001. Number of employees in public sector fluctuates. Table 2.17 shows the number of registered employees in the period of 2000 – 2007.

Table 2.17: Average registered number of employees in construction enterprises according to ownership (persons) in the period 2000 – 2007.

Indicator	2000	2001	2002	2003	2004	2005	2006	2007
Employees in total	**126 822**	**125 097**	**127 824**	**131 154**	**133 600**	**142 751**	**156 647**	**165 987**
Employees in public sector	1 520	1 112	1 565	1 085	1 144	661	518	662
Employees in private sector	125 302	123 985	126 259	130 069	132 456	142 090	156 129	165 325

Source: Statistical Office of the Slovak Republic, 2009.

Housing development has been increasing since 2005, but not all people have sufficient finances for its realisation. Therefore, municipalities ask the State for subsidies. In 2006, the provided subsidies were 1,261 million SKK, what was the increase by 25% in comparison with 2005 and the number of applicants for subsidies decreased by 40%. The biggest increase in subsidies was in 2007, when the subsidies reached 913 billion SKK, but the number of applicants was the same as in 2002 (the biggest number of applicants).

Housing development closely relates also to keeping technical standards. In 2005, Construction Act was issued together with implementing regulations that have been harmonised with EU directives. This act deals indirectly also with funding construction of flats. Table 2.18 shows subsidies and number of applicants.

Table 2.18: State subsidies for housing development in the period 2000 – 2007.

Indicator	2000	2001	2002	2003	2004	2005	2006	2007
Subsidies in million SKK	364	1 442	2 838	0	778	1 006	1 261	913 643
Total number of applicants	54	152	292	0	133	149	60	166

Source: Ministry of Construction and Regional Development of the Slovak Republic, 2009.

2.11 SECTOR AGRICULTURE

In comparison with other sectors, the generation of emissions and sinks of greenhouse gases in agriculture have not been investigated thoroughly. Some sources are difficult to quantify, the others are hidden. Besides significant climate differences, there are also different types of soil due to indented ground of the Slovak Republic. This fact affects sowing procedures, manure applications and the management in agriculture.

By the end of 2007, the soil fund of the Slovak Republic was 4,903,400 ha. The importance of agriculture in economy shows a long-lasting decrease, as regards either the share in GDP or employment. The share of GDP generated in agriculture decreased from 4.55% in 2003 to 2.5% in 2007. Since the accession of the Slovak Republic to the EU, the sum of direct payments, including supplementary national direct payments, reached for the first time maximal level (70%) of payments provided within EU-15. Provision of maximal supplementary national direct payments also contributed to this fact. In 2007, gross agricultural production increased by 2.2% in current prices, but it decreased by 4.2% in constant prices. The increase in production was accompanied with the increase in plant production (9.7%) and the decrease in animal production (2.9%). The structure of production was changed too in conjunction with the increased share of plant production and the decreased share of animal production in gross agricultural production.

Table 2.19: Gross agricultural production (GAP) in the Slovak Republic in the period 2000 – 2007.

Indicator	2000	2001	2002	2003	2004	2005	2006	2007
GAP (mil. SKK)	52 790	58 030	58 927	57 503	60 722	56 899	57 419	58 183
Of which								
Gross plant production	20 542	25 596	26 831	24 117	27 767	26 810	27 460	24 268
Gross animal production	32 248	32 434	32 096	33 386	32 955	30 089	29 959	33 915

Source: Statistical Office of the Slovak Republic, 2009.

In 2007, the area of seeded soil slightly increased (0.7%), but the areas of following plants were reduced: sugar-beet (31.8%), potatoes (1.1%), lucerne (4.2%), annual forage (10.7%), root crops (16.7%), legume (24.9%) and sunflower (7.4%). Yarn plants were not seeded at all. However, Act 77/2009 Coll. changing and amending Act 139/1998 Coll. on narcotics and psychotropic substances, which has been effective since March 2009, allows growing of technical cannabis. Crop seeding was increased in total (6.4%), barley (13.8%), oilseed rape (25.3%) and multi-year forage (4.5%). In case of sugar-beet, the reform of sugar regime goes on and its growing is has been reduced. Potatoes growing have been influenced in the long term by several factors, like climate change, decrease in human and animal consumption and the absence of companies processing potatoes. Increased interest of producers in oilseed rape was caused by increasing demands on the production of methylester and higher average price.

In animal production, the problems persist with the nutrition, feeding 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 dairy cows. Free stabling of animals is the most important technological change in animal production. Production of pigs is stagnant; however, it does not cover domestic consumption. Trend in poultry breeding is positive.

Table 2.20: Number of animals in agricultural production in the Slovak Republic in the period 2000 – 2007.

Number in thousand	2000	2001	2002	2003	2004	2005	2006	2007
Dairy cows	271	259	260	246	232	230	219	216
Other cattle	375	366	348	347	308	298	289	286
Sheep	348	316	316	326	321	320	333	347
Goats	51	40	40	39	39	40	38	38
Pigs	1 488	1 517	1 554	1 443	1 149	1 108	1 105	952
Poultry	12 446	13 612	13 959	14 217	13 713	14 084	13 038	12 880

2.12 SECTOR FOREST MANAGEMENT

Current situation in forestry is connected with several problems. The most serious problem relates to the health of forests with the predominance of spruce. The conditions in spruce monocultures are getting worse and it is demonstrated mainly as their withering and destruction. In principle, two different opinions are available how to solve this problem. The first one is about the effort to regulate bark beetles also in non-harvesting zones. The second one is about leaving these localities without any intervention. This has resulted in the propagation of Ips typographus also in surrounding monoculture forests. The expansion of bark beetle started after wind calamity in 19th November 2004. Remedial measures against bark beetles require significant higher financing of forest conservation.

In 2007, forestry soil covered 2,006,600 ha, overgrown soil covered 1,932,900 ha and the share of forests was 41%. Since a new act on forests entered into force, the share of forests for specific purposes has been decreased due to the elimination forests affected by pollutants. The decrease in area of commercial forests has stopped and their share is 68.2%. This means the increase by 1.9% in comparison with 2000. The area of protective forests has been stabilised in the long term. Table 2.21 shows that wood supply in forests has been increased.

Table 2.21: Wood supply in forests in the Slovak Republic in the period 2000 – 2007.

Indicator	2000	2001	2002	2003	2004	2005	2006	2007
Total in mil. m^3	410.0	415.6	423.2	428.2	434.4	438.9	443.8	445.9
Average per ha in m^3	215.0	217.0	219.0	221.9	226.0	229.0	231.0	232.0

Source: Slovak Environmental Agency, 2009.

Due to many random harvests, current volume of felled trees is above carrying capacity every year (table 2.22). Since 2000, this exceeding has been 16.7% on average, but in 2005 – 2007 it reached 27.8%. Manmade recovery of forests has been increased in proportion to these figures.

Table 2.22: Harvest of trees in the Slovak Republic in the period 2000 – 2007.

Indicator	2000	2001	2002	2003	2004	2005	2006	2007
Volume in mil. m^3	6.2	6.2	6.2	6.7	7.3	10.2	8.4	8.6

Source: Statistical Office of the Slovak Republic, 2009.

The share of total GDP generated by forestry decreased to 0.46% in 2007 in spite of slightly increased absolute amount. In comparison with 2003, the usage of private forests is higher than the usage of forests owned by the State. Value added of the environmental function of forests is 2 – 3 times higher than the production value; however, the environmental value is not a market subject and it is not captured in GDP figures. Wood processing industry is based on the raw material produced by forest management, and its share in GDP is 8%. Investments in forest management vary from 0.36% to 0.19% in total investments in the Slovak Republic. The decrease in funding of forest management has stopped during last two years, the value is relatively stable; however, in current prices it is only 32% of the level in 1990.

2.13 REFERENCES

FAŠKO, P., LAPIN, M., PECHO, J., 2008: 20 – year extraordinary climatic period in Slovakia. In: Meteorologický časopis, 11, 3, 99 – 105.

GAÁL, L., SZOLGAY, J., LAPIN, M., 2008: Regional frequency analysis of heavy precipitation totals in the High Ta¬tras region in Slovakia for flood risk estimation. In: Contributions to Geophysics and Ge-odesy, 38, 3, 327 – 355.

LAPIN, M., NEJEDLÍK, P., 2008: Occurrence of dry and wet periods during vegetation season at selected stations of Slovakia for the period 1951 – 2005 / J. Hrvoľ; Symposium on Climate Change and Variability – Agro Meteorologi¬cal Monitoring and Coping Strategies for Agriculture : Book of abstracts, As: Bioforsk, 16.

LAPIN, M., DAMBORSKÁ, I., DRINKA, R., FAŠKO, P., GAÁL, L., MELO, M., 2008: Úvod k scenárom extrémnych poveternostných situácií a vybrané výsledky spracovania. In: Národný klimatický program Sloven¬skej republiky, vol. 12: Dôsledky klimatickej zmeny a adaptačné opatrenia. Bratislava: MŽP SR, s. 9 – 30. ISBN 978 – 80 – 88907 – 63 – 3.

LAPIN, M., DAMBORSKÁ, I., FAŠKO, P., GAÁL, L., MELO, M., 2008: Some facts on extreme weather events analysis in Slovakia. In: Bioclimatology and natural hazards. Dordrecht; London: Springer, 2008. s. 39 – 53. ISBN 978 – 1 – 4020 – 8875 – 9.

LAPIN, M., DRINKA, R., KREMLER, M., TOMLAIN, J., 2008: Scenarios of air humidity and potential evapotran¬spiration change for Hurbanovo [CD ROM]. In: Bioklimatologické aspekty hodnocení procesů v krajine: Sborník příspěvků z mezinárodní konference. Praha: Česká bioklimatologická společnost, 2008. 16 s. ISBN 978 – 80 – 86690 – 55 – 1.

LAPIN, M., FAŠKO, P., PECHO, J., MELO, M., 2007: Snow cover changes scenarios for the Tatra Mountains in Slova¬kia. In: 29th International Conference on Alpine Meteorology: Extended Abstracts: Oral Ses¬sions, Vol. 1. Toulouse: Météo France, 2007. 175 – 178.

LAPIN, M., GERA, M., HRVOĽ, J., MELO, M., TOMLAIN J., 2009: Possible impacts of climate change on hy¬drologic cy¬cle in Slovakia and results of observations in 1951–2007. Biologia, 64, 3, 454 – 459. ISSN 0006 – 3088.

MELO, M., LAPIN, M., DAMBORSKÁ, I., 2007: Končekov index zavlaženia ako možný indikátor aridizačných trendov v krajine. In: Acta Hydrologica Slovaca, 8, 2, 224 – 230.

MINISTERSTVO ŽIVOTNÉHO PROSTREDIA SR, 2007: Správa o stave životného prostredia Slovenskej republiky v roku 2007, Slovenská agentúra ŽP, časť odpady.

ŠKODA, P., MAJERČÁKOVÁ, O., DEMETEROVÁ, B., DANÁČOVÁ, Z., 2008: Zhodnotenie vývoja minimálnych prietokov na území Slovenska, In: Národný klimatický program Sloven¬skej republiky, vol. 12: Dôsledky klimatickej zmeny a adaptačné opatrenia. Bratislava: MŽP SR, s. 49 – 60. ISBN 978 – 80 – 88907 – 63 – 3.

ŠKVARENINA J., TOMLAIN J., HRVOĽ J., ŠKVARENINOVÁ J., HLAVATÁ H., 2008: Výskyt suchých a vlhkých období vo ve¬getačných stupňoch Západných Karpát na Slovensku: analýzy časového radu 1951 – 2005 a prognóza očakáva¬ných zmien klímy; In: Národný klimatický program Sloven¬skej republiky, vol. 12: Dôsledky klimatickej zmeny a adaptačné opatrenia. Bratislava. MŽP SR, s. 123 – 142. ISBN 978 – 80 – 88907 – 63 – 3.

VIDA, T., ŠKVARENINA, J., HOLÉCY, J., 2008: Meteorologické podmienky, vývoj, frekvencia a príčiny vzniku krajin¬ných požiarov na území Národného parku Slovenský raj v období 1976 – 2005. In: Bioklimatologické aspekty hodnocení procesů v krajině [elektronický zdroj]: sborník příspěvků z mezinárodní konference : Mikulov 9. – 11.9.2008 / ed. Jaroslav Rožnovský, Tomáš Litschmann. – Praha : Česká bioklimatologická společnost, ISBN 978 – 80 – 86690 – 55 – 1.

03

Greenhouse gas inventory information, including on National System and National Registry

The Slovak Republic as well as most of Central and Eastern European countries have committed themselves to reduce the level of aggregated emissions of six greenhouse gases by 2008 and, in the period of 2008 – 2012, to keep the drop of 8% under the level of the reference year 1990. Reduction commitments are evaluated every year in the inventory of GHG emissions and precursors, which comply with the requirements of the United Nations Framework Convention on Climate Change (the Convention) and the Kyoto Protocol (the KP). In line with the recommendations of the expert review teams under the UNFCCC, several methodologies and parameters have been implemented gradually in accordance with the IPCC 2006 Guidelines and several formal IPCC methodologies (Guidelines for National GHG Inventory 1996, Good Practice Guidance 2000 a Good Practice Guidance for LULUCF 2003) have been fully implemented. Recalculations have always led to a higher accuracy and complexity of emission inventory. The responsibility for coordination of the National Inventory System according to Article 5.1 of the Kyoto Protocol lies with the Emission Department of the SMHÚ as the Single National Entity of the Slovak Republic.

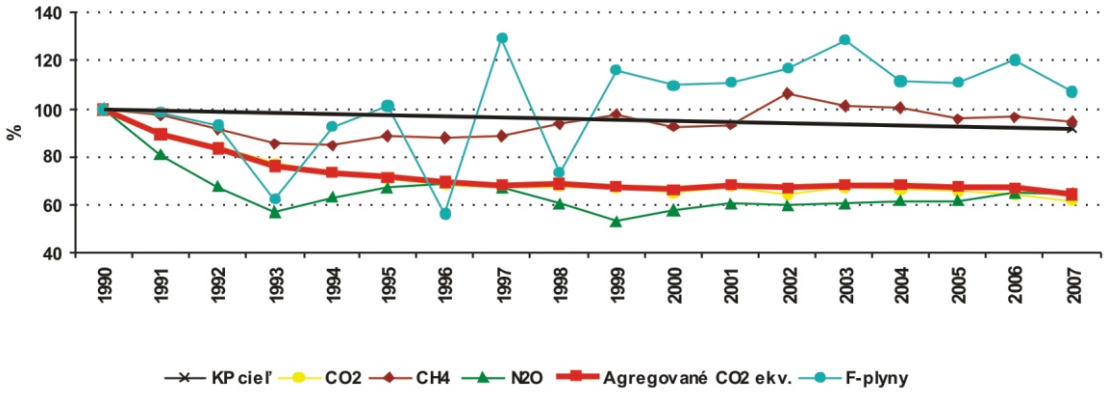
3.1 SUMMARY TABLES

Table 3.1 presents national GHG emissions (CO_2, CH_4, N_2O, PFCs, HFCs and SF_6) and precursors (NO_x, CO, NMVOC, SO_2) and trends and their aggregated equivalents since the reference year 1990 up to 2007 as they have been set in the latest emission inventory of 15th April 2009.[1]

GHG emissions published in the Fourth National Communication of the Slovak Republic on Climate Change have been updated annually and recalculated according to the latest available official information, national conditions and data published by the Statistical Office of the Slovak Republic.

In 2007, total amount of GHG emissions reached 46,950.67 Gg CO_2 equivalents without including sinks from sector land use, land use change and forestry (LULUCF), what was the decrease by approx. 36% compared to the base year 1990. Compared to 2006, the emissions decreased by 4.1%. In 2007, total GHG emissions were the lowest since the reference year 1990, but up-to-date results of preliminary inventory of 2008 have already indicated the increasing trend. It is questionable whether the economic and gas crises will have impact on total trend of emissions in the future. Due to several recalculations, also total GHG emissions of the reference year 1990 representing 73,255.28 Gg CO_2 equivalents without including sinks from LULUCF were updating.

Figure 3.1: The GHG emission trends (1990 – 2007) compared with the Kyoto target (8%) in the Slovak Republic.



Emissions submitted on 15th April 2009 in % rate to the reference 1990 without LULUCF.

Total GHG emissions including sinks from sector LULUCF represented 43,754.23 Gg CO_2 equivalents in 2007 and they dropped by more than 38% compared to the reference year 1990 (70,866.79 Gg CO_2 equivalents). The amount of carbon sinks in forest ecosystems in the Slovak Republic shows a higher fluctuation due to the sensitivity of sector LULUCF to meteorological conditions and weather extremes.

[1] *GHG emissions are expressed in molecular weight units (Gg CO_2, not Gg C). According to the currently valid convention the emission reduction expressed in CO_2 equivalent should be reported, Climate Change 1995, The Science of Climate Change GWP100: CO_2=1, CH_4=21, N_2O=310, F-gases=140-23 900.*

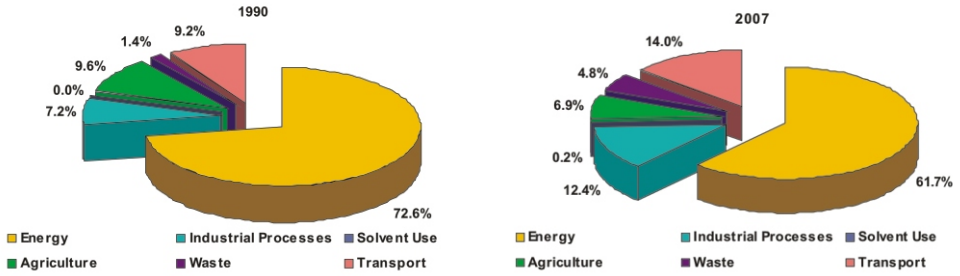
Table 3.1: Aggregated GHG emissions in CO_2 equivalents (Tg) in the Slovak Republic.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Net CO_2	59,56	52,14	47,91	43,53	42,25	41,34	40,07	40,01	40,16	39,72	37,92	36,52	34,80	36,59	36,86	39,86	36,93	34,92
CO_2	61,96	55,65	52,06	47,82	45,56	44,04	42,50	41,42	42,10	41,35	40,32	41,74	40,05	41,42	41,11	40,74	39,98	38,14
CH_4	4,80	4,65	4,39	4,10	4,08	4,26	4,22	4,25	4,51	4,71	4,44	4,48	5,10	4,86	4,84	4,60	4,65	4,55
N_2O	6,24	5,04	4,22	3,58	3,92	4,16	4,29	4,18	3,78	3,33	3,59	3,77	3,73	3,76	3,87	3,85	4,08	4,01
HFCs	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,02	0,04	0,06	0,04	0,07	0,08	0,08	0,10	0,13	0,15	0,17	0,20	0,23
PFCs	0,27	0,27	0,25	0,16	0,13	0,11	0,03	0,03	0,03	0,01	0,01	0,02	0,01	0,02	0,02	0,02	0,04	0,02
SF_6	0,00	0,00	0,00	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,02	0,02	0,02	0,02	0,02
Total with net CO_2	**70,87**	**62,10**	**56,77**	**51,37**	**50,39**	**49,91**	**48,66**	**48,55**	**48,53**	**47,85**	**46,04**	**44,88**	**43,76**	**45,38**	**45,75**	**48,53**	**45,91**	**43,75**
Total	**73,26**	**65,60**	**60,91**	**55,64**	**53,70**	**52,59**	**51,07**	**49,94**	**50,46**	**49,47**	**48,42**	**50,09**	**48,99**	**50,19**	**49,98**	**49,37**	**48,94**	**46,95**

Net CO_2 = emissions with sinks from LULUCF. NO = not occurring, NA = not applicable.

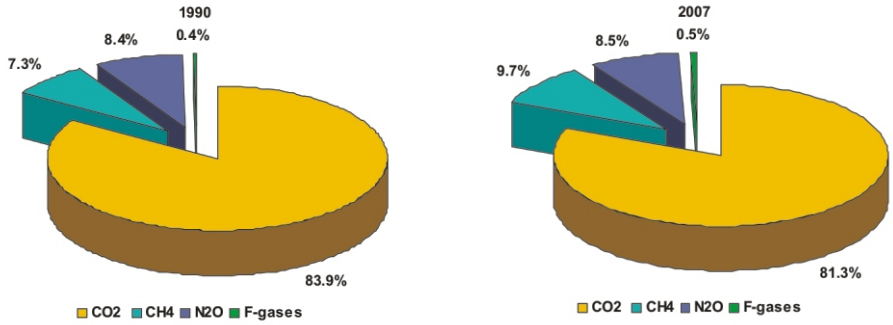
The energy sector with its share of 76% in 2007 is a main contributor to the overall GHG emissions. Within this sector, transport with 14% share contributes significantly to the GHG emissions and it shows the most increasing trend. The share of transport in total emissions has increased by 5% since 1990. In addition to fuel combustion in stationary sources of pollution, also the pollution from small sources of residential heating systems and fugitive methane emissions from transport, processing and distribution of oil and natural gas contribute significantly to the total GHG emissions. Sector industrial processes was the second important sector in 2007 with its 12% share in total GHG emissions, producing mainly technological emissions from processing mineral products, chemical production and steel and iron production. The efficient reduction of emissions from technological processes is very expensive, therefore the emissions have remained on the same level since the reference year and they have been influenced only by the size of production in industrial processes. In 2007, the share of sector agriculture in total GHG emissions was approx. 8% and the trend of emissions has remained relatively stable since 1999. The most significant reduction of emissions from agriculture was achieved at the beginning of nineties and it was caused by the reduction of breeding livestock and the restricted use of fertilizers. Sector waste contributed by more than 5% to total GHG emissions. Introduction of more exact methodology for the evaluation of methane emissions from solid waste disposal on sites resulted in continual increase of emissions by more than 110% compared to the base year 1990. Similar trend is expected to remain in the future, although only with slight increase in emissions. The amount of emissions from landfills depends, to a large extent, on the methodology adopted to evaluate landfills and on the implementation of energy recovery of landfill gases by landfill operators. Sector solvents use is the least significant sector with respects to the generation of GHG emissions in the Slovak Republic. Its contribution to the total GHG emissions was less than 1%. The shares of individual sectors in total GHG emissions have not been changed significantly compared to the base year 1990. The increase in transport and the decreased share of stationary sources of pollution in sector energy are noticeable.

Figure 3.2: The share of individual sectors in total GHG emissions in 1990 and 2007.



Carbon dioxide (CO_2) is definitely the most important GHG given its 81% share in total GHG emissions in the Slovak Republic. Methane is the second most important GHG and its share in CO_2 equivalents is 9.7% in total emissions. The share of N_2O in total emissions is 8.5%. F-gases contribute to the overall emissions only by 0.6%, but their emissions have been increasing every year. The shares of individual gasses have not changed significantly compared to the reference year 1990.

Figure 3.3: The shares of individual gasses in total GHG emissions in 1990 and 2007.



Detailed information on GHG emissions, trends and reductions are published in the National Inventory Report of the Slovak Republic of 2009, which is available at www.ghg-inventory.gov.sk and in Annex to this Communication.

3.2 DESCRIPTIVE SUMMARY

Based on the national emission inventory submitted to the Secretariat of UNFCCC on 15th April 2009, it is clear that the emissions of the Slovak Republic without including sinks of sector LULUCF were by 35.9% lower compared to 1990. This reduction has can be attributed to the following factors:

- *Higher share of services in the GDP generation.*
- *Higher share of gaseous fuels on primary energy consumption.*
- *Structural changes in industry.*
- *Decrease in energy demand in certain energy intensive industry (except for metallurgy).*
- *Effect of the legislation adopted on air protection with indirect impactd on the GHG emissions.*

Comparison of the trend of GDP growth and the trend of aggregated GHG emissions shows that the Slovak Republic is one of few countries, where the GDP growth does not copy the trend of GHG emissions, which has been stable since 1997. It shows that the decoupling is feasible. But in international comparison, the indicator of GHG emissions per inhabitant still remains high.

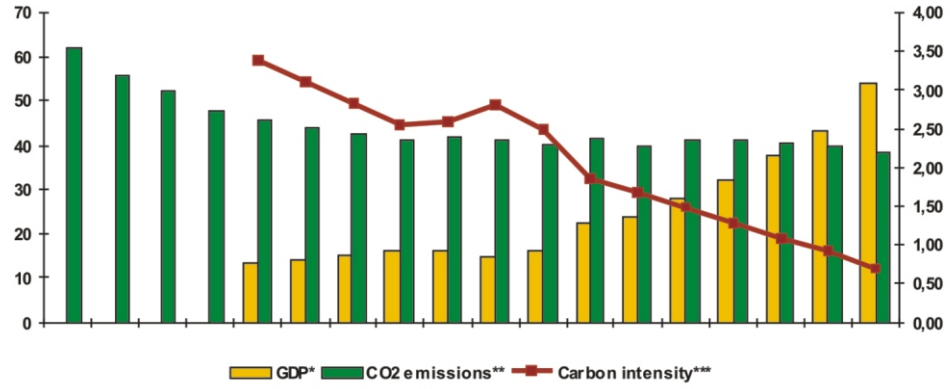
Carbon intensity defined as CO_2 emissions per GDP is a similar indicator. The carbon intensity has been reduced four times since 1994. This trend was maintained also in the period of high economic growth and it pointed out on the decreased share of high energy intensity industry in GDP generation and increased share of services.

Table 3.2: The carbon intensity per GDP in absolute values in the Slovak Republic in the period 1990 – 2007.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GDP					13,50	14,20	15,10	16,20	16,20	14,80	16,22	22,44	23,69	28,00	32,10	37,60	43,30	54,24
CO_2 emissions**	61,96	55,65	52,06	47,82	45,56	44,04	42,50	41,42	42.10	41,35	40,32	41,74	40,05	41,42	41,11	40,74	39,98	38,14
carbon intensity***					3,38	3,10	2,81	2,56	2,60	2,79	2,49	1,86	1,69	1,48	1,28	1,08	0,92	0,70

mld. Euro in 2006, **CO_2 (Tg) without LULUCF, *CO_2/mld. Euro.*

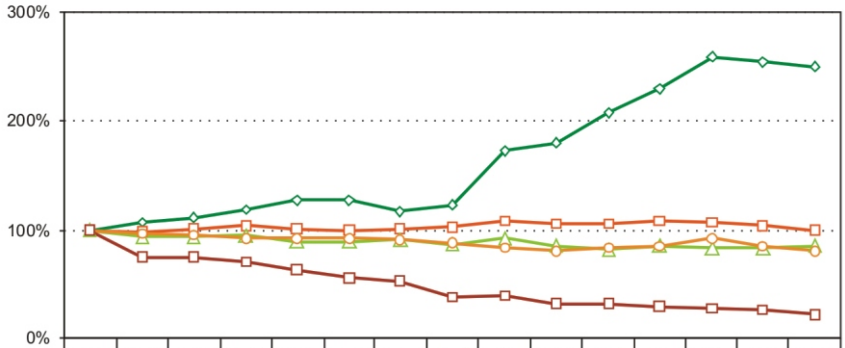
Figure 3.4: The comparison of CO_2 emissions trend with GDP growth in the period 1990 – 2007.



y axis left = emissions in Tg, y axis right = GDP in mld. Euro.

For comparison, further historical indicators, which define the interconnection between macro-economic, energy characteristics and emissions need to be presented.

Figure 3.5: The historical development of basic indicators in indexes (1993=100%) in the period 1990 – 2007.



	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GDP	100%	106%	112%	119%	127%	127%	116%	123%	173%	180%	207%	229%	259%	254%	251%
TPES*	100%	99%	102%	103%	101%	100%	101%	102%	108%	105%	106%	108%	106%	103%	100%
FEU*	100%	93%	94%	95%	89%	89%	90%	87%	92%	85%	81%	85%	84%	84%	85%
CO2	100%	97%	95%	92%	92%	92%	91%	87%	84%	80%	84%	85%	92%	85%	80%
SO2	100%	75%	75%	70%	62%	56%	53%	39%	40%	31%	32%	30%	27%	27%	21%

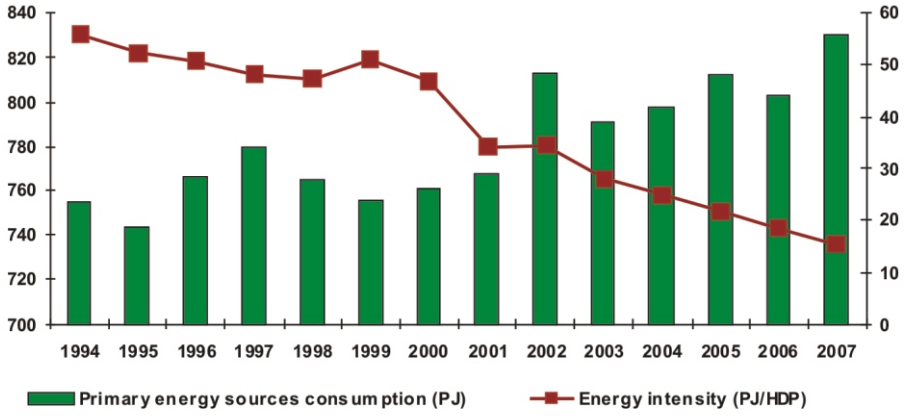
*GDP in constant prices 2000, *TPES = total primary energy supply, FEU = final energy use, CO_2 = emissions of CO_2, SO_2 = emissions of SO_2.*

Structural changes in sector energy and the implementation of economic instruments have played an important role in achieving the current status, when the trend of GHG emissions does not copy the fast GDP growth. In this context, the most important measure seems to be the adoption of the national legislation on air quality, which was approved in 1999 and it has initiated the positive trend in the reduction of the emissions of basic air pollutants and indirectly also GHG emissions. At the same time, the consumption of primary energy resources as well as total energy has decreased.

3.2.1 Sector energy – category energy industry

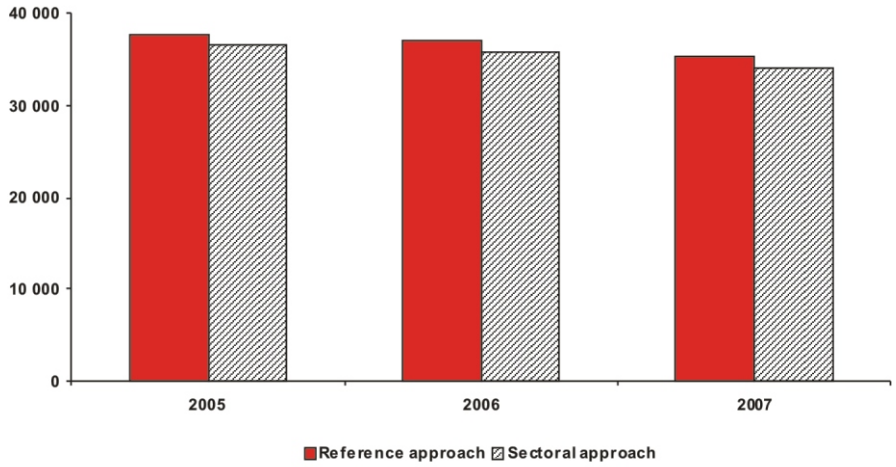
According to the statistical information from the Ministry of Economy, energy industry reached 2.7% share in the total GDP of the Slovak Republic in 2007. Energy intensity is still 1.9 times higher than the average in the EU-15, in spite of its continual decrease. Reason for that is the adversely high share of energy intensive industry on GDP. This trend can be presented also by the indicator comparing the primary consumption of energy resources (which is approximately at the same level as used to be in 1994) with the GDP growth. Energy intensity is expressed in PJ/Bilion. Euro.

Figure 3.6: The trend of energy intensity (right y axis) in the period 1994 – 2007 (after formation of the Slovak Republic).



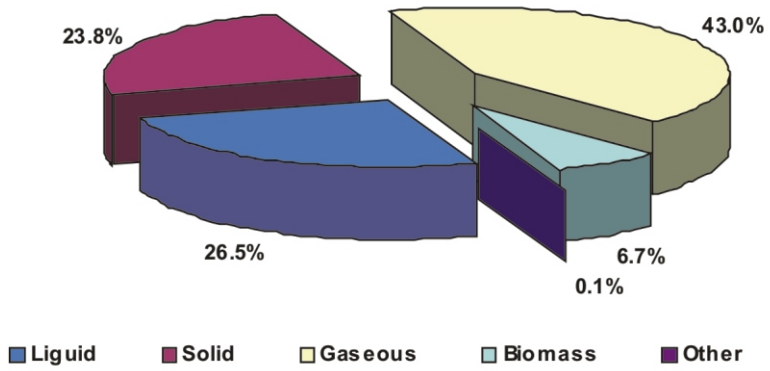
The balance of GHG emissions from fuel combustion in stationary sources of air pollution is assessed according to IPCC methodology by two independent methods. Reference approach is based on energy balance published by the Statistical Office of the Slovak Republic (ŠÚ SR) and it assesses the emissions top down. The reference approach is based on the actual consumption of all kinds of fuels (primary, secondary and biomass) according to the Catalogue of fuels covered by the ŠÚ SR. The reference approach provides comparisons for more a precise sectoral approach, which is based on the National Emission Information System (NEIS). NEIS is a database of all stationary sources of air pollution. The methodology based on sectoral approach is fully independent on the reference approach of emission balancing and provides more comprehensive information on stationary sources of air pollution. Therefore, it was treated as a more precise method and the results of the balance are included in the national emission account. By comparing the reference and sectoral approaches, 97% conformity can be achieved, while at the same time, the uncertainty rate of the balance can be determined. The differences are likely caused by the accuracy of statistical methods used by the ŠÚ SR and by averaging certain parameters and fuel characteristics.

Figure 3.7: The comparison of reference and sectoral approach in CO_2 emissions (Gg) in the period 2005 – 2007, difference is under 3%.



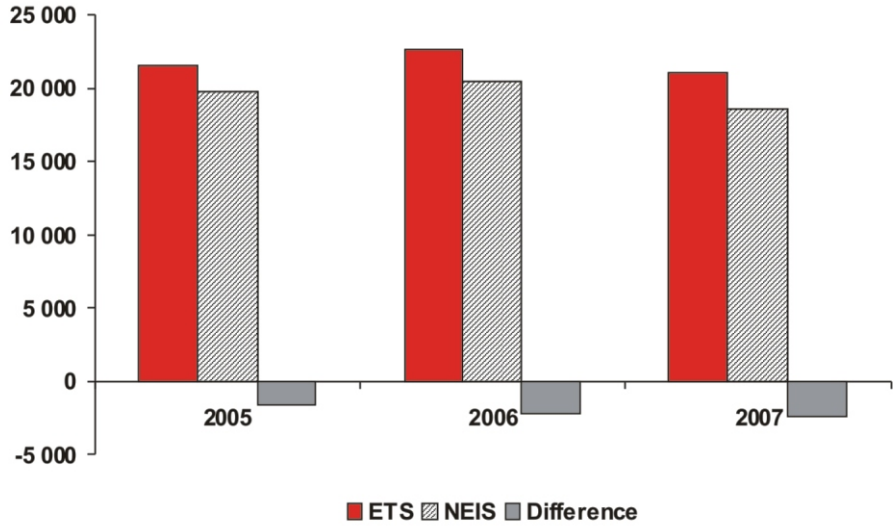
Gaseous and liquid fuels, as well as biomass, have been increasingly utilised in the recent years. Combustion of municipal and industrial waste is being used as a source of energy and heat production; therefore the emissions from waste combustion are reported in the energy sector.

Figure 3.8: The share of basic fuels according to the sectoral approach in 2007.



Since 2005, the energy balances from the most significant sources of air pollution have been included in the National Allocation Plan and monitored within Directive 2003/87/EC on trading with GHG emission allowances, which has been transposed into Act 527/2004 Coll. on emission trading scheme (ETS). In order to comply with the quality management criteria and data harmonisation between ETS and the national emission balance on sectoral level, emission factors of the most important fuels have been re-evaluated and new methods at the level of source operators have been implemented. By comparison and correct allocation of CO_2 emissions in sector energy, one can be concluded that the balance is in a good compliance with the emissions verified within ETS. The comparison of the years 2005 – 2007 was carried out and the results are shown in figure 3.9. The trend of increasing differences in emissions from 0.5% in 2005 to almost 6% in 2007 is evident and significant. It can be explained by non-compatibility of source allocation, different definitions of technological and energy emissions according to 572/2004 Coll. and allocation of polluting sources according to IPCC methodology.

Figure 3.9: The comparison of CO_2 emissions (in Gg) allocated in ETS and estimated by sectoral approach from dbase NEIS.



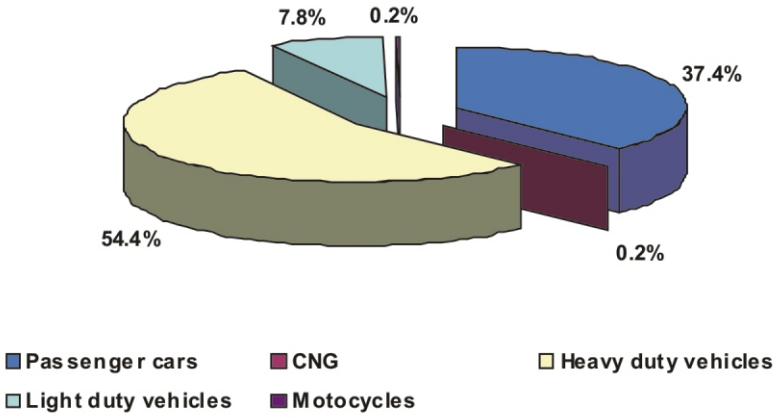
3.2.2 Sector energy – category transport

Transport is a significant source of emissions in sector energy, with 14% share in total GHG emissions in the Slovak Republic. The proportion of transport is growing each year and the adopted policies and measures have no positive impact on increasing trend of emissions from transport. Emission balances in road transport are modelled according to method COPERT IV. Due to harmonization of emission factors for N_2O emissions, time series in road transport have been recalculated since 2000. GHG emissions from non-road transport are balanced by the use of EMEP/EEA 2008 methodology according to individual transport types (air, water and

rail). The share of rail and water transports is decreasing from year to year, while the share of air transport is increasing rapidly, especially due to the increasing activity of low cost airlines.

In 2007, total aggregated GHG emissions from transport achieved 6,917.36 Gg CO_2 equivalents, what means an increase by 17% in comparison to 2006. Compared to the reference year 1990 the emissions increased by 33%. The emissions from road transport have the largest share in GHG emissions from transport. In 2007 the emissions were 6,580 Gg CO_2, what means the increase by 14%. Compared to the reference year 1990 the emissions increased by 43%. A major share of the GHG emissions is generated by the passenger cars and heavy duty vehicles (transit). In recent years, the shift from bus and rail transport to the individual transport has occurred. GHG emissions from international aviation are increasing very rapidly and in 2007, they increased by 73% relative to the 1990.

Figure 3.10: The share of different categories on emissions in road transport in 2007.



3.2.3 Sector energy – category fugitive emissions

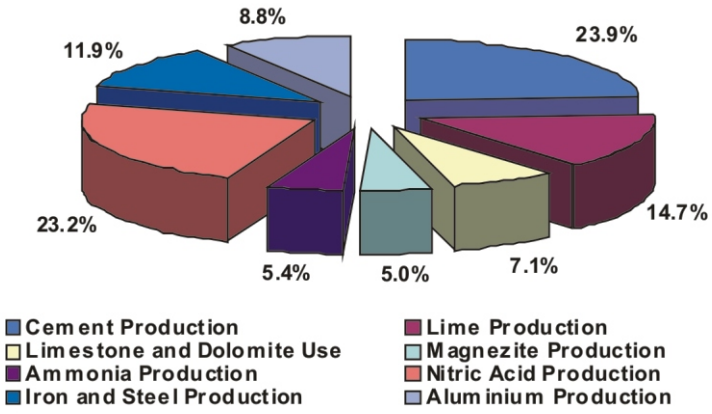
Fugitive methane emissions from the extraction and distribution of fossil fuels are important as the Slovak Republic is an important transit country regarding the transport of oil and natural gas from the former Soviet Union countries to Europe. Raw materials are transported through high pressure pipelines and distribution network and they are pumped in pipeline compressors. In 2007, the fugitive emissions from all these activities were 35.45 Gg CH_4 and 0.15 Gg CO_2. While the extraction of oil and natural gas is less significant for the Slovak Republic, brown coal is mined in several underground mines in the Slovak Republic. In 2007, total methane emissions from brown coal mining were 13.52 Gg CH_4. Emission factors for the underground mining of brown coal have been taken from IEA – CIAB methodology.

3.2.4 Sector industrial processes

Sector of industrial processes includes all GHG emissions generated from technological processes producing raw materials and products. Within the preparation of the GHG emission balance in the Slovak Republic, consistent emphasis is put on the analysis of individual technological processes and distinction between the emissions from fuel combustion in heat and energy production and the emissions from technological processes and production. Most important emission sources are balanced separately, emission and oxidation factors are re-evaluated, as well as other parameters entering the balancing equations and the results are compared with the verified emissions in the Slovak National Registry for CO_2 emissions.

In 2007, total aggregated GHG emissions from industrial processes were 5,825.32 Gg CO_2 equivalents and they slightly decreased compared to the previous year. Compared to the reference year 1990 the emissions increased by 10.72%. Most important source of CO_2 emissions are cement production (24%), lime production (15%) and limestone and dolomite use (7%). CO_2 Emissions from iron and steel production are partially allocated in sector energy (category 1.A.2a) and consequently, they do not form so significant share in total emissions in this sector as could be expected (12%). The most important source of N_2O emissions is nitric acid production, which contributes, given in CO_2 equivalents, to total emissions in the sector by 23%.

Figure 3.11: The share of individual categories on emissions in sector industrial processes in 2007.



3.2.5 Sector industrial processes – F-gases

Emissions of F-gases are generated from the use of filling in refrigerants, fire extinguishers, foam blowers, aerosols, insulating gases and aluminium production. CF_4 and C_2F_6 emissions are generated from aluminium production and they are balanced according to the following equation:

$$EF(PFC) = const \cdot \frac{x}{\eta} \cdot AE \cdot AED$$

where

$const$ is the constant equal to emission factor PFC;

x molar ratio of PFC fraction;

η is actual efficiency;

AE is a number of anode effects per day;

AED is equal to the duration of anode effect in minutes.

According to the information received directly from the operator, in 2007 the actual efficiency of aluminium production was 94%, the number of anode effects was 0.053 a day and their average duration 2.732 minutes. These figures imply that emission factor CF_4 was 0.0209 kg/t of produced aluminium and emission factor C_2F_6 was 0.00209 kg/t of produced aluminium. In 2007, total production of aluminium in the Slovak Republic was 160,464 tonnes of aluminium.

Actual F-gases emissions of HCFs group in the Slovak Republic reached 227 Gg in CO_2 equivalents and they are increasing rapidly due to their use as substitutes for PFCs substances. In comparison to 2006 they have increased by 14% and compared to the base year 1995 more than ten times. In 2007, potential emissions of F-gases from the HCFs group reached 540 Gg CO_2 equivalents. The ratio of potential and actual emissions was 2.38 in 2007.

In 2007, actual F-gases emissions of PFCs group decreased to 25 Gg CO_2 equivalents in the Slovak Republic. PFCs emissions are decreasing continually due to their replacement by HFCs gases. In 2007, the emissions decreased by more than four times compared to the reference year 1995.

In 2007, actual SF_6 emissions reached 17 Gg CO_2 equivalents and they are slightly increasing. They have increased by 100% compared to the reference year 1995.

3.2.6 Sector solvent and other products use

Fundamental emission inventory is based on the balance of non-methane volatile organic compounds (NMVOC) according to EMEP/EEA 2008 methodology. Emissions are recalculated according to stochiometric coefficients to CO_2 emissions. Total GHG emissions recalculated to CO_2 equivalents reached 89 Gg CO_2 equivalents, in particular due to the N_2O emissions, while they increased by four times compared to the base year 1990. Emissions of N_2O are being generated in particular in food industry and from the N_2O use of anaesthetics.

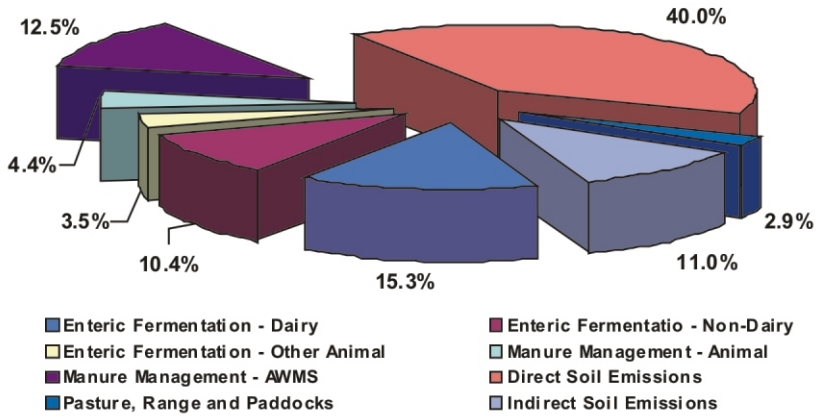
3.2.7 Sector agriculture

Sector agriculture is the main source of methane and N_2O emissions in the GHG emissions balance in the Slovak Republic. The emission balance is compiled annually on the basis of sectoral statistics and in recent years on the basis of a new regionalisation of agricultural areas of the Slovak Republic. The Ministry of Agriculture of the Slovak Republic issued annual statistics "Green Report", part agriculture and food industry on a yearly basis.

GHG emissions in 2007 reached 3,245 Gg CO_2 equivalents and a trend of mild decrease has been recorded since the base year. It is mainly related to the reduction of livestock number, in particular cattle, and the restricted use of fertilizers. In recent years, the good emission balances have been achieved also owing to the introduction of new procedures in cattle stabling and animal waste management (waste recovery by incineration and bio-gas utilisation).

The largest share of methane emissions is generated by enteric fermentation, which produced in 2007 45.07 Gg of methane, in particular in category cattle (dairy cows 15.3% and other cattle 10.4%). Regarding N_2O emissions, direct emissions from fertilization of agricultural soils are the most important sources, and in 2007 they produced 5.64 Gg N_2O (40%).

Figure 3.12: The share of individual categories on emissions in sector agriculture in 2007.



AWMS = Animal Waste Management Systems

3.2.8 Sector LULUCF

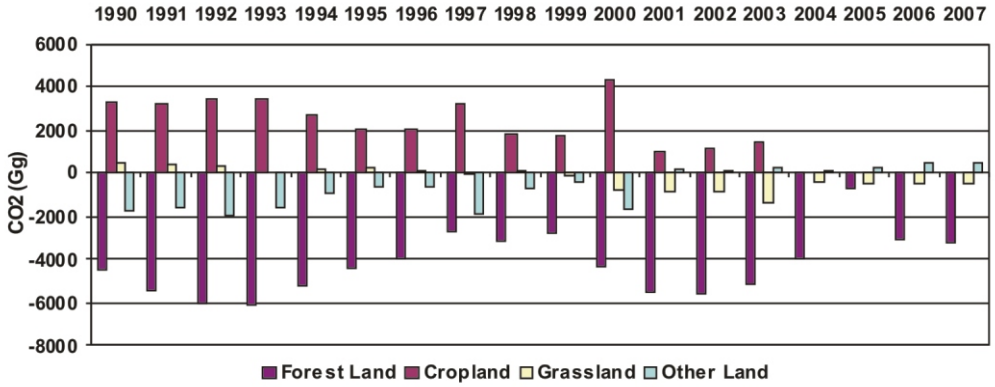
The area of forest land in the Slovak Republic covers 40% of the territory and wood harvesting is historically an important economic activity. Since 1990, sinks from sector LULUCF have remained at the level of 8-10% of total GHG emissions. Historically stable trend was disrupted in 2004 by a wind calamity in the High Tatras, which resulted in increased harvest of wood damaged by the calamity and pests and consequently in the decrease in total sinks to the half of earlier volumes.

Total net emissions/sinks of CO_2 were –3,219 Gg in 2007, where forest management remains the most important category. CO_2 Emissions in sector LULUCF are balanced according to IPCC methodology according to the COP decision 13/CP.9[2]. Emissions balance from category wetlands and settlements have not been estimated due to a lack of reliable data and the data are included in category other land.

In addition to CO_2 emissions and sinks, also methane and N_2O emissions from forest fires are monitored. In 2007 these emissions were 0.91 Gg CH_4 and 0.0125 Gg N_2O.

[2] *IPCC Good Practice Guidance for LULUCF, 2003*

Figure 3.13: Emission/removals balance in the sector LULUCF in the period 1990 – 2007.



3.2.9 Sector waste

Several significant changes and re-evaluations of the applied methods have been carried out in sector waste, followed by recalculations in all categories of waste treatment. Methane emissions from municipal waste disposal sites (SWDS) have the largest share in total emissions from the sector. Waste balance methodology has been revised and tier 2 approach FOD (First Order Decay) methodology[3] has been used for the recalculations of the time series since 1960. The trend of methane emissions has been increasing depending on the adopted values for parameters of municipal waste landfills. A more detailed description of the methodology as well as with the Monte Carlo uncertainty analysis are described in the references.[4,5]

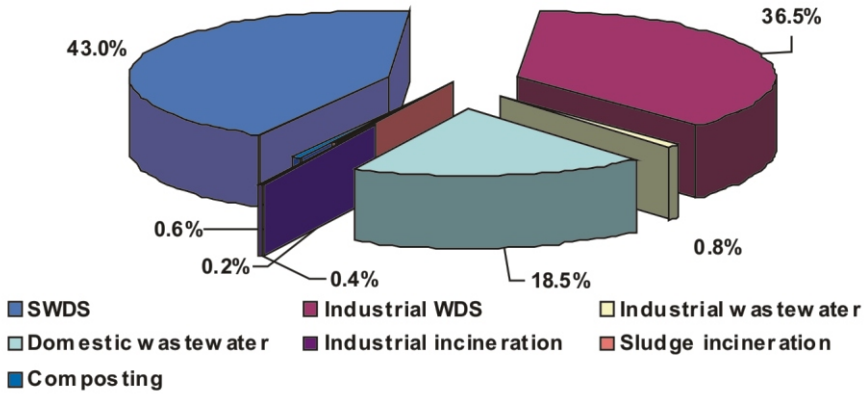
The disaggregation of emissions from municipal waste incineration into two groups, i.e. waste incineration for and without energy utilisation, was another important change with respect to the quality improvement of the emission inventory. The emissions from waste incineration with energy utilisation were reported under energy sector, sub-category 1.A.1.a (other fuels). The emissions from waste incineration without energy utilisation are reported under sector waste.

Emissions from waste composting are a new category in sector waste, the share of which is supposed to increase due to adopted policies and measures.

Less important changes of parameters and methodology have occurred in categories domestic wastewater treatment and industrial wastewater treatment.

In 2007, total GHG emissions in sector waste reached 2,269 Gg in CO_2 equivalents, and they increased by more 100% in comparison to 1990. The trend of emissions is slightly increasing, mainly due to increased methane emissions from municipal waste landfills, which represent 43% of total emissions generated in the sector.

Figure 3.14: The share of GHG emissions in individual categories of sector waste in 2007.



[3] *IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories, 2000.*

[4] *Szemesová J., Gera M. Uncertainty Analysis for Estimation of Landfill Methane Emissions Contribution to Geophysics and Geodesy, SAS, Vol. 37, No 3, , 251 - 265. 2007.*

[5] *Szemesová J., M. Gera Emission estimation of solid waste disposal sites according to the uncertainty analysis methodology, Bioclimatology and Natural Hazards, ISBN 978-80-228-17-60.*

3.2.10 Indirect GHG emissions

The production of electricity and heat is the main source of indirect GHG (SO_2, NO_x and CO) emissions. The contribution of transport is growing continually and it influences negatively all emissions of pollutants.

Emissions of NO_x, CO and SO_2 were taken from the national inventory of basic pollutants based on the database NEIS. The categorization of emissions sources in NEIS is implied by the national air protection legislation and it does not comply with the requirements of CRF categorisation. Therefore it is not possible to provide the information on emissions and emission factors in required disaggregation by standard tables. The electricity and heat production is the main source of NO_x, CO and SO_2 emissions and the transport contributes with an increasing share to the NO_x, CO emissions. Metallurgy is an important source of CO emissions.

NMVOC emissions are regularly estimated within the National Programme to Reduce Non-Methane Volatile Organic Compounds. The base year is 1990 and updates were carried out for the following years: 1993, 1996 –1998 and 2006. The use of solvents, transport, refinery and storage of oil and the transport of gasoline and diesel oil belong to the largest sources of the emissions.

Table 3.3: The total anthropogenic emissions of NO_x, CO, NM VOC and SO_2 (Gg) in the period 1990 – 2007.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO	**511,6**	**487,1**	**444,6**	**455,9**	**431,0**	**419,6**	**363,8**	**363,5**	**346,1**	**335,5**	**312,9**	**315,1**	**292,3**	**308,1**	**309,8**	**299,4**	**289,8**	**276,7**
Stationary	351,3	340,0	300,0	301,0	272,6	258,9	208,2	205,6	187,6	185,4	185,2	175,6	165,2	184,2	189,6	181,4	193,5	183,3
Transport	154,2	142,1	140,6	150,7	154,8	156,7	151,1	153,2	153,9	144,7	121,9	133,6	121,3	117,5	113,1	108,7	88,4	85,4
Other*	6,1	5,0	4,0	4,2	3,6	4,0	4,5	4,7	4,6	5,4	5,8	5,9	5,8	6,4	7,1	9,4	7,9	7,9
NO_x	**221,9**	**201,1**	**188,6**	**180,3**	**170,0**	**177,9**	**134,9**	**127,5**	**133,1**	**121,1**	**109,1**	**108,7**	**101,1**	**98,1**	**98,0**	**98,0**	**86,8**	**83,3**
Stationary	164,8	153,4	144,7	137,7	126,3	132,3	89,7	82,3	86,6	77,6	70,5	67,8	59,9	58,6	56,7	55,7	52,1	46,8
Transport	56,8	47,4	43,7	42,4	43,5	45,4	45,0	44,9	46,2	43,2	38,3	40,6	40,9	39,1	40,9	41,8	33,8	35,7
Other*	0,3	0,3	0,2	0,2	0,2	0,2	0,2	0,3	0,3	0,3	0,3	0,3	0,3	0,4	0,4	0,5	1,0	0,7
NM VOC	**141,4**	**NE**	**NE**	**107,9**	**NE**	**101,1**	**97,2**	**91,9**	**88,4**	**82,5**	**76,0**	**79,7**	**77,2**	**81,9**	**82,8**	**79,5**	**75,1**	**74,0**
Energy	14,0	NE	NE	12,6	NE	10,7	11,1	9,5	9,6	9,0	8,7	9,3	7,9	8,4	9,9	12,9	12,2	12,1
Industry	8,8	NE	NE	5,9	NE	2,8	2,7	2,7	1,6	1,5	1,4	1,3	1,4	1,7	1,7	1,6	1,6	1,5
Transport	33,6	NE	NE	30,9	NE	33,0	31,8	32,0	31,9	29,1	25,0	26,6	23,8	26,0	24,7	18,7	15,4	16,0
Crude oil	27,1	NE	NE	21,8	NE	16,8	17,2	17,8	14,5	13,8	13,3	13,2	12,4	12,9	13,1	11,9	10,5	10,1
Solvent use	52,9	NE	NE	35,0	NE	37,1	33,8	29,3	30,2	28,4	27,0	28,7	31,0	32,3	32,8	33,6	34,6	33,6
Agriculture	0,7	NE	NE	0,4	NE	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4
Waste	4,5	NE	NE	1,3	NE	0,3	0,1	0,2	0,2	0,2	0,2	0,2	0,3	0,2	0,2	0,2	0,2	0,2
SO_2	**526,1**	**445,5**	**389,6**	**328,2**	**245,2**	**246,3**	**230,6**	**204,7**	**184,1**	**173,3**	**127,0**	**131,2**	**103,3**	**106,1**	**96,9**	**89,0**	**87,8**	**70,6**
Stationary	522,7	442,8	387,2	326,0	242,9	243,8	228,1	202,1	181,4	172,2	126,1	130,2	102,5	105,3	96,0	88,8	87,5	70,3
Transport	3,4	2,7	2,4	2,2	2,3	2,5	2,5	2,6	2,7	1,1	0,9	1,0	0,8	0,8	0,9	0,2	0,3	0,3

**Biomass burning and forest fires, NE = not estimated.*

3.3 NATIONAL SYSTEM IN ACCORDANCE WITH ARTICLE 5.1, OF THE KYOTO PROTOCOL

The obligation of the Slovak Republic to establish and develop a national inventory system (NIS) in compliance with actual requirements for regular monitoring GHG emissions is stipulated in the United Nations Framework Convention on Climate Change (the Convention) and the Kyoto Protocol to this Convention (Article 5, paragraph 1).

3.3.1 Contact information

The National Inventory System was formally established by the Decision of the Minister of Environment of the Slovak Republic of 1st January 2007 and the report was published in the Official Journal of the MŽP SR.[6] The Ministry of Environment of the Slovak Republic, the Department of Climate Change and Economic Instruments is a National Focal Point for compliance with the commitments under the UN Framework Convention on Climate Change and the Kyoto Protocol (KP). The Slovak Hydrometeorological Institute, the Department of Emissions is a Single National

[6] *Vestnik (Official Journal of the Ministry of Environment, XV, 3, 2007, page 19 (http://www.enviro.gov.sk/servlets/files/16715).*

Change and the Kyoto Protocol (KP). The Slovak Hydrometeorological Institute, the Department of Emissions[7] is a Single National Entity in charge of the coordination of the National Inventory System of the Slovak Republic.

Table 3.4: Contact information about NFP and SNE for the National Inventory System of the Slovak Republic.

Country:	Slovak Republic
Date of NIS establishment:	15 January, 2010
Legal guarant:	Ministry of the Environment Department of Climate Change and Economic Instruments (National Focal Point)
Address:	Namestie L. Stura 1 812 35 Bratislava 1, Slovak Republic
Contact person:	Ing. Helena Princova, PhD.
Telephone No.:	00421-905-976286
E-mail:	helena.princova@enviro.gov.sk
Webpage:	www.enviro.gov.sk

Single National Entity:	Slovak Hydrometeorological Institute Department of Emissions (National Inventory Point)
Address:	Jeseniova 17 833 15 Bratislava, Slovak Republic
Contact person:	Ing. Janka Szemesova, PhD.
Telephone No.:	00421-905-693623
E-mail:	janka.szemesova@shmu.sk
Webpage:	www.ghg-inventory.gov.sk

3.3.2 Institutional arrangement

The Ministry of Environment of the Slovak Republic (MŽP SR) is the institution responsible for the environmental policy of the Slovak Republic, including the policies and measures on climate change and air protection. MŽP SR, the Department of Climate Change and Economic Instruments is a National Focal Point for compliance with commitments under the Convention and the Kyoto Protocol. MŽP SR cooperates with other interested ministries in developing a legislative proposals and measures with aim to mitigate climate change impacts and implement mitigation measures.

The Slovak Hydrometeorological Institute (SHMÚ) was delegated by the MŽP SR as an authorised organization to carry out activities related to air quality monitoring and to estimate GHG emissions and other pollutants. The Department of Emissions of the SHMÚ is in charge of the coordinator of the National Inventory System (Single National Entity - SNE) according to Article 5.1 of the KP. The SHMÚ has signed long-term contracts with nominated experts from various sectors to fulfill the commitments under the UNFCCC and the KP. The sectoral experts are fully responsible for their particular inventories and they are coordinated by the SNE SHMÚ.

[7] *www.shmu.sk*.

Table 3.5: Contact information about sectoral experts and organisations involved in NIS of the SR.

Sector/Activity	Organisation/Name:	Address:	Phone No.:	E-mail
Coordinator	SHMÚ, Ing. Janka Szemesová, PhD.	Jeséniova 17, 833 15 Bratislava	00421 905 693 623	janka.szemesova@shmu.sk
Quality Manager	SHMÚ, RNDr. Martina Jusková	Jeséniova 17, 833 15 Bratislava	00421 2 59 415 396	martina.juskova@shmu.sk
Projections	Ecosys Slovakia, Ing. Jiří Balajka DrSc.	Šášovská 12, 851 06 Bratislava	00421 905 734 924	ecosys@orangemail.sk
Projections	SHMÚ, Ing. Stanislava Morová	Jeséniova 17, 833 15 Bratislava	00421 48 4729 682	stanislava.morova@shmu.sk
Energy	Profing, s.r.o., Ing. Ján Judák CSc.	Miekárenská 10, 824 92 Bratislava	00421 905 734 925	judak@profing.eu
Transport	SHMÚ, Mgr. Michaela Kollárová	Jeséniova 17, 833 15 Bratislava	00421 2 59 415 463	michaela.kollarova@shmu.sk
Transport	Centrum dopravného výskumu, Mgr. Jiří Dufek, konzultant	Lisenská 33a, 636 00 Brno	00420 549 429 305	jiri.dufek@cdv.cz
Industry	Fakulta chemickej-potravinárskej technológie, Doc. Ing. Vladimír Danielik	Radlinského 9, 312 37 Bratislava	00421 2 593 25 523	vladimir.danielik@stuba.sk
F-gases	Zväz chladiarenskej a klimatizačnej techniky, Doc. Ing. Peter Tomlein CSc.	Mliečňanská 36, 931 03 Šamorín	00421 2 456 46 971-3	zvazchkt@isternet.sk
Agriculture	Slovenská poľnohospodárska univerzita, Doc. RNDr. Bernard Šiška PhD.	Trieda A. Hlinku 2, 949 76 Nitra	00421 37 641 52 44	bernard.siska@uniang.sk
LULUCF	Národné lesnícke centrum, Ing. Tibor Priwitzer PhD.	T.G. Masaryka 8041, 960 53 Zvolen	00421 45 531 42 03	priwitzer@nlcsk.org
Waste	Ing. Juraj Farkaš	Sasinková 7, 960 21 Svätý Jur	00421 903 419 229	jfarkas@integrated-skills.com
Uncertainty	Fakulta matematiky, fyziky a informatiky, RNDr. Martin Gera PhD.	Mlynská dolina, 842 48 Bratislava	00421 2 602 95 863	mgera@fmph.uniba.sk

Eight regional and 46 district environmental offices play important roles in the National Inventory System, too, within the competencies under Act 478/2002 Coll. on air. The regional and district offices are obliged to keep registrations of large, medium and small stationary sources of air pollution in database NEIS (the National Emission Information System), to issue decisions regarding permits to emit pollutants and to charge for air pollution. Information from the database NEIS are gathered at the Department of Emissions of the SHMÚ, where data on all stationary sources of air pollution from the whole Slovak Republic are verified, archived and used for reporting.

Company Spirit Informačné systémy, a.s., is responsible for the administration of the database NEIS, the official webpage of the National Inventory System (www.ghg-inventory.gov.sk) and provision of support for information technologies for NIS under the long-term contract.

3.3.3 Process of inventory preparation

A comprehensive description of the inventory preparation procedure for GHG emissions is provided described in methodologies for individual sectors. The methodologies are updated annually within the QA/QC plan and they are archived after formal approval at the web page of the National Inventory System www.ghg-inventory.gov.sk.

The National Inventory System for GHG emissions is decentralised according to the definition of Article 5.1 of the KP. Individual sectors are fully under responsibilities of sectoral experts, who are authorised to evaluate the emission inventory within the delegated sectors.

The compilation of the emission inventory starts with the collection of activity data, where the nominated sectoral experts cooperate with the Statistical Office of the Slovak Republic, major operators of air pollution sources, relevant ministries and their organizations, expert and professional associations. The database NEIS is the most important source of emission data on fuels and other characteristics of stationary air pollution sources. NEIS is operated by the Department of Emissions of the SHMÚ. Collected input data are compared with international statistics (Eurostat, IAE, FAO and others). In some cases, the collected input data are compared with the results from models (e.g. in road transport it is model COPERT).

Since 2005, the reports of participants in the scheme for GHG emission allowance trading integrated within the National Allocation Plan have been the most important sources of input data for the emission inventory. Sectoral experts for energy and industry have access to the reports of operators and auditors. Data received directly from

measurements in operational units are harmonised with data entering the emission balance. Verified emissions are compared with results of calculations and then harmonized.

Based upon the approved plan for improving emission inventories within the quality management, i.e. quality assurance and quality control (QA/QC), further improvements of emission factors and methodologies are planed annually. The majority of key sources are balanced according to higher methodologies (tier 2 and higher). Also used emission factors are re-evaluated and standard emission factors are replaced by the national specific ones. The national emission factors for most important fuels in sectors energy and industry are updated annually. Certified measurements of emission factors are available also for natural gas (http://www.spp.sk/o-zemnom-plyne/emisie/), hard coal (energetic, cooking coal, blast furnace coal), lignite, brown coal of various origin, gaseous fuels and other, from monthly protocols.

The assessment of uncertainty of input data, emission factors and other input parameters is the final step in the preparation of emission inventory. The assessment of uncertainty for all relevant categories is done annually by methodology tier 1 and for certain selected categories by methodology tier 2 – Monte Carlo (1.A.1 Fuel combustion in energy, 6.A Municipal waste disposal sites, sector 2 Industrial processes and sector 3 Solvent use). The results are published every year in papers[4,5] and in the National Inventory Report to the emission inventory.

The emission balances prepared by external experts for individual sectors are gathered at the Department of Emissions of the SHMÚ, where they are checked, reported and archived. Members of the Committee for the Climate and Energy Package commenting to the emission inventory every year. External experts from the Czech Republic make comments occasionally.

According to the COP decision 7/CP.11 the countries of Annex I are obliged to use the program CRF Reporter in reporting GHG emission inventory. The Slovak Republic uses the actual version of the program and reports the emissions according to approved methodology.

Table 3.6: The list of important information sources for inventory preparation.

Sector	Source of input data
Energy	Energy Statistics of the SR, www.spp.sk, www.transpetrol.sk
Industrial Processes	Association of cement and lime producers, Association of refrigeration and air conditioning engineers, Association of paper producers
Solvent Use	Assiciation for coating and adhesives, solvent distributors, Research institute for drude oil, www.vurup.sk
Agriculture	Green Report of the Ministry of Agriculture of the SR - Agriculture, http://www.land.gov.sk/sk/index.php?navID=122&id=1964
LULUCF	Green Report of the Ministry of Agriculture of the SR - Forest, http://www.land.gov.sk/sk/index.php?navID=123&id=2102
Waste	Dbase RISO http://www.sazp.sk/slovak/struktura/COH/oim/data/index.htm

Documents and emission inventories are archived at three levels. Official documents, methodologies and reports are archived and stored at the web page of the National Inventory System. The access to sensitive documents is through the user's name and password. Statistics and calculations are archived at the level of sectoral experts. All other relevant documents, papers and reports are stored in electronic and printed forms at the Department of Emissions of the SHMÚ.

3.3.4 Key sources analyses

The identification of key sources is important for the reduction of the uncertainty of emission inventories. The key sources and categories are set in accordance with the methodology tier 1 described in IPCC GPG[3] every year after the preparation of emission inventory for the particular inventory year. The key sources are updated every year as well as for the base year 1990. In accordance with the recommendation of the expert inspection team from the last in-country review, more detailed analysis was elaborated in 2009, which included 100 categories in detailed disaggregation also by fuel types. Key sources have been selected according to the cumulative contributions to total emissions that represent in summary over 95% of total GHG emissions. Sources with sector LULUCF and sources without sector LULUCF are assessed separately regarding the level (actual year) and regarding the trend (since the base year 1990). Based on the emission inventory of 2007 17 key categories with LULUCF in the level of 2007 and 24 key categories without LULUCF. With regard to the trend assessment,

45 key categories with LULUCF and 33 key categories without LULUCF were identified. Combustion of fossil fuels, road transport, and emissions from agricultural soil, SWDS, enteric fermentation, nitric acid production and the production of cement, iron and steel are most important key sources in the Slovak Republic. The composition of key sources has changed from year to year only to a small extent.

Table 3.7: Information about responsibilities and archiving of key source analyses.

Name:	Coordinator NIS
Verificator:	Quality manager NIS
Aproval:	NFP (MŽP SR)
Deadline:	15-30th January after finishing of emission inventory for X-2
Archiving:	www.ghg-inventory.gov.sk

Table 3.8: Identification of key sources in 2007.

Category	Gas	Level Assessment with LULUCF	Level Assessment	Trend Assessment with LULUCF
1.A.1 Energy Industries - gaseous	CO_2	X	X	X
1.A.1 Energy Industries - gaseous	CH_4			X
1.A.1 Energy Industries - liquid	CO_2	X	X	X
1.A.1 Energy Industries - liquid	CH_4			X
1.A.1 Energy Industries - solid	CO_2	X	X	X
1.A.1 Energy Industries - solid	N_2O			X
1.A.1 Energy Industries - other	CO_2			X
1.A.1 Energy Industries - other	N_2O			X
1.A.2 Manufacturing Industries and Construction - gaseous	CO_2	X	X	X
1.A.2 Manufacturing Industries and Construction - gaseous	CH_4			X
1.A.2 Manufacturing Industries and Construction - liquid	CO_2	X	X	X
1.A.2 Manufacturing Industries and Construction - liquid	N_2O			X
1.A.2 Manufacturing Industries and Construction - solid	CO_2	X	X	X
1.A.2 Manufacturing Industries and Construction - solid	N_2O			X
1.A.2 Manufacturing Industries and Construction - solid	CH_4			X
1.A.3.a Transport - Civil Aviation - jet kerosen	CO_2			X
1.A.3.b Transport - Road Transportation - gaseous	CO_2			X
1.A.3.b Transport - Road Transportation - liquid	CO_2	X	X	X
1.A.3.b Transport - Road Transportation - liquid	N_2O			X
1.A.3.b Transport - Road Transportation - liquid	CH_4			X
1.A.3.c Transport - Railways - liquid	CO_2			X
1.A.3.c Transport - Railways - liquid	N_2O			X
1.A.3.e Transport - Other - liquid	CO_2			X
1.A.4 Other sector - gaseous	CO_2	X	X	X
1.A.4 Other sector - gaseous	CH_4			X
1.A.4 Other sector - liquid	CO_2			X
1.A.4 Other sector - solid	CO_2	X	X	X
1.A.4 Other sector - solid	CH_4			X
1.A.5.a Other non-specified - gaseous	CO_2	X	X	X
1.A.5.a Other non-specified - gaseous	CH_4			X
1.A.5.a Other non-specified - liquid	CO_2			X
1.A.5.a Other non-specified - solid	CO_2			X
1.B.1.a Coal Mining and Handling	CH_4	X	X	X
1.B.1.b Fugitive Emission from Oil, Natural Gas and Other	CH_4	X	X	X
2(I).A.1 Cement Production	CO_2	X	X	X
2(I).A.2 Lime Production	CO_2	X	X	X
2(I).A.3 Limestone and Dolomite Use	CO_2			X
2(I).A.7.1 Glass Production	CO_2			X
2(I).A.7.2 Magnezite Production	CO_2	X	X	X
2(I).B.1 Ammonia Production	CO_2	X	X	X
2(I).B.1 Ammonia Production	CH_4			X
2(I).B.1 Ammonia Production	N_2O			X
2(I).B.2 Nitric Acid Production	N_2O	X	X	X
2(I).B.4 Carbide Production	CO_2			X
2(I).C.1 Iron and Steel Production	CO_2	X	X	X
2(I).C.1 Limestone USE	CO_2			X
2(I).C.2 Ferroalloys Production	CO_2			X
2(I).C.3 Aluminium Production	CO_2			X
2(I).C.3 Aluminium Production	PFCs			X
2(I).F HFCs emissions	HFCs			X
2(I).F SF6 emissions	SF_6			X
3.D Other Solvent Use	N_2O			X
4.A Enteric Fermentation	CH_4	X	X	X
4.B Manure Management	N_2O	X	X	X
4.B Manure Management	CH_4			X
4.D Agricultural Soils	N_2O	X	X	X
5.A Forest Land	CO_2	X	X	
5.A Forest Land	CH_4			X
5.A Forest Land	N_2O			X
5.C Grassland	CO_2	X		X
5.F Other Land	CO_2			X
6.A Solid Waste Disposal on Land	CH_4	X	X	X
6.B Wastewater Handling	CH_4	X	X	X
6.B Wastewater Handling	N_2O			X
6.C Waste Incineration	CO_2			X
6.C Waste Incineration	N_2O			X
6.C Waste Composting	N_2O			X
6.C Waste Composting	CH_4			X

3.3.5 Process of recalculation

Recalculation of emission data from previous years is handled in order to increase consistency, transparency, comparability and accuracy. Annual review report from the previous year in case of finding out of discrepancies with IPCC GPG[3] is the obligatory document. The preparation of recalculations is the competency of sectoral experts and the recalculations are included in the quality management plan (QA/QC plan) for the actual year. Sectoral experts submit the results of recalculation for each sector together with the description of methodology and changes of parameters of calculations to the NIS coordinator. At the same time, sectoral experts are obliged to fill in verification protocol for each recalculation step. The verification protocol is approved by the Quality Manager of NIS and put in the controlled documentation. Details of recalculated data for particular categories are described in the National Report to GHG emission inventory. The list of recalculated categories is shown in CRF table 8(a).

Table 3.9: Information about responsibilities and archiving of recalculations.

Name:	Sectoral experts
Verificator:	Coordinator NIS
Aproval:	Quality manager NIS
Deadline:	28th February annual
Archiving:	Verification document

3.3.6 Quality management system

The Slovak Hydrometeorological Institute has introduced and maintains the Quality Management System according to EN ISO 9001:2001 standard for the following activities:

- Monitoring of indicators characterising the air and water quality in the Slovak Republic.
- Evaluation, archiving and interpretation of the data and information on the status and regime of air and water.
- Provision of the data and information on the quality and regime of air and water.
- Studying and description of actions in the atmosphere and hydrosphere.
- Educational activities within the competency of the SHMÚ.

In conformity with the definition of qualitative and quantitative parameters of the National Inventory System specified in the COP decision 15/CMP.1, the Ministry of Environment of the Slovak Republic decided to announce a tender on project "The proposal for Quality Management System (QMS) and the National Inventory System of GHG emissions according to Article 5.1 of the Kyoto Protocol and the proposal for the Quality Assurance and Quality Control". Harmonisation of the NIS with the requirements of quality assurance and quality control according ISO 9001 is the main objective of the project. Differently from the QMS of the SHMÚ, the project covered the National Inventory System as a whole, including all external subjects and data processing. Certification Company TÜV Süd Slovakia won the tender in conformity with Act 25/2006 Coll. on public procurement.

The project started in August 2009 and its first phase focused on the preparation of controlled documentation was completed in December 2009. The second phase will be completed in March 2010 by the certificate ISO 9001:2008 awarding to the National Inventory System.

Within the first phase of the project, the Quality Manual was prepared, procedures were updated, the organisation chart was developed together with the delegation of responsibilities and the verification protocol was established.

Table 3.10: The QA/QC plan – external.

	Sector/Activity	Who	Check-in	Time schedule	Record
1	3.3.6Annual Report submission 280/2004/EC, Article 3.1 (a)-(k): a) Emission GHG inventory for year X-2 b) National Inventory System information c) Annual Report for year X-2.	NIS coordinator	Ministry of Environment (NFP)	15. January	CDR (Central Data Repository) upload: http://cdr.eionet.europa.eu/sk/eu
2	Inter-ministerial annotation of GHG inventory and NIR for year X-2: - Publishing of draft on website, - Assessment and revising	NIS coordinator	Ministry of Environment (NFP) Expert group CEP	15. January - 15. March	Comments Final version of NIR
3	Biennial Report submission 280/2004/EC, Article 3.2 (a)-(d): a) Biennial Report b) GHG emission projections	NIS coordinator	Ministry of Environment (NFP)	15. March	CDR upload
4	Annual Report submission 280/2004/EC, Article 3.1: a) Emission GHG inventory for year X-2 b) National Inventory Report for year X-2	NIS coordinator	Ministry of Environment (NFP)	15. March	CDR upload
5	Submission to the secretariat UNFCCC: a) Emission GHG inventory for year X-2 b) National Inventory Report for year X-2 c) Key source and uncertainty analyses d) KP – LULUCF for year X-2 e) National Registry information for year X-1.	NIS coordinator National Registry (e)	Ministry of Environment (NFP)	15. April	UNFCCC submission upload: https://unfccc.int/submissionportal/webportal/SubmissionStatusComponent.jsp
6	National GHG emission inventory publishing on the official website of the NIS.	NIS coordinator	Ministry of Environment (NFP)	30. April	NIS website upload: www.ghg-inventory.gov.sk
7	Revising based on findings in UNFCCC (Annual Status Report)	NIS coordinator	Ministry of Environment (NFP)	27. May	Resubmission ASR UNFCCC
8	Uploading emission information to the Statistical Office of the SR. Publishing of the NIR for the year X-2 to the relevant national institutions. Preparing of the Report on air quality and climate change (SHMU).	NIS coordinator	Ministry of Environment (NFP) Expert group CEP Statistical Office SHMU	31. August	Statistical report Emission inventory Report on air quality and climate change (SHMU)
9	UNFCCC review.	NIS coordinator Sectoral experts of NIS	Ministry of Environment (NFP)	July - October	Comments to UNFCCC Annual Review Report UNFCCC
10	Sectoral improvement plan for increasing quality of the inventory process (based on the results of UNFCCC review).	NIS coordinator Sectoral experts of NIS	NIS coordinator Expert group CEP	30. June - 30. November	Assessment, improvements steps
11	Submission of National Communication UNFCCC 10/CP.13	NIS coordinator Sectoral experts of NIS	Ministry of Environment (NFP)	31. December	Publishing on UNFCCC website.

Table 3.11: The QA/QC plan – internal.

	Sector/Activity	Who	Check-in	Time schedule	Record
1	Closing of contracts or annexes to the contracts, actualization of the research subjects in sectors.	NIS coordinator Sectoral experts of NIS	SHMU Director	31. January	Frame contracts Annexes for actual year Nominations for experts
2	Final inventory data for year X-2	Sectoral experts of NIS	NIS coordinator	28. February	Verification Protocol Recalculation Protocol
3	Uncertainty assessment of final data for sectors for year X-2	Uncertainty expert Sectoral experts of NIS	NIS coordinator	28. February	Report on uncertainty assessment
4	UNFCCC review process participation	Sectoral experts of NIS	NIS coordinator	May - October	Comments on sector
5	Draft inventory for year X-1. Update of the sectoral methodological guidebooks	Sectoral experts of NIS	NIS coordinator	31.VIII	Minutes from workshop
6	Final sectoral reports and final inventory data.	Sectoral experts of NIS	NIS coordinator	30.XI	Sectoral Reports http://unfccc.int/files/national_reports/annex_i_ghg_inventories/reporting_requirements/application/pdf/annotated_nir_outline.pdf
7	Worshop – sectoral experts, ministry of environment and coordinator of NIS Program: assessment of final results for the year X-2, assessment of QA/QC improvements plan, proposal of work for next year	Sectoral experts of NIS NIS coordinator	Ministry of Environment (NFP)	15.XII	Program Minutes from workshop

Fulfilling the QA/QC Plan for a particular year is assessed at the annual workshop, which is organised after submitting sectoral reports. Within the training, the experts are integrated into activities either as the UNFCCC or national experts.

3.3.7 Approval process

Ministry of Environment, the Department of Climate Change and Economic Instruments as the National Focal Point is responsible for the definitive approval of emission inventory and it gives the permission to publish all documents and reports at the official web page. The director of the Department is a contact person for the communication with the UNFCCC Secretariat.

According to point B.2 of the Decision of the Slovak Republic Government no. 413/2008, the Committee for Climate and Energy Package was established at the level of state secretaries of relevant ministries in relation to the implementation of legislative measures within the Climate and Energy Package of the EC. In addition to the coordination and drafting strategy for practical achieving targets of CEP in the Slovak Republic, the Committee has all competencies within its sectors to make comments to the national emission inventory and relevant reports of the X-2 year before their formal publishing at the UNFCCC portal and the national information page of NIS www.ghg-inventory.gov.sk. The minutes from the Committee's meeting, where the approval of the national emission inventory was discusses is a binding document for the NIS coordinator.

Table 3.12: Information on responsibilities in the approval procedure.

Name:	Coordinator NIS
Verificator:	Climate-energy Package Committee
Aproval:	National Focal Point
Deadline:	15th March annually
Archiving:	Minutes from meeting

3.4 NATIONAL REGISTRY (NR)

In January 2005, the Ministry of Environment of the Slovak Republic authorised the private company Dexia Bank Slovakia, a.s. to administrate the National Registry of Emission Quotas/Allowances of the Slovak Republic. The National Registry is a standard electronic database and its purpose is to ensure exact evidence of issuance issue, allocation, holding, shifts and abolition of allowances. Dexia Bank Slovakia, a.s. as operator establishes an holding account in the Registry a holding account of an operator for each operational unit, who has a permit to emit GHGs into air, issued by the MŽP SR and included in the National Allocation Plan.

The National Registry of the Slovak Republic is equipped a French software Seringas™, which is updated regularly (currently the version 4.2.1.0. is used and the version 5.0 is being prepared). The National Registry testing with ITL and CITL was finished successfully and the administrator authorised the National Registry of the Slovak Republic allowing the operation from 19th October 2009. The NR was successfully connected to ITL between other EU countries in October 2008 and since it has been functional.

3.4.1 Contact information

The National Registry is available through the internet address http://co2.dexia.sk in English and Slovak versions. Clients can enter the public internet page through user's name and password and browse also in secure protocols.

Name:	Dexia banka Slovensko, a.s.
Address:	Hodžova 11
City	žilina
Postcode:	010 11
Country	Slovak Republic
Phone NO.:	+421 41 5111 909 (914)
Fascimile number:	+421 41 5111 910
Website:	http://www.dexia.sk/C12571BE00484DE/en/101
E-mail:	co2@dexia.sk

3.4.2 Consolidated system with other Parties

The Slovak Republic does not cooperate with any other country in the management of the National Registry.

3.4.3 Description of the database structure and capacity of the National Registry

The National Registry of the Slovak Republic is equipped a French software Seringas™, which was updated in 2008 (from version 2.95 to version 4.06). This allows the use of new functions of the NR.

No changes in the capacity of the NR have been carried out since 2008. The capacity of the NR is 4,000 accounts. Currently there are 173 Operator Holding Accounts and 25 Personal Holding Accounts in the National Registry.

3.4.4 Conformity with data exchange standards

The version 4.2.1.0 of Seringas software currently used by the NR is programmed according to the data exchange standards for registry systems under the Kyoto Protocol (DES).

3.4.5 Minimization of discrepancies

To minimize discrepancies, internal checks and routines are implemented, as far as possible, including:

- Checks concerning the handling of tCERs and lCERs (such as replacement, expiry date change, cancellations).
- Checks concerning carry-over procedures.
- Checks concerning the handling of notifications.
- Checks concerning net source cancellations and non-compliance cancellations and other procedures that are performed after notification from the ITL.
- Commitment period reserve checks.

Measures to deal with discrepancies, measures to prevent or handle communication problems and measures to prevent the reoccurrence of discrepancies have been established and implemented in order to correct problems in the event of a discrepancy or a communication problem.

3.4.6 Security measures

The security features comprise those features that ensure the protection of the product against intervention from outside.

Registry Administrator is using numerous security measures such as:

- Encryption of data transferred to and from the registry.
- Firewalls, IDS and anti-virus protection measures.
- Audit trails recording activities at the server.
- Using strong password that are frequently changed.
- Enforced deletion of all unused User ids.

3.4.7 Publicly accessible information

The National Registry Administrator makes available all the information according to UN and EU legislation via its website.

3.4.8 Internet address

The internet address of the national registry is: https://co2.dexia.sk.

3.4.9 Safeguard and recovery of Data

Safety and stability features that ensure the safety of the system limit the possibility of damage following a software error or system failure and provide information about the reliability and availability of the system such as following are used:

- Backup hardware (tape robot) is located separately from the computer hardware.
- At least daily database backups.
- 10 generations stored backups.
- All servers (Database, Application Server and WEB Server) exist two-folded.
- Server rooms using uninterruptible power supply (UPS).
- Essential hardware components of the server implemented with redundancy (power supply, multiprocessor, hard-disks RAID).
- All important services are monitored 24 x 7.

3.4.10 Test procedures

Slovak Registry Administrator has successfully completed these tests:

- Tests according Annex H of DES.
- ETS MS Registry Testing.

04

Policies and measures

in conformity with Article 2 of the Kyoto Protocol, national and regional programmes, legislative measures, application of the act and administration

Activities of the Slovak Republic with respect to the development of policies and measures to mitigate greenhouse gas emissions have been intensified at all levels of the process since the time when the Fourth National Communication of the Slovak Republic on Climate Change was published. Ambitious policy of the EU in this field, in particular the approval of the unilateral goal to achieve a 20% reduction of emissions by 2020 compared to 1990 at the meeting of the EU Council in March 2007, is the driving force of these activities. In addition to this effort, the Ministry of Environment of the Slovak Republic and the Slovak Hydrometeorological Institute have realised a number of real steps in order to implement more effective mechanism to achieve our commitments under the Convention and the Protocol. The European Council Decision of March 2007 has initiated the development and approval of legislative instruments in the field of achieving goals in emission reduction and the goals in the enhancement of energy efficiency and share of renewable energy in total consumption. Despite of several improvements implemented in systemic provision for the solution, there is still a large scope for improved coordination and effectiveness of the activities aimed at achieving the goals within climate change and adaptation.

4.1 LEGISLATIVE PROCESS

Ministry of Environment of the Slovak Republic (MŽP SR), the Department of Climate Change and Economic Instruments, is the National Focal Point (NFP) under the Convention and the Kyoto Protocol. In addition to the coordination of the compliance with our international commitments and obligations under the Convention and the Protocol, the NFP in cooperation with other ministries play an important role in the development of strategic documents and positions in this field.

With respect to the cross-sectoral nature of the issue, a cross-sectoral expert group for climate change policy[1] was established in 2005. Besides the coordination of national policy and the development of strategic documents, including national communications on climate change, since 2007, the cross-sectoral expert group has developed national allocations plans within the EU emission trading scheme.

In August 2008, a high-level coordination body for climate change and renewable energy resources at a higher political level was established according to the Resolution of the Slovak Government no. 416/2008 of 18th June 2009. A Commission for Climate and Energy Package at the level of state secretaries of all relevant ministries was established under the leadership of the Ministry of Environment and the Ministry of Economy of the Slovak Republic. In 2008, the main objective of the Commission was to prepare positions for the negotiations on consolidated versions of the EU legal instruments. Currently, the Commission is preparing the national policy for climate change and renewable energy resources together with the draft measures for the practical compliance with targets adopted under the Climate and Energy Package. The Commission regularly presents the information on its activities to the Slovak Government.

To meet the reduction targets under the Kyoto Protocol, the European Union adopted Directive 2003/87/EC of the European Parliament and of the Council of 13th October 2003 establishing a scheme for greenhouse gas emission allowances trading within the Community and amending Council Directive 96/61/EC concerning integrated pollution prevention and control. In 2004, Directive 2004/101/EC of the European Parliament and of the Council of 27th October 2004 amending Directive 2003/87/EC establishing a scheme for emission trading within the Community, in respect to the flexible mechanisms of the Kyoto Protocol was adopted. Directive 2003/87/EC was transposed into the Slovak legislation by Act 572/2004 Coll. on trading with CO_2 emission allowances. This act was amended by Act 117/2007 Coll. which has transposed the Directive 2004/101/EC and its specific definitions also in relation to other EU legal acts, such as in particular Commission Regulation (EC) 2216/2004 from 21st December 2004 on the standardised and secured system of registries.

The basic legal framework for climate change was gradually expanded in 2008 by other new as well as existing revised legal instruments, in particular Directive 2004/101/EC of the European Parliament and of the Council amending Directive 2003/87/EC, expanding the emission trading scheme, which will also cover aviation since 2012. The Climate and Energy Package was officially approved in 2009 as a complex framework for compliance with the ambitious goals of the European Union by 2020 (for more detail treatment see section 4.3.1). A parallel process of the transposition of approved standards into national legislation is progressing, as well as the development of new legislative instruments at the level of the European Commission.

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[1] *Besides the MŽP SR, also the representatives of the Ministry of Economy, the Ministry of Finance, the Ministry of Agriculture, the Ministry of Foreign Affairs, the Ministry of Construction and Regional Development, the Ministry of Transportation, Posts and Telecommunication, the Ministry of Education and the Ministry of Health are the members of the Commission.*

4.2 INTERNAL AND REGIONAL PROGRAMMES OF THE SLOVAK REPUBLIC IN THE PROTECTION OF ENVIRONMENT AND CLIMATE CHANGE

This chapter provides an overview of strategic documents, programmes and action plans developed for the relevant sectors of the economy that define direct or indirect economic instruments for the compliance with the mitigation and adaptation objectives of the Slovak Republic. Sectoral policies and measures presented in this chapter follow, regarding their contents and objectives, the strategies presented in the Fourth National Communication of the Slovak Republic on Climate Change (2005) and they cover the period after 2005.

4.2.1 Sector energy, including transport

Majority of policies within this sector presented in the Fourth National Communication of the Slovak Republic on Climate Change (2005) are still relevant. In addition to legislative instruments on emission trading, Act 478/2002 Coll. on air protection plays an important role. This act has amended Act 401/1998 Coll. on charges for air pollution as amended by later regulations (Act on air). Monitoring and keeping records on emissions from stationary air polluting sources, as well as a system of fees and charges, that is mandatory for the operators of medium and large sources of air pollution, have affected positively greenhouse gas emissions and contributed to decoupling (greenhouse gas emissions do not follow the growth in GDP).

- ***Energy Efficiency Conception***

Development of Energy Efficiency Conception of the Slovak Republic is one of the fundamental priorities of the Energy Policy, which was approved by the Government of the Slovak Republic in January 2006. The main objective of the Conception is to attain gradual reduction of the energy intensity to the level of the European Union, to establish an environment providing incentives for energy efficient behaviour of the inhabitants and market stakeholders at the optimal level of regulatory intervention, as well as to support sustainable energy solutions and to introduce innovations and energy efficient technologies in all sectors of the economy. With respect to the specific quantified objectives of the energy efficiency, it is necessary to achieve yearly savings in terms of the final energy consumption at the level of 4,135 TJ on average. This figure corresponds to the indicative target adopted in the Directive 2006/32/EC on energy end-use efficiency and energy services in the period of 2008 – 2017.

Energy Efficiency Action Plan (EEAP) is being prepared each third year (2007 was the first year) and it contains the following topics:

- Energy saving target in the Slovak Republic and the measures to meet this target for the period of three years.
- Analysis and evaluation of adopted measures.
- Proposals for new measures to meet energy saving target.
- Information for public and other market stakeholders on the role and activities of the public sector.
- Means to attain energy efficiency, financial and legal framework to attain the national indicative energy saving.

The second EEAP is being prepared for the year 2010.

GHG affected: CO_2, CH_4 and N_2O

Type of the measure: regulative with direct impact on emissions

Status: in force since 2007

Implementing entity: Ministry of Economy of the Slovak Republic.

- ***Energy Security Conception***

The Conception has defined three targets:

- To secure safe, effective and reliable supply of all kinds of energy in required quantity and quality.
- To reduce the share of the gross domestic consumption of energy in gross domestic product and to reduce energy intensity.
- To secure total electricity production that will cover the demand effectively.

The objective of Energy Security Conception is to reach a competitive energy securing safe, effective and reliable supply of all kinds of energy at acceptable prices and taking into account the protection of consumers, protection of environment, sustainable development and supply assurance.

Due to the increased demand in industry and transport, total supply of energy resources should be increased by 2.6% to 18.7 Mtoe[2] and final consumption by 5.4% to 3.5 Mtoe. The electricity consumption is expected to increase by 12% to 25.6 TWh (2.2 Mtoe) and oil consumption by 2.9% to 3.5 Mtoe, keeping gas consumption at a constant level of 4.1 Mtoe.

GHG affected: CO_2, CH_4 and N_2O

Type of the measure: regulative with direct impact on emissions

Status: in force since 2007

Implementing entity: Ministry of Economy of the Slovak Republic.

- ***Conception of Higher Use of Biofuels in Transportation in the Slovak Republic***

The Slovak Government approved the National Development Programme for Biofuels by Resolution no. 1022/2005. The Programme has come from the nature and the potential of further development in the chain of subjects such as breeder/planter – processor – producer of bio-components and fuels – distributor – customer/client. The Conception presents reference values for biofuels calculated from the energy content of total quantity of gasoline and diesel oil for the period of 2006 – 2010, as follows:

- By 31st December 2006 – 2%.
- The period of 2007, 2008 and 2009 – 2%.
- By 31st December 2010 – 5.75%.

Furthermore, the Conception presents the current stage of compliance with the Biofuel Programme in 2006 and 2007. In 2006, the share of fossil fuels within the internal fuel market was the highest (more than 97%) and the share of alternative fuels was the lowest (CNG, LPG and biofuels 2.3%). In 2007, the share of fossil fuels decreased to 95% and the share of alternative fuels increased to 4.3%. The second part of the Conception describes the expected evolution of the internal fuel market till 2030, while considering the increase of the consumption of motor fuels together with increased of the share of biofuels in motor fuels to 10% in 2020. The last part of the Conception presents amendments of the selected policies aimed at further development programmes on biofuels in the Slovak Republic:

- Amended Regulation of the Slovak Government no. 246/2006 Coll. and amended Ordinance of the Ministry of Economy of the Slovak Republic no. 608/2006 Coll.
- Amendment of Act 98/2004 Coll. as amended by further regulations.

GHG affected: CO_2, CH_4 and N_2O

Type of the measure: regulative with direct impact on emissions

Status: in force since 2005

Implementing entity: Ministry of Economy of the Slovak Republic and Ministry of Agriculture of the Slovak Republic.

- ***Biomass Utilisation Action Plan for 2008 – 2013***

With respect to the potential of biomass and the need of biomass utilisation, the Government of the Slovak Republic adopted the task to develop the National Biomass of Utilisation Action Plan by its Resolution no. 383/2007 within the Strategy for Further Utilisation of the Renewable Energy Resources. Comprehensive information about the progress in biofuels utilisation is available reports under Directive 2003/30/EC published in July. The 10% share of biofuels in 2020 can be reached presumably only by the utilisation of the second generation biofuels. Currently in the Slovak Republic 4% of the overall energy demands is covered by biomass. But the energy potential of agricultural biomass is considerably higher and theoretically it represents 20.4% of annual energy consumption in the Slovak Republic, which is 800 PJ. The energy potential of forest biomass has been determined from the average heat value as 12 GJ/t.

[2] *Mtoe=10^6 toe; 1 ton of oil is 1 ton of oil equivalent; 1 toe=41,868 GJ.*

GHG affected: CO_2, CH_4 and N_2O

Type of the measure: regulative with direct impact on emissions

Status: in force since 2008

Implementing entity: Ministry of Agriculture of the Slovak Republic.

- ***Strategy for the further utilisation of Renewable Energy Resources in the Slovak Republic***

Adoption of targets for 2010, 2015 and the implementation of measures presented in this document will contribute to the increase of renewable energy resources in the total energy consumption from its current level at 4%. The 2010 target is 4% share of renewable energy resources (excluding large hydroelectric power plants) in total energy consumption. Until 2015 the target is 7% share of renewable energy resources in total energy consumption in the Slovak Republic:

GHG affected: CO_2, CH_4 and N_2O

Type of the measure: regulative with direct impact on emissions

Status: in force since 2004

Implementing entity: Ministry of Agriculture of the Slovak Republic.

- ***Governmental Programme for Thermal Insulation of Buildings***

Governmental Programme for Thermal Insulation of Buildings was approved by the Slovak Government Resolution no. 379 of 20th May 2009. The programme defines the conditions for thermal insulation leading to the reduction of energy intensity of residential buildings. Further to the programme, Act 607/2003 Coll. on the State Fund for Housing Development has been amended. Apartment houses and family houses, for which the certificates were issued before 1989, are all subject of the state subsidy.

The subsidy is implemented through the advantaged loan with the time of repay ability of 15 years and zero interest rate. The loan can be provided up to 100% of eligible costs of the building, but not more than 50 EURO/m^2 of insulated surface in the case of family house and 80 EURO/m^2 of insulated surface in the case of apartment house.

The State Fund for Housing Development takes a decision on the provision of the loan according to the order of applications received within the overall budget allocated for the programme implementation.

GHG affected: CO_2

Type of the measure: regulative with direct impact on emissions

Status: planned

Implementing entity: Ministry of Construction and Regional Development of the Slovak Republic.

4.2.2 Sector industry

- ***Sectoral Operational Programme Industry and Services***

The programme aims at attaining the quantified targets for the period of 2004 – 2006 with the support of the EU Structural Funds through the following activities:

- Analysing the impact of entrepreneurs' activities on the environment and reducing the share of industry and services on air pollution and generation of greenhouse gas emissions from waste and waste water by 2% (CO_2, NO_2, SO_2 emissions) in 2006 compared to 2001.
- Reducing energy intensity in supported enterprises by 2.5% by 2006 compared to 2001.

  Subsidizing 25 projects on energy savings and renewable energy.
- Reducing energy and raw materials intensity in production processes by 2.5% at minimum after the termination of the operational programme, compared to 2001.
- Reducing energy cost in 2006 by 2.5% compared to 2001.

GHG affected: CO_2, CH_4 and N_2O and basic pollutants

Type of the measure: economic with indirect impact on emissions

Status: in force since 2003

Implementing entity: Ministry of Economy of the Slovak Republic.

4.2.3 Sector agriculture

- ***Common Agricultural Policy (CAP)***

Common Agricultural Policy is a set of relevant legislation in the sector agriculture. Within the approved policy of sustainable management in agriculture, it is necessary to implement the following activities:

- Gathering information on a number of cattle and analyzing trends in methane emissions per animal.
- Gathering information on agricultural activities in Member States and identifying areas that are not used for agricultural production.
- Registering greenhouse gas emissions from all agricultural activities.
- Implementing more efficient manure handling.
- Determining the reduction of CO_2 emissions in relation to energy intensity.
- Quantifying impacts of the introduction of subsidies in the biomass production of agricultural crops.

GHG affected: CO_2, CH_4 and N_2O

Type of the measure: regulative with indirect impact on emissions

Status: in force since 2003

Implementing entity: Ministry of Agriculture of the Slovak Republic.

4.2.4 Sector land use, land-use change and forestry

- ***Medium-term Conception of Agricultural Policy for 2004 – 2006, section Forest Management***

The conception sets up the fundamental framework for the implementation of medium-term objectives of forest management towards sustainable management and the stability of carbon stocks in the Slovak Republic's forest:

GHG affected: emissions and sinks of CO_2

Type of the measure: regulative with indirect impact on emissions

Status: in force since 2003

Implementing entity: Ministry of Agriculture of the Slovak Republic.

- ***National Forest Programme of the Slovak Republic***

The main objective of programme is to reach sustainable forest management and to meet requirements for the protection of environment through adaptation and mitigation measures proposed in the individual action plans. The Indicative Action Plan of the National Forest Programme identifies a set of specific measures:

GHG affected: emissions and sinks of CO_2

Type of the measure: regulative and economic with indirect impact on emissions

Status: in force since 2007

Implementing entity: Ministry of Agriculture of the Slovak Republic.

4.3 OVERVIEW OF POLICIES AND MEASURES, INCLUDING THEIR IMPACTS ON THE REDUCTION OF GREENHOUSE GAS EMISSIONS

4.3.1 Cross-sectoral policies and measures

Majority of policies and measures adopted before 2005, presented in detail in the Fourth National Communication of the Slovak Republic on Climate Change, are still relevant, such as:

- ***Act 478/2002 Coll. on air protection amending Act 401/1998 Coll. on charges for air pollution its further amendment was prepared and approved at the operative meeting of Ministry of Environment no. 7509/2009 3.1; it has transposed relevant EU acts.***
- ***Act 587/2004 Coll. on the Environmental Fund and its implementing Regulation 157/2005 Coll.***
- ***Act 243/2003 Coll. on integrated pollution prevention and control.***
- ***Act 205/2004 Coll. on gathering, keeping and disseminating environmental information and its implementing Regulation 411/2007 Coll.***

Common Agricultural Policy is a set of relevant legislation in the sector agriculture. Within the approved policy of sustainable management in agriculture, it is necessary to implement the following activities:

- ***Act 117/2007 Coll. changing and amending Act 572/2004 Coll. on emission trading and on the change and the amendment of certain acts, as amended by Act 733/2004 Coll***.

The Act amends several provisions of the Act 572/2004 Coll. regarding terms and definitions, rights and obligations of the Ministry of Environment, the administrator of the Registry and traders with emission allowances. In relation to the transposition of Directive 2004/101/EC, the act defines conditions for the use of certified emission reduction (CER) and emission reduction units (ERU) within the trading scheme.

GHG affected: CO_2

Type of the measure: economic and regulative with direct impact on emissions

Status: implemented, amended on 9th February 2007

Implementing entity: Ministry of Environment of the Slovak Republic.

- ***Climate and Energy Package***

The Climate and Energy Package, which was formally introduced by the European Commission on 23rd January 2008, is a set of legislative standards with the aim to achieve the following commitments of the European Union:

- To reach at least a 20% reduction of greenhouse gas emissions by 2020 compared to 1990.
- To reach 20% share of the renewable energy resources within the EU energy consumption by 2020.
- To reach 10% share of biofuels within the EU energy consumption.

These commitments were adopted by the heads of states and governments of EU Member States at the meeting of the European Council in March 2007. At the meeting of the European Council on 11th and 12th December 2008, an agreement was reached and compromised proposals of the Climate and Energy Package were approved. Consecutively on 17th December 2008, also the European Parliament voted for the compromised proposals of the Climate and Energy Package. The final version of the compromised proposals of the Climate and Energy Package did not change targets adopted at the March meeting of the European Council. The endeavour of the Council is to meet targets without significant negative impacts on economic and social development in Member States. The most important changes in the compromised proposal aiming at the reduction of greenhouse gas emissions can be specified briefly, as follows:

- Purchase of allowances through auctioning in sectors that are not exposed to the risk of carbon leakage determined on the basis of benchmarks (technical and fuel standards) will be changed for 20% in 2013 to 70% in 2020. In the original proposal the level of 100% was supposed to be reached in 2020, but the amended proposal has postponed the target to 2027.
- Qualitative and quantitative criteria for the assessment of the industrial sectors with regard to the risk of carbon leakage are defined directly in the revised EU ETS Directive.
- Allowances provided free of charge at 100% up to the reference value of the best available techniques shall

be allocated to the installations in sectors and sub-sectors that are exposed to significant risk of carbon leakage.

- Further compromise, which is important for the Slovak Republic, is the fact that total greenhouse gas emissions in sectors that are excluded from the Community trading scheme, shall not be reduced in 2013 to reflect the average annual emissions of the period of 2008 – 2012, the final target can be achieved through the linear trajectory.

Most important changes in the compromised proposal in relation to renewable energy resources are the following:

- Establishment of the mechanisms of cooperation (statistical transfers, joint projects), which have replaced the guaranty of origin as the main source of flexibility in compliance with the adopted objectives of renewable energy policy.
- The authority of the European Commission to assess the scope of breaching the targets of action plans for renewable energy resources and the possibility to exempt a Member State from the obligation to submit a revised action plan.
- The addition of transparency platform aimed at increasing transparency and facilitating cooperation among Member States. This platform will show national action plans, predictions and offers of Member States for cooperation in statistical transfers, as well as the information on realized transfers.
- Since 2012, public sector should be an example in utilization of renewable energy resources in the construction of new public buildings and the reconstruction of existing ones.
- Increasing the limit for the saving of greenhouse gases for biofuels that will be produced after 2017 to 50% and increasing the limit to 60% for the installations that will start to operate after 1st January 2017; at the same time, the addition of the factor of indirect change in utilising soil in the calculation of greenhouse gas emission savings.
- Enlargement of areas, where plants for biofuel production cannot be grown, compliance with sustainability criteria (wetlands, soil with a high content of carbon).
- Extension of the obligations of the European Commission in the assessment and elaboration of the action plan for better use of the Structural Funds and other financial instruments, the assessment of cost efficiency in achieving the target.
- Increasing the share of fuel consumption produced from the renewable energy resources in road transport, to be accounted towards the target within transport sector by 2.5 times.

A comprehensive set of fundamental legal standards for the Climate and Energy Package was published in the Official Journal of the European Union of 5th June 2009, as follows:

- *Regulation (EC) 443/2009 of the European Parliament and of the Council of 23rd April 2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles.*
- *Directive 2009/28/EC of the European Parliament and of the Council of 23rd April 2009 on the promotion of the use of energy from renewable resources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.*
- *Directive 2009/29/EC of the European Parliament and of the Council of 23rd April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission trading scheme of the Community.*
- *Directive 2009/30/EC of the European Parliament and of the Council of 23rd April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland navigation and repealing Directive 93/12/EEC.*
- *Directive 2009/31/EC of the European Parliament and of the Council of 23rd April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) 1013/2006.*
- *Decision 406/2009/EC of the European Parliament and of the Council of 23rd April 2009 on the effort sharing of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020.*

These legal acts still do not provide a definitive legal framework for the Climate and Energy Package. The European Commission in cooperation with Member States will be developing further documents aiming at practical compliance with the Climate and Energy Package targets up to 2011.

GHG affected: CO_2, CH_4 and N_2O

Type of the measure: regulative, economic with direct impact on emissions

Status: planned

Implementing entity: Cross-sectoral measure also regarding competences.

Since 2005, several legal acts have been adopted, which affect the greenhouse gas emissions indirectly, as follows:

- ***Act 515/2008 Coll. changing and amending certain acts regarding the environment in relation to the introduction of a new Euro currency in the Slovak Republic.***
- ***Act 24/2006 Coll. on the environmental impact assessment and on changing and amending some acts as amended by Act 275/2007 Coll. and Act 454/2007 Coll.***
- ***Regulation of the Ministry of Environment of the Slovak Republic no. 133/2006 Coll. on requirements for the reduction of volatile organic compounds emitted from the use of organic solvents in regulated products, as amended by Regulation 30/2009 Coll.***
- ***Regulation of the Ministry of Environment of the Slovak Republic no. 131/2006 Coll. providing national emission ceilings and total quantity of allowances for pollutants, as amended by Regulation 203/2008 Coll.***

4.3.2 Sector energy, including transport

The overview of legal acts in sector energy, including transport, adopted before 2005 and presented in the Fourth National Communication of the Slovak Republic on Climate Change that have remained in force:

- ***Act 656/2004 Coll. on energy and on changes of certain acts as amended by later regulations and Act 657/2004 Coll. on thermal energy as amended by later regulations.***
- ***Act 725/2004 Coll. on the conditions for motor vehicles operation and traffic on roads and Regulation of the Slovak Government no. 584/2004 Coll. on measures to reduce emissions from combustion engines installed in non-road machines.***
- ***Regulation 144/2000 Coll. on requirements for fuel quality, on keeping records and reporting date to air protection bodies.***
- ***Regulation of the Slovak Government no. 135/2006 Coll. on technical requirements for type approval system for motor vehicles pursuant to Council Directive 70/156/EEC.***
- ***Regulation of the Slovak Government no. 367/2006 Coll. on technical requirements relating to measures to be taken against air pollution by gases from positive-ignition engines of motor vehicles pursuant to Council Directive 70/220/EEC.***
- ***Regulation of the Slovak Government no. 368/2006 Coll. on technical requirements relating to the measures to be taken against the emission of pollutants from diesel engines for use in vehicles pursuant Council Directive 72/306/EEC and Council Directive 88/77/EEC.***
- ***Regulation of the Slovak Government no. 374/2006 Coll. on technical requirements for carbon dioxide emission monitoring and fuel consumption of motor vehicles pursuant to Council Directive 80/1268/EEC.***
- ***Directive 2003/54/EC of the European Parliament and of the Council of 26th June 2003 concerning common rules for the internal market in electricity and Directive 2003/55/EC of the European Parliament and of the Council concerning common rules for the internal market in natural gas.***
- ***Directive 2001/77/EC of the European Parliament and of the Council on electricity production from renewable energy resources in the internal electricity market.***

Further to above legislation and measures, several legal acts in sector energy have been implemented or amended since 2005, as follows:

- ***Act 107/2007 Coll. changing and amending Act 276/2001 Coll. on regulation of network industries and amendment and supplement of some acts in wording of latter provisions***.

This act amends Act 276/2001 Coll., which regulates the establishment and competences of the Regulatory Office for Network Industries, scope and conditions of the State regulation of network industries, conditions for performance of regulated activities and rights and obligations of regulated entities.

GHG affected: CO_2

Type of the measure: regulative with indirect impact on emissions

Status: implemented, in force since 2007

Implementing entity: Ministry of Economy of the Slovak Republic.

- ***Act 99/2007 Coll. changing and amending Act 657/2004 Coll. on thermal energy and amending Act 455/1991 Coll. on entrepreneurship, as amended by later regulations.***

The Act amends Act 657/2004 Coll. on the demonstration of education and practical experiences in energy fields by formal certificate, as well as the conditions for permit's owner in relation to the his/her business and compliance with obligations in supplying heat and heated water.

GHG affected: CO_2

Type of the measure: regulative with indirect impact on emissions

Status: implemented, in force since 2007

Implementing entity: Ministry of Economy of the Slovak Republic.

- ***Act 112/2008 Coll. changing and amending Act 656/2004Coll. on energy and on change of certain acts, as amended by later regulations and Act 283/2008 Coll. changing and amending Act 656/2004 Coll. on energy and on change of certain acts, as amended by later regulations .***

The amendment defines rules aiming at the prevention of discrimination within the entry into the electricity and gas markets. Furthermore, it defines the obligations to prepare reports on monitoring of energy security accessible to public, in order to improve the transparency. It also defines the conditions for the construction of electric energy or gas facilities and the obligations of the operator of distribution network to measure gas supplied to consumers by predefined measuring device, which are provided, maintained and verified on a regular basis and free of charge.

Further amendment of this act has been prepared for interdepartmental annotation. This amendment specifies conditions for the access into the existing distribution network for the electricity producers from renewable energy resources.

GHG affected: CO_2, CH_4 and N_2O

Type of the measure: regulative with indirect impact on emissions

Status: implemented, in force since 2008

Implementing entity: Ministry of Economy of the Slovak Republic.

- ***Act 476/2008 Coll. on efficiency in energy use (Act on energy efficiency) and on the change and amendment of Act 555/2005 Coll. on energetic efficiency of building and on changes and amendments of certain acts, as amended by Act 17/2007 Coll.***

The act provides the obligation to develop Energy Efficiency Use Conception for ten years period in cooperation with central bodies of the state administration. The Ministry of Economy is obliged to assess the compliance with the targets and to propose the changes and amendments of the Concept. According to this act, the ministry is also obliged to develop Action Plan for Energy Efficiency Use once in three years and to assess the progress of its implementation each year. In addition to these provisions, the act defines other technical and monitoring requirements, parameters for thermal insulation of the distribution of heat and heated water in buildings, as well as the sphere of actions of energy service.

GHG affected: CO_2

Type of the measure: regulative and economic with indirect impact on emissions

Status: in force since 2008

Implementing entity: Ministry of Economy of the Slovak Republic.

- ***Act 309/2009 Coll. on the support for renewable energy resources and a highly effective combined production of energy.***

This act defines the concept of support for renewable energy resources and a highly effective combined heat production. Furthermore, it defines rights and obligations of energy producers, rights and obligations of the distribution network operators, the support for bio-methane production, pricing and provision of the electricity certificates of origin.

Producers of electricity with the capacity of 50 MW shall produce electricity with 20% share of renewable resources at minimum. Producers and operators of facilities with capacity of 30 MW at minimum, who produce energy from renewable resources, shall inform relevant agencies and ministries on their production. Both groups have the preferential right to enter the public distribution network.

GHG affected: CO_2, CH_4

Type of the measure: regulative and economic with indirect impact on emissions

Status: in force since 2009

Implementing entity: Ministry of Economy of the Slovak Republic.

- ***Act 135/1961Coll. of 30th November 1961 on roads (Road Act) amended by Act 8/2009 Coll. on road traffic of 1st February 2009 together with implementing Regulation of the Ministry of Interior of the Slovak Republic no. 9/2009 Coll. and repealing Act 315/1995 Coll. on road traffic***

The act specifies conditions and rules for the construction, use and protection of roads, including rights and obligations for owners, administrators and users of roads. Furthermore, the act defines the sphere of action of the state administration and supervision regarding roads and road traffic. The provisions aim to increase the safety in road traffic and decrease in the number of accidents and victims of car accidents.

GHG affected: CO_2, CH_4 and N_2O

Type of the measure: regulative with indirect impact on emissions

Status: in force since 1st February 2009; Act 135/1961 Coll. still in force

Implementing entity: Ministry of Interior of the Slovak Republic.

- ***Regulation no. 578/2006 Coll. stipulating details of certain provisions of Act 725/2004 Coll. on the conditions for motor vehicles operation and road traffic, and on changes and amendments of certain acts, as amended by Regulation no. 482/2007 Coll. and Regulation no. 48/2008 Coll.***

The regulation stipulates emission controls of mobile polluting sources, periods and conditions of their verification, conditions for conversion disposal, prolongation, repealing and expiration of licences of legal and personal entities for the detection of emission levels from the mobile sources. The concentration of carbon oxide (CO) and non-burnt carbohydrates (HC) from free running rotations of non-loaded vehicle engine with applied ignition must not exceed emission limits set by producers, as follows:

- 6.0% of CO and 2,000 ppm of HC, if it is an ignition motor of a vehicle, for the first time registered before 31st December 1972.
- 4.5% of CO and 1,200 ppm of HC, if it is an ignition motor of a vehicle, for the first time registered before 31st December 1985.
- 3.5% of CO and 800 ppm of HC, if it is an ignition motor of a vehicle, for the first time registered from 1st January 1986.

GHG affected: CO_2

Type of the measure: regulative with direct impact on emissions

Status: in force since 1st November 2006; amending Act 725/2004 Coll.

Implementing entity: Ministry of Interior of the Slovak Republic.

- ***Regulation no. 125/2004 Coll. of 27th February 2004, providing details on end-of-life vehicles and on some requirements for vehicle production, as amended by Regulation of the Ministry of Environment of the Slovak Republic no. 227/2007 Coll.***

The regulation has transposed the provisions of Directive 2000/53/EC on end-of-life vehicles. It provides

detailed conditions for the collection and processing of end-of-life vehicles, the documentation on end-of-life vehicle placed at assigned car parks and handling and processing of end-of-life vehicles.

GHG affected: CO_2, CH_4 and N_2O

Type of the measure: regulative with indirect impact on emissions

Status: in force since 1st April 2004; changed and implemented by Regulation no. 227/2007 Coll., this has been in force since 15th May 2007

Implementing entity: Ministry of Environment of the Slovak Republic.

- ***Regulation of the Slovak Government no. 246/2006 Coll. of 19th April 2006 on minimal amount of fuels produced from renewable resources in diesel oil and gasoline put on market in the Slovak Republic.***

The regulation refers to the Directive 2003/30/EC of 8th May 2003 on the promotion of the use of biofuels or other renewable fuels for transport. The regulation adopts minimum amount of driving fuels produced from renewable energy resources introduced on the market of the Slovak Republic and use for transport as the substitution for gasoline and diesel oil.

Producers and distributors are obliged to offer minimum amounts of biofuels (or other renewable fuels) in diesel oil and gasoline, which are determined by reference value 2.65%[3] for the period from 1st January 2009 to 31st December 2009 and by reference value 3.4% from 1st January 2010 to 31st December 2010.

GHG affected: CO_2, CH_4 and N_2O

Type of the measure: regulative with direct impact on emissions

Status: effective since 1st May 2006 as amended by Regulation of the Slovak Government no. 304/2008

Implementing entity: Ministry of Economy and Ministry of Environment of the Slovak Republic.

- ***Regulation of the Slovak Government no. 384/2004 of 2nd June 2004 on the accessibility to the information regarding fuel consumption and carbon dioxide emissions at sale and leasing of passenger cars.***

The regulation stipulates an obligation for sellers of new passenger cars to provide a consumer with complete and truthful information on fuel consumption and CO_2 emissions before the purchase or leasing of a new passenger car.

GHG affected: CO_2

Type of the measure: regulative with direct impact on emissions

Status: in force since 1st October May 2004

Implementing entity: Ministry of Economy of the Slovak Republic.

- ***Directive 2008/101/EC of the European Parliament and of the Council of 19th November 2008 amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community.***

The directive includes aviation activities in the scheme for greenhouse gas emission allowance trading within the Community. The directive defines the obligations for operators in the field of monitoring and verification of emissions and data reporting. Since 1st January 2010, aircraft operators shall be obliged to monitor the evidence in tonne-kilometre on the basis of a monitoring plan accredited by the competent authority (i.e. the Ministry of Environment of the Slovak Republic). In addition they are required to present these reports to the responsible authorities. Member States shall submit the monitoring plans to the European Commission four months before the deadline (1st January 2010). The average of historical greenhouse gas emissions of the years 2004 – 2006 will be used as the starting level for the determination of total volume of emissions for monitoring plans. In 2012, the total quantity of allowances to be allocated to aircraft operators shall be equivalent to 95% of historical aviation emissions. The average share in the use of ERU and CER units set down by Member States is approximately 15% of total allocated emissions. It is being suggested, that revenues from auctioning should be used preferentially for the development and promotion of low emissions transport.

[3] *The share is calculated from the energy content in total amount of diesel oil and gasoline.*

GHG affected: CO_2

Type of the measure: regulative and economic with direct impact on emissions

Status: approved and in force since 1st January 2012

Implementing entity: Ministry of Transportation, Posts and Telecommunication and Ministry of Environment of the Slovak Republic.

Table 4.1 shows a summary of selected policies and measures in energy and transport sector, as well as reduction potential in 2010, 2015 and 2020.

4.3.3 Sector industry

The overview of legal acts in sector industry, adopted before 2005 and presented in the Fourth National Communication of the Slovak Republic on Climate Change that have remained in force:

- ***Act 408/2000 Coll. changing and amending Act 76/1998 Coll. on protection of the ozone layer of the Earth and amending Act 455/1991 Coll. on entrepreneurship, as amended by later regulations.***
- ***The European Parliament and Council Regulation no. 2037/2000/EC of 29th June 2000 on substances that deplete the ozone layer***
- ***Council Regulation no. 1407/2002/EC on State aid to the coal industry.***
- ***Act 184/2002 Coll. on water.***
- ***Directive 2002/96/EC of the European Parliament and Council of 27th January 2003 on waste from electrical and electronic equipment.***

Further legal acts have been adopted after 2005. These acts affect directly or indirectly greenhouse gas emission production in sector industry, and they are as follows:

- ***Regulation of the Slovak Government no. 655/2007 on technical conditions to reduce emissions from air conditioning systems in motor vehicles.***

The regulation stipulates technical requirements for the approval of vehicles of M1 and N1 categories up to 1,280 kg in view of emissions from air condition systems in cars and their safety operation, as well as the conditions for additional installation of air condition systems and their replenishment.

With the effect from 1st January 2017, it is banned to fill the air conditioning systems in all motor vehicles with fluorinated greenhouse gases with a global warming potential higher than 150. This provision will not be applied to air conditioning systems installed in motor vehicles before 1st January 2017.

GHG affected: F-gases

Type of the measure: regulative with direct impact on emissions

Status: implemented

Implementing entity: Ministry of Environment of the Slovak Republic.

- ***Directive 2006/40/EC of the European Parliament and of the Council of 17th May 2006 relating to emissions from air conditioning systems in motor vehicles.***

The Directive regulates EC type-approval or national type-approval, with regard to emissions from air conditioning systems installed in motor vehicles and safety operation of these systems, as well as the conditions for additional installation of air condition systems and their replenishment.

GHG affected: F-gases

Type of the measure: regulative with direct impact on emissions

Status: implemented

Implementing entity: Ministry of Environment of the Slovak Republic.

- ***Regulation no. 842/2006/EC of the European Parliament and of the Council on certain fluorinated greenhouse gases.***

The objective of this regulation is to prevent and thereby reduce emissions of the fluorinated greenhouse gases covered by the Kyoto Protocol. Annex I to this regulation contains a list of the fluorinated greenhouse gases currently covered by this regulation, together with their global warming potentials. This regulation deals also with

reduction of emissions, utilisation and destruction of the fluorinated greenhouse gases listed in Annex I; labelling and disposal of products and equipment containing these gases; reporting of information on these gases and training and certification of personnel and companies involved in activities covered by this regulation.

GHG affected: F-gases

Type of the measure: regulative with direct impact on emissions

Status: implemented

Implementing entity: Ministry of Environment of the Slovak Republic.

- ***Act 286/2009 Coll. on fluorinated greenhouse gas emissions and on the change and amendment of certain acts.***

This act regulates the obligations of physical persons and legal entities handling fluorinated greenhouse gases, products and equipment, the sphere of action of the state administration bodies and the responsibilities for breaching obligations set down by this act or other specific regulations.

GHG affected: F-gases

Type of the measure: regulative with direct impact on emissions

Status: in force since June 2009

Implementing entity: Ministry of Environment of the Slovak Republic.

- ***Regulation of the Ministry of Environment of the Slovak Republic no. 314/2009 Coll. implementing Act 286/2009 Coll. on fluorinated greenhouse gas emissions and on the change and amendment of certain acts.***

The regulation presents templates for reporting data of the operators of cooling systems, air conditioning systems, heat pumps, stationary fire systems and fire extinguishers, data on production of fluorinated greenhouse gases in a particular year, on import, export or putting on the market of fluorinated greenhouse gases, on the production, import and export of products and equipment. Furthermore, the reporting contains data on the recovery, checking leakages, installations, maintenance of cooling systems, air conditioning systems and heat pumping systems containing fluorinated greenhouse gases, stationary fire systems and fire extinguishers containing fluorinated greenhouse gases, the collection of fluorinated greenhouse gases from the distribution points of high voltage, collection of solvents of fluorinated greenhouse gases from equipment.

GHG affected: F-gases

Type of the measure: regulative with direct impact on emissions

Status: in force since April 2009

Implementing entity: Ministry of Environment of the Slovak Republic.

- ***Regulation of the Ministry of Environment of the Slovak Republic no. 314/2009 Coll. implementing Act 286/2009 Coll. on fluorinated greenhouse gas emissions and on the change and amendment of certain acts.***

Table 4.1 shows a summary of selected policies and measures in sector industry, as well as reduction potential in 2010, 2015 and 2020.

4.3.4 Sector agriculture

The overview of legal acts in sector agriculture, adopted before 2005 and presented in the Fourth National Communication of the Slovak Republic on Climate Change that have remained in force:

- ***Act 220/2004 Coll. on the preservation of agricultural soil fund.***
- ***Act 555/2004 Coll. on manure.***
- ***Act 415/2002 Coll. on the ecologic agriculture in the product of bio-foodstuff.***
- ***Act 188/2003 Coll. on the application of the sludge from wastewater treatment plants and the sediments on the soil.***
- ***Act 364/2004 Coll. on water; §35 protection against the pollution by nitrates from agricultural sources.***

Further legal acts have been adopted after 2005, which affect directly or indirectly the generation of greenhouse gas emissions in the agriculture sector:

- ***Council Regulation no. 1782/2003/EC establishing common rules for direct support schemes under the common agricultural policy and establishing certain support schemes for farmers, as amended by Regulation no. 1009/2008/EC.***

The regulation represents a crucial and comprehensive legislative framework for agriculture. It is complemented by legal regulations related to the Common Agricultural Policy.

GHG affected: CO_2, N_2O

Type of the measure: regulative with indirect impact on emissions

Status: implemented

Implementing entity: Ministry of Agriculture of the Slovak Republic.

- ***Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources, as amended by later regulations.***

The objective of this directive is to avoid or reduce the water pollution caused by nitrates from the use or the storage of inorganic or organic fertilizers in the agricultural soil. Member States shall identify vulnerable zones, identify and implement programmes with the aim to reduce water pollution by nitrates in vulnerable zones. The directive also defines criteria for the identification of waters affected by nitrate pollution and measures that must be incorporated in programme activities, as well as reference measurement methods and reporting obligations.

GHG affected: N_2O

Type of the measure: regulative

Status: implemented with indirect impact on emissions

Implementing entity: Ministry of Agriculture of the Slovak Republic.

Table 4.1 shows a summary of selected policies and measures in sector agriculture, as well as reduction potential in 2010, 2015 and 2020.

4.3.5 Sector land use, land-use change and forestry (LULUCF)

The overview of legal acts in sector LULUCF adopted before 2005 and presented in the Fourth National Communication of the Slovak Republic on Climate Change that have remained in force:

- ***Act 217/2004 Coll. on forest generative material and on change of certain acts.***
- ***Act 236/2005 Coll. on forests.***

Further legal acts have been adopted after 2005, which affect directly or indirectly the generation of greenhouse gas emissions in sector LULUCF:

- ***Act 360/2007 Coll. changing and amending Act 326/2005 Coll. on forests and on the change of Act 217/2004 Coll. on forest generative material and on change of certain acts, as amended by Act 545/2004 Coll.***

The act provides a basic framework for the conservation of forest soils and forest management. It sets up basic conditions for sustainable wood felling and prevents the exploitation of forests. The act also defines basic framework for retaining carbon stocks in forests at current level. It regulates the use of genetic material in forest management and thus it determines generative ability of future trees from the perspective of carbon sequestration taking into account ecological demands for woods.

GHG affected: CO_2

Type of the measure: regulative, economic with indirect impact on emissions

Status: implemented

Implementing entity: Ministry of Agriculture of the Slovak Republic.

- ***Regulation of Ministry of Agriculture of the Slovak Republic no. 453/2006 Coll. on the commercial arrangement in forests and on the forest's protection.***

The regulation sets down details on the commercial arrangement in forests and on the protection of forests. It provides basic framework for sustainable forest management taking into account productive and non-productive functions of forests.

GHG affected: CO_2

Type of the measure: regulative, economic with indirect impact on emissions

Status: implemented

Implementing entity: Ministry of Agriculture of the Slovak Republic.

- ***Regulation of Ministry of Agriculture of the Slovak Republic no. 12/2009 Coll. on the protection of forest lands at regional-planning activities and at their exemption from and restriction of fulfilling forest's functions.***

The regulation sets down details on the submission of applications for the approval of the draft of regional-planning documentation, for the determination of protected deposit areas and for determination and enlargement of mining areas and the mining permit. Furthermore, it regulates the details of application for the exemption or the restriction of the use of forest lands.

GHG affected: CO_2

Type of the measure: regulative, economic with indirect impact on emissions

Status: implemented

Implementing entity: Ministry of Agriculture of the Slovak Republic.

4.3.6 Sector waste

The overview of legal acts in sector of waste, adopted before 2005 and presented in the Fourth National Communication of the Slovak Republic on Climate Change that have remained in force:

- ***Act 223/2001 Coll. on wastes and on change and amendment of certain acts.***
- ***Act 529/2002 Coll. on packaging and on change and amendment of certain acts.***
- ***Act 364/2004 Coll. on waters and on change of Act 372/1990 Coll. on offences, as amended by later regulations (Water Act).***
- ***Act 17/2004 Coll. on charges for disposal of waste on landfills.***
- ***The Council Directive 1999/31/EC on the landfill of waste.***
- ***The Council Directive 91/271/EEC concerning urban wastewater treatment.***

Further legal acts have been adopted after 2005, which influence directly or indirectly the generation of greenhouse gas emissions in sector waste:

- ***Directive 2006/12/EC of the European Parliament and of the Council of 5th April 2006 on waste***

The directive adopts measures to protect environment and human health against adverse impacts of collection, transport, treatment, storage, recovery and disposal of waste. Member States shall adopt appropriate measures to support the prevention or reduction of waste production and its harmfulness in particular by development of clean technologies aiming at the environmental benefit, also to sparing in the use of natural resources. The other field should be technical development and marketing of products designed so as to make no contribution or to make the smallest possible contribution, by the nature, use or disposal, to the increase of the amount or harmfulness of waste and pollution hazards. The support of the development of appropriate methods of final dangerous substances disposal contained in waste that goes for recovery, the support of waste recovery through recycling, re-use or any other processes allowing gaining secondary raw materials, or the use of waste as energy source, are the activities that can positively influence greenhouse gas emissions. The directive defines also waste categories, recovery and disposal of wastes. The increase in a number of waste incineration plants is not expected, therefore this measure is taken into account as constant level also for the future.

GHG affected: N_2O

Type of the measure: regulative with direct impact on emissions

Status: implemented

Implementing entity: Ministry of Environment of the Slovak Republic.

Table 4.1 shows a summary of selected policies and measures in waste management, as well as reduction potential in 2010, 2015 and 2020.

4.3.7 Summary of selected policies and measures in relevant sectors, including their reduction potential in specific years

Table 4.1: Summary table of policies and measures with reduction potential.

Sector energy including transport:						
Measure	Type of measure	Status	Greenhouse gas	Gg CO_2ekv.		
				2010	2015	2020
Act 572/2004 Coll.	economic regulative	implemented	CO_2, CH_4, N_2O	983	1.372	1.802
Act 476/2008 Coll. Directive 2002/91/EC	regulative	implemented	CO_2, CH_4, N_2O	38	38	38
Regulation no. 246/2006 Coll. Directive 2003/30/EC	regulative	implemented	CO_2, CH_4, N_2O	262	418	631
Climate and Energy Package	economic regulative	planned	CO_2, CH_4, N_2O	1.585	2.578	2.643
Sector industry:						
Regulation 842/2006/EC Act 286/2009 Coll.	regulative	implemented	HFCs	2	82	117
Sector agriculture:						
Directive 91/676/EEC	regulative	implemented	N_2O	412	409	427
Sector waste:						
Directive 2006/12/EC	regulative	implemented	N_2O	262	418	631

4.3.8 Other information on policies and measures

Costs and benefits of PAM

On the basis of the planned activities within the Ministry of Environment and other relevant ministries in 2010, a comprehensive analysis of measures implemented in the field of climate change and renewable energy resources should be available by the end of the year. In addition to the modelling of the reduction potential of the selected measures (including the analysis of their mutual synergies), the Commission for Climate and Energy Package should also prepare macro-economic analysis of the expected costs and benefits of the compliance with objectives of the Climate and Energy Package, together with proposals for the adequate forms of financing.

- ***Interactions of PAM***
- PAM no. 1 - energy consumption: Energy Performance of Buildings (Directive 2002/91/EC) (National policy or measure: Act 555/2005 Coll. on energy performance of buildings).

Will cause the decrease of heat consumption demand, that has positive impact on the GHG emission level in sectors 1A1a (Public electricity and heat production) and sector 1A4b (Residential). Data represent impact in residential individual space heating only; the impact for building supplied from centralized district heat supply is included in PAM no. 3.

- PAM no. 2 - energy supply: Electricity Production from Renewable Energy Resources (Directive 2001/77/EC) (National policy or measure: Act 656/2004 Coll. on energy).

Impact on fuel mix in sector 1A1a (Public electricity utilities) and decrease of GHG emissions. Interaction with PAM no. 3 and impact included in PAMs no. 3 and 13.

- PAM no. 3 - cross-cutting: Emission Trading Scheme (Directive 2003/87/EC) (National policy or measure: Act 572/2004 Coll. on emission trading in amendments and Decree of Ministry of Environment no. 711/2004).

Emission trading scheme will support the increase of less carbon intensive fuel consumption, preferably biomass. Interaction with PAM no. 2.

- PAM no. 4 - energy supply: Internal Electricity Market (Directive 2003/54/EC) (National policy or measure: Act 656/2004 Coll. on energy, Act 658/2004 Coll. on regulation in power industry).

Not direct impact, only in the case of increase of electricity import will cause the decrease of GHG emissions from domestic electricity generation.

- PAM no. 5 - energy supply: Internal market in natural gas (Directive 98/30/EC) (National policy or measure: Act 658/2004 Coll. on regulation in power industry).

Not direct impact.

- PAM no. 6 - agriculture: Nitrates Directive (Directive 91/676/EEC)..

Direct impact on N_2O emission in sector agriculture.

- PAM no. 7 - waste: Directive on waste (Directive 2006/12/EC).

Direct impact on N_2O emission in sector waste.

- PAM no. 8 - transport: Biofuels Directive (Directive 2003/30/EC) (National policy or measure: Regulation no. 246/2006 Coll. on minimum share of biofuels in gasoline and diesel oil).

Direct impact on the GHG emission in sector transport. Included in PAM no. 3.

- PAM no. 9 - agriculture: Common Rules for Direct Support Schemes under CAP (Regulation (EC) no. 1782/2003).

There is not direct impact in sector agriculture, secondary it help to higher standard of production and agriculture waste handling.

- PAM no. 10 - national policy or measure: Act Proposal 988/2009 Coll. on support renewable energy resources and high-efficiency combined energy production.

Interaction with PAMs no. 1 and 2. Positive impact on GHG emission level at electricity and heat generation.

- PAM no. 11 - national policy or measure: Directive 2008/74/EC amending, as regards the type approval of motor vehicles with respect to emissions from light passenger cars and commercial vehicles (Euro 5 and Euro 6) and access to vehicle repair and maintenance information.

Direct impact on GHG emissions from sector transport due the specific fuel combustion decrease.

- PAM no. 12 - national policy or measure: Act 476/2008 Coll. on energy efficiency.

Direct impact on GHG emission level due the fuel consumption at electricity and heat generation in sectors public and industry.

- PAM no. 13 - national policy or measure: Climate and Energy Package.

Interaction with previous PAMs no. 1 to 12.

- PAM no. 14 - industrial processes: HFC emissions from air conditioning in motor vehicles (Directive 2006/40/EC) (National policy or measure: Regulation of the Slovak Government no. 655/2007 on technical requirements for emission reduction in air-condition in vehicles).

Direct impact in sector industry (F-gases).

- PAM no. 15 - industrial process: F-gas regulation (Regulation no. 842/2006) (National policy or measure: Regulation of the Government no. 655/2007 on technical requirements for emission reduction in air-condition in vehicles).

Interaction with PAM no. 14.

- ***Impact on long-term mitigation under the Kyoto Protocol***

The impact on long-term mitigation under the Protocol has not been investigated specifically in the Slovak Republic yet.

- ***PAM pursuant to Article 2 of the KP (in case of the differences between PAM under the Convention and PAM under the KP)***

Policies and measures pursuant to Article 2 of the KP are described in section 4.3.8. No differences are registered between PAMs under the Convention and PAMs under the KP in the Slovak Republic.

- ***International aviation and maritime transport***

Airline operators in the Slovak Republic have implemented all recommendations and technical requirements of the International Civil Aviation Organisation (ICAO). Specific identification codes of ICAO have been introduced to identify flights under ICAO codes in the flight plans. The identification of airports has not been changed and it complies with ICAO nomenclature.

4.3.9 Information on policies and measures, which minimize the adverse effects on climate change, international trade, the social and economic impacts and impacts on environment of the other countries

This chapter addresses the potential economic, social and environmental consequences of the mitigation measures adopted and implemented within the environmental policy in the SR for developing countries. Measures adopted within a particular economy can affect the price and thus also real economic development in other countries through so called spill-over effects. Therefore Kyoto Protocol in Article 3, section 14[4] requires a quantification and assessment of the expected macroeconomic impacts of measures adopted by Annex I countries on developing countries. At the same time it requires an identification of a manner of adoption of these measures in terms to minimize their adverse social, environmental and economic impacts. A subsequent removal of the remaining barriers of price flexibility as well as liberalization of the international trade leads towards a more profound interaction between the particular regional markets, what also increases the importance of the spill-over effects of the particular measures of the environmental policies.

Economy of the Slovak Republic, being a small open economy does not allow for a significant impact of its internal price mechanism on the development of world prices. From this point of view, any potential impacts of the measures adopted in the Slovak Republic on other countries can be considered as minimal. This situation has changed to some extent following our accession to the EU and integration into the single European market. Historically, a major bulk of the adopted measures within the environmental policy was of command and control type of regulatory measures. By the end of nineties a shift has occurred towards an increasing application of the polluter pays principle penalizing polluters and providing incentives for adoption of more environmentally sound technologies in particular through fiscal policy instruments. Their major benefit expected was an increasing emphasize on cost effective compliance with the adopted environmental target through the function of the price mechanism. The fundamental ideal of the price liberalization was establishment of a competitive environment, where market generates an equilibrium price of commodities. An adequate regulation is acceptable in case of a lasting existence of market imperfections. In charge of supervision on the price development founded by the macroeconomic fundamentals are independent regulatory institutions, which are also responsible to correct the existing market distortions.

- ***Coal industry***

State aid granted to the coal industry consists of three main pillars: coal, steel and electricity markets. The Slovak Republic has fully privatized the former state owned mines and continues in granting the coal industry investment aid. Report prepared by the EC notes that mines in the Slovak Republic are in terms of production costs competitive with respect to the prevailing world prices. Subsidies granted to the coal industry affect only the provision of the coal resources, i.e. the decision whether to buy own or imported coal. However, the other regulation such as compulsory utilization of home extracted coal does also affect the composition of the energy

[4] *While taking into the account the methodology outlined in the decision 31/CMP.1, §11*

mix, i.e. the share of coal on the electricity production. European Commission has highlighted the potential impact of these decisions on the internal electricity market. Impacts of similar types of measures adopted within the coal industry on the steel markets have not been observed. Within the period of 2003 – 2006 coal prices on world markets remained more stable in comparison with other fossil fuels such as oil and gas. The Slovak Republic does not export its coal to the other countries. On the base of the mentioned facts we can conclude that the economy of the Slovak Republic has minimal impact on the existing structure of the international trade with coal and pricing.

- ***Flexible mechanism KP***

During the first commitment period of the Kyoto Protocol (2008 – 2012) the emission allowances for the EU ETS sectors are allocated free of charge. No quantitative study has yet examined the potential transmission of the emission allowances prices on the producer prices and the price of electricity within EU ETS sectors. No significant impact of the variation of emission allowance prices on the oil consumption within the Slovak Republic in the near term future is expected. As well as any influence originating from the actions taken by the regulators in the Slovak Republic on the potential revenues of the oil exporting countries will remain insignificant. The Slovak Republic is hosting one JI project and at this stage does not participate in any CDM project in developing countries.

- ***Utilization of biofuels***

Policies supporting the utilisation of the biofuels are closely linked to the EU trade and common agricultural policies. Strategies to faze in the alternative sources of motor fuels have been developed within the National Program of Development of Biofuels, while their practical implementation has been regulated by the Directive 246/2006 Coll. which entered into force the 1st May 2006. This directive has set the minimum levels of biofuels in motor gasoline and diesel oil. A range of programs with focus on enhancement of biofuels utilisation within European Union[5] has provided a significant stimulus for the production of biofuels as well as to the stronger growth of the international trade with biofuels, often with negative side impacts on the economies of developing countries. Despite increasing imports of biofuels we perceive the impact of the Slovak Republic on the world prices of biofuels as negligible.

- ***Carbon leakage***

Carbon leakage due to the decreasing share of allocation of emission allowances through grandfathering pro bono of auctions and benchmarks requires detailed and continuous analysis. A potential solution to minimize the risk of carbon leakage and reallocation of the industrial base in the countries with less stringent environmental policies is subsequent rise of the shares of allowances to be allocated through auctioning. This measure is relevant for the sectors, where the risk of the carbon leakage has been identified.

- ***Foreign aid***

According to the preliminary assessment of the bilateral and specific projects of the foreign development policy of the SR within 2004 – 2007, more than 21% of these projects focused on the support of the utilization of renewable energy resources and energy efficiency, on the adaptation measures including construction of the early warning systems, adjustments and efficiency improvements of the water management as well as for capacity building and improvement in the infrastructure for the compliance with Convention and Kyoto Protocol (Serbia, Kazakhstan). The Slovak Republic as a country with rich experiences within this area, participates on aid delivered in order to strengthen practical implementation of the Kyoto Protocol and compliance with its commitments and preparation of the legislative framework for implementation of the market mechanisms and emission trading systems (administration and national emission registries, emission audits, monitoring systems and emission balances). The Slovak Republic is able to deliver projections of hydro power plants, complex delivery of the relevant technology as well as inspection of construction. Currently, we have not been carrying out any programs of assistance for oil exporting countries. Recently Slovak oil imports have remained stable with slightly increasing trend, what is not expected to have any negative impacts on oil exporting economies. In addition to the delivered development aid, the Slovak Republic has expanded the provisions of preferential market access for the developing and the least developed countries

[5] *A strong demand growth for biofuels has contributed also a combination of different supporting policies in the EU and USA.*

4.4 POLICIES AND MEASURES FOR CLIMATE CHANGE THAT ARE NOT IN FORCE ANYMORE

- ***Act 658/2004 Coll. changing and amending Act 276/2001Coll. on the regulation of network sectors and on change and amendment of certain acts***

Common This act regulated subject, scope, conditions and the way of regulation in network sectors, the establishment and competences of the Regulatory Office for Network Industries, the subject and conditions of the State regulation, conditions for performance of regulated activities and rights and obligations of regulated subjects, and rules for electricity and gas markets.

GHG affected: CO_2, CH_4 and N_2O

Type of the measure: regulative

Status: terminated activity

Implementing entity: Ministry of Economy of the Slovak Republic.

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Projections, total effect of policies and measures and supplementarity relating to Kyoto Protocol mechanisms

Since the publication of the Fourth National Communication of the Slovak Republic on Climate Change, significant political and economic transformations have been carried out. These transformations have been reflected in designing scenarios of projections of greenhouse gas emissions. Accession of the Slovak Republic to the Euro zone in January 2009 was the most important change having impact on economy. Since the end of 2008, the global economic crisis has been deepening, which has resulted in temporary decrease in economy and stagnation of production. Basic development of the activities determining the level of projected emissions has resulted from the assumptions of macro-economic development and conceptions of relevant sectors of national economy, which have not considered potential impacts of the economic crisis. So called "gas crisis" at the beginning of 2009 was critical with regard to energy and production stability of the Slovak Republic.

Complexity and dynamic changes of economic development in recent years have complicated significantly also the preparation of projections of greenhouse gas emissions, particularly with respect to continual changes of estimated development of macro-economic indicators for near future. The impact of changes of economic indicators on the production of emissions has been a monitored parameter within the sensitive analysis. Long-term development of greenhouse gas emissions depends also on other parameters, such as opening energy market and CO_2 emission allowance trading. In spite of existing restrictions resulting from the dynamic changes of governing parameters, the reality of achieving the reduction target under the Kyoto Protocol, as well as the potential for further reduction of emissions after 2012, can be done through the results of modelling.

5.1 PROJECTIONS OF EMISSIONS

The year 2006 was determined as the reference year for modelling of greenhouse gas emissions for all the scenarios, for which verified data sets were available from the national inventory of greenhouse gas emissions. Projections of greenhouse gas emissions[1] were elaborated for 2010, 2015 and 2020 according to the following scenarios:

- ***Scenario without measures***

It represents the status not taking into account policies and measures regarding the projections that have been implemented, adopted or projected after the reference year 2006.

- ***Scenario with measures***

It represents the status taking into account the effect of implemented and adopted policies and measures regarding the projections that have been adopted after the reference year 2006.

- ***Scenario with additional measures***

It represents the status taking into account, besides the policies and measures implemented and adopted after the reference year 2006, also the effect of projected policies and measures.

Projections of GHG emissions have been elaborated for all relevant IPCC sectors by CRF categories, as well as by greenhouse gases (CO_2, CH_4, N_2O, PFCs, HFCs and SF_6). Results of total aggregated projections of GHG emissions in CO_2 equivalent by IPCC sectors are presented in Table 5.44. Projections of GHG emissions from international aviation and navigation have not been calculated within the national projections and they have been quantified separately.

Due to missing relevant data on long-term macroeconomic indicators, the projections of GHG emissions for 2030 have not been determined.

Table 5.1 presents historical data on Gross Domestic Product (GDP) and Value Added (VA) in constant prices in 2000 together with projected indicators by 2020.

[1] *www.ghg-inventory.gov.sk, http://cdr.eionet.europa.eu/sk/eu/colqjazmw*

Table 5.1: Historical data and projections of GDP and VA in billions SKK and Euro.

Indicator	Unit	2000*	2005*	2010	2015	2020
GDP	SKK	938,755	1,193,169	1,755,535	2,313,552	2,911,342
VA	SKK	837,149	1,085,825	1,551,514	2,110,499	2,659,139
GDP	Euro	22,042	30,917	58,273	76,796	96,639
VA	Euro	19,656	28,135	51,501	70,056	88,267

*Source: The Institute of Financial Policy of 1st May 2009. * In these cases the average rate was used from the archive of the National Bank of Slovakia.*

5.2 ASSESSMENT OF AGGREGATE EFFECTS OF POLICIES AND MEASURES

This chapter presents results of modelling of GHG emissions by individual sectors and gases together with the assessment of impact of policies and measures for all scenarios. Total impact of policies and measures has been determined as the distinctions between scenarios after the definition of the impact of a particular measure.

5.2.1 Sector energy including transport

Sector energy produces GHG emissions form combustion and transformation of fossil fuels. Fugitive methane emissions are generated from fuel extraction, transport and processing.

5.2.1.1 Projections of CO_2 emissions

Projections of CO_2 emissions have resulted from the results of the last emission inventory, independently verified, in sector energy[1]. With respect to projections, this sector covers also CO_2 emissions from the combustion of motor fuels in transport.

Basic assumptions for scenario modelling of CO_2 emissions:

Projections of CO_2 emissions from combustion and transformation of fossil fuels have been determined by the optimization model MESSAGE[2]. Depending on the structure and the trend in final energy consumption, model MESSAGE allows quantifying influence of emission ceilings.

Basic input data for scenarios development are as follows:

- Expected development of macro-economic indicators by 2020. Data are presented in table 5.1.
- Structure of heat consumption in sectors residential and services quantified on the base of data of the Ministry of Construction and Regional Development of the Slovak Republic.
- Expected increase in the electricity production in electric power stations (SE-ENEL, a.s.). In defining the scenario it was assumed that boilers in ENO and EVO electricity plants that do not comply with emission limits, will be eliminated and replaced by new fluid equipment. The scenario will take into account also shutting-down of one block of the nuclear power station in Jaslovské Bohunice in 2008.
- Composition of vehicles in road transport, annual mileage of vehicles and their consumption.
- Outputs in railway, water and air transports.

[2] *Model for Energy Supply Strategy Alternatives and their General Environmental Impacts.*

Table 5.2: Historical data and projections of GDP and VA in Billions EURO.

NACE	2000	2005	2010	2015	2020
Total	**18,102.98**	**18,102.98**	**45,827.46**	**62,075.00**	**78,027.02**
A, B. Agriculture, hunting and forestry, fishing	880.32	880.32	2,515.41	2,955.94	3,225.37
C. Mining and quarrying	155.67	155.67	235.83	245.42	253.31
D. Manufacturing	**3,298.25**	**3,298.25**	**12,437.83**	**16,789.48**	**20,302.81**
of which:					
DA. Manufacture of food products, beverage and tobacco products	287.82	287.82	2,145.74	2,824.02	3,577.55
DB. Manufacture of textiles and textile products	405.88	405.88	659.84	724.04	788.88
DE. Manufacture of pulp, paper and paper products, publishing and printing	375.59	375.59	1,056.13	1,464.48	1,899.20
DF. Manufacture of coke, refined petroleum products and nuclear fuel	281.60	281.60	351.23	454.63	539.69
DG. Manufacture of chemical products	360.96	360.96	548.09	828.05	1,076.80
DJ. Manufacture of basic metals and metal products	800.89	800.89	2,716.66	3,313.07	3,767.26
DK. Manufacture of machinery and equipment	386,79	386,79	1,776.02	2,590.73	3,371.50
DM. Manufacture of transport equipment	398.72	398.72	3,184.14	4,590.46	5,281.93
E. Electricity, gas and water supply	722.98	722.98	1,077.05	1,218.19	1,278.51
F. Construction	1,386.09	1,386.09	3,476.08	4,711.86	5,963.64
G. Wholesale and retail trade, repair of motor vehicles, motorcycles and personal household goods	2,652.49	2,652.49	8,118.70	11,056.93	14,156/62
H. Hotels and restaurants	296.39	296.39	697.21	813.57	937.06
I. Transport, storage, posts and telecommunication	1,988.94	1,988.94	3,749.05	5,984.39	8,425.43
J. Financial intermediation	472.56	472.56	876.36	1,102.35	1,369.87
K. Real estate, renting and business activities	2,891.73	2,891.73	5,758.05	8,698.88	11,738.55
L. Public administration and defence, compulsory social security	1,459.84	1,459.84	2,580.24	2,852.67	3,248.80
M. Education	715.47	715.47	1,296.13	1,694.57	2,161.38
N. Health and social work	701.43	701.43	1,551.75	2,038.53	2,600.09
O,P. Other activities of services and private household	480.83	480.83	1,457.79	1,912.24	2,365.58

Constant prices in 2000 and 2005 are recalculated through the exchange rate of the archive of the National Bank of Slovakia and constant prices in 2010, 2015 and 2020 through the exchange rate provided for the Slovak Republic.

Scenario without measures:

Differently from the Fourth National Communication of the Slovak Republic on Climate Change, the measures in relation to fulfilling provisions of Act 478/2002 Coll. on air protection are included in scenario without measures. Input data for projections come from:

- Database NEIS and the National emission inventory of GHG for 2006.
- Estimated increase in electricity generation in SE-ENEL, a.s., simultaneously taking into account impacts of policies and measures adopted and/or implemented by 2006.
- Dynamics of expected inter-years increase in heat consumption by residents has been quantified in conformity with the assumptions published by the Institute for Financial Policy.
- Final consumption of fuels in industry was set down on the base of expected share of this sector in GDP. At the same time it was assumed, that internal energy efficiency improvement in industry would be improved by 1% annually. This will lead to the decrease in specific emission generation (per unit) in industrial heating plants.
- Volumes of processed oil and production of oil products complying with assumptions published by the dominant producer at the Slovak market, i.e. Slovnaft, a.s.

Table 5.3: Input data for the calculation of heat consumption in family houses in sector residential heating – scenario without measures.

Indicator	2005	2010	2015	2020
Number of apartments in family houses	**854,008**	**856,271**	**858,243**	**856,777**
	TJ/year			
Total heating	**65,177**	**62,079**	**59,113**	**56,102**
Old houses	51,935	49,213	46,634	44,190
New houses	13,241	12,866	12,479	11,912
	TJ/year			
Total hot water	**940**	**895**	**853**	**810**
Old houses	733	695	658	624
New houses	207	201	195	186
	TJ/year			
Total consumption	**66,116**	**62,975**	**59,966**	**56,911**
Old houses	52,668	49,908	47,292	44,813
New houses	13,448	13,067	12,674	12,098

Table 5.4: Input data for the calculation of heat consumption in apartment houses without central heating system – scenario without measures.

Indicator	2005	2010	2015	2020
Number of apartments in family houses	**852,180**	**854,400**	**856,333**	**854,896**
	TJ/year			
Total heating	**3,195**	**3,231**	**3,264**	**3,267**
Old houses	462	460	458	457
New houses	2,733	2,771	2,806	2,810
	TJ/year			
Total hot water	**1,512**	**1,529**	**1,545**	**1,547**
Old houses	204	203	202	201
New houses	1,309	1,326	1,343	1,345
	TJ/year			
Total consumption	**4,707**	**4,760**	**4,809**	**4,813**
Old houses	665	663	660	658
New houses	4,042	4,097	4,149	4,155

Table 5.5: Input data for the calculation of heat consumption in apartment houses with central heating system – scenario without measures.

Indicator	2005	2010	2015	2020
Number of apartments in family houses	**13,168**	**13,124**	**13,086**	**13,114**
	TJ/year			
Total heating	**26,729**	**25,451**	**24,227**	**22,991**
Old houses	19,287	18,276	17,318	16,411
New houses	7,442	7,174	6,909	6,581
	TJ/year			
Total hot water	**15,630**	**15,697**	**15,758**	**15,739**
Old houses	3,563	3,612	3,657	3,663
New houses	12,067	12,085	12,100	12,076
	TJ/year			
Total consumption	**42,359**	**41,148**	**39,985**	**38,731**
Old houses	22,850	21,888	20,976	20,074
New houses	19,509	19,260	19,009	18,657

Scenario with measures:

In defining the scenario with measures, the policies and measures adopted after the reference year for projections (2006) are considered. The effect of direct legislative standard concerning the supervision and reduction of GHG emissions in undertakings incorporated into the scheme for GHG emission allowance trading under Act 572/2004 Coll., is also included in this scenario. Analysis of input data from database NEIS confirms that most of sources have already met of emission limits of basic air pollutants, or use less carbon intensive fuels, in particular natural gas. Therefore, no significant changes of fuels in selected stationary sources can be expected in the future.

Results of modelling indicate that technically and economically viable potential for the reduction of emissions is as follows:

- Shift to combined coal and biomass combustion up to 30% share of biomass compared to the original fuel (with respect energy input of existing equipment).
- Shift to sole combustion of natural gas in boilers originally combusting liquid fuels in combination with natural gas.

Table 5.6: Input data for the calculation of heat consumption for residential heating in family houses – scenario with measures.

Indicator	2005	2010	2015	2020
Number of apartments in family houses	**854,008**	**856,271**	**858,243**	**856,777**
Old houses	644,036	641,731	639,434	637,145
New houses	209,972	214,541	218,809	219,632
TJ/year				
Total heating	**65,177**	**62,079**	**59,113**	**56,102**
Old houses	51,935	49,213	46,634	44,190
New houses	13,241	12,866	12,479	11,912
TJ/year				
Total hot water	**940**	**895**	**853**	**810**
Old houses	733	695	658	624
New houses	207	201	195	186
TJ/year				
Total consumption	**66,116**	**62,975**	**59,966**	**56,911**
Old houses	52,668	49,908	47,292	44,813
New houses	13,448	13,067	12,674	12,098

Table 5.7: Input data for the calculation of heat consumption in apartment houses without central heating system – scenario with measures.

Indicator	2005	2010	2015	2020
Number of apartments in family houses	**852,180**	**854,400**	**856,333**	**854,896**
TJ/year				
Total heating	**3,195**	**3,072**	**2,952**	**2,810**
Old houses	462	437	414	393
New houses	2,733	2,635	2,537	2,417
TJ/year				
Total hot water	**1,512**	**1,454**	**1,397**	**1,330**
Old houses	204	193	183	173
New houses	1,309	1,261	1,215	1,157
TJ/year				
Total consumption	**4,707**	**4,527**	**4,349**	**4,140**
Old houses	665	630	597	566
New houses	4,042	3,896	3,752	3,574

Table 5.8: Input data for the calculation of heat consumption in apartment houses with central heating system – scenario with measures.

Indicator	2005	2010	2015	2020
Number of apartments in family houses	**13,168**	**13,124**	**13,086**	**13,114**
	TJ/year			
Total heating	**26,729**	**25,451**	**24,227**	**22,991**
Old houses	19,287	18,276	17,318	16,411
New houses	7,442	7,174	6,909	6,581
	TJ/year			
Total hot water	**12,067**	**12,085**	**12,100**	**12,076**
Old houses	8,504	8,473	8,443	8,413
New houses	3,563	3,612	3,657	3,663
	TJ/year			
Total consumption	**38,796**	**37,536**	**36,327**	**35,068**
Old houses	27,791	26,750	25,761	24,824
New houses	11,005	10,786	10,566	10,244

Scenario with additional measures:

Scenario with additional measures models effects of policies and measures included in scenario with measures complemented by anticipated policies and measures, such as:

- Act 309/2009 Coll. on the promotion of renewable energy resources and particularly efficient combined production and on the change and amendment of certain acts.
- Legislative standards of the Climate and Energy Package.

In the quantification of reduction potential effect of the European Directive 2003/30/EC of 8th May 2003 on the promotion of the use of biofuels or other renewable fuels for transport, it is supposed that the share of these fuels in total consumption will be 5.75% in 2010 and 10% in 2020. The reduction effect of this measure represents emission reduction approximately by 262 Gg CO_2 equivalents in 2010 and 631 Gg CO_2 equivalents in 2020, what has been reflected in scenario with measures.

Table 5.9: Input data for the calculation of heat consumption for residential heating in family houses – scenario with additional measures.

Indicator	2005	2010	2015	2020
Number of apartments in family houses	**854,008**	**856,271**	**858,243**	**856,777**
	TJ/year			
Total heating	**65,177**	**59,007**	**53,406**	**48,177**
Old houses	51,935	46,777	42,132	37,947
New houses	13,241	12,229	11,274	10,229
	TJ/year			
Total hot water	**940**	**851**	**771**	**695**
Old houses	733	660	595	536
New houses	207	191	176	160
	TJ/year			
Total consumption	**66,116**	**59,858**	**54,177**	**48,872**
Old houses	52,668	47,438	42,726	38,483
New houses	13,448	12,420	11,450	10,389

Table 5.10: Input data for the calculation of heat consumption in apartment houses without central heating system – scenario with additional measures.

Indicator	2005	2010	2015	2020
Number of apartments in family houses	**852,180**	**854,400**	**856,333**	**854,896**
Old houses	547,697	545,737	543,783	541,837
New houses	304,483	308,663	312,550	313,059
	TJ/year			
Total heating	**3,195**	**2,920**	**2,667**	**2,413**
Old houses	462	416	374	337
New houses	2,733	2,504	2,292	2,075
	TJ/year			
Total hot water	**1,512**	**1,454**	**1,397**	**1,330**
Old houses	204	193	183	173
New houses	1,309	1,261	1,215	1,157
	TJ/year			
Total consumption	**4,707**	**4,375**	**4,064**	**3,743**
Old houses	665	609	557	510
New houses	4,042	3,766	3,507	3,233

Table 5.11: Input data for the calculation of heat consumption in apartment houses with central heating system – scenario with additional measures.

Indicator	2005	2010	2015	2020
Number of apartments in family houses	**13,168**	**13,124**	**13,086**	**13,114**
	TJ/year			
Total heating	**26,729**	**20,708**	**16,039**	**12,385**
Old houses	19,287	14,871	11,465	8,840
New houses	7,442	5,837	4,574	3,545
	TJ/year			
Total hot water	**12,067**	**12,085**	**12,100**	**12,076**
Old houses	8,504	8,473	8,443	8,413
New houses	3,563	3,612	3,657	3,663
	TJ/year			
Total consumption	**38,796**	**32,793**	**28,140**	**24,461**
Old houses	27,791	23,344	19,909	17,253
New houses	11,005	9,449	8,231	7,208

Results of modelling:

Figure 5.1 shows the results of modelling projections of CO_2 emissions according to the particular scenarios. Anticipated dynamics of economic growth will lead to the increase in CO_2 emissions. In spite of this, keeping the level of adopted target of the Slovak Republic under the Kyoto Protocol is real for all modelled scenarios in the first binding period. Based on the results of modelling and comparing these results with the projections in foregoing communications (table 5.12), the following conclusions can be presented:

- The share of natural gas in sector energy has been increasing progressively as the result of measures that have been implemented within complying with the provisions of Act 478/2002 Coll. on air protection. Thus the room for the introduction of additional measures aiming at the change of fuels in favour of fuels with lower carbon emission factor has been diminished significantly.
- Due to ongoing structural changes of economy, the degree of uncertainty for correlation between the trend in added value and final energy consumption is still high. With respect to the trend in heat and energy consumption, the projections consider the coefficient of autonomous reduction of energy intensity in industry at the level of 1%.

- In foregoing national communications, the projections made use of the assumption of relatively balanced iron production. Current scenarios make use of adapted increase in metallurgy, which reflects current trend in this sector more precisely.
- Projections in sector transport come out from annual mileage of motor vehicles and their specific consumptions in road transport and from transport outputs in rail, water and air transports. All available policies and measures in sector transport, as well as national conditions, have been taken into account in modelling

Figure 5.1: Projections of CO_2 emissions according to defined scenarios in sector energy (Gg).

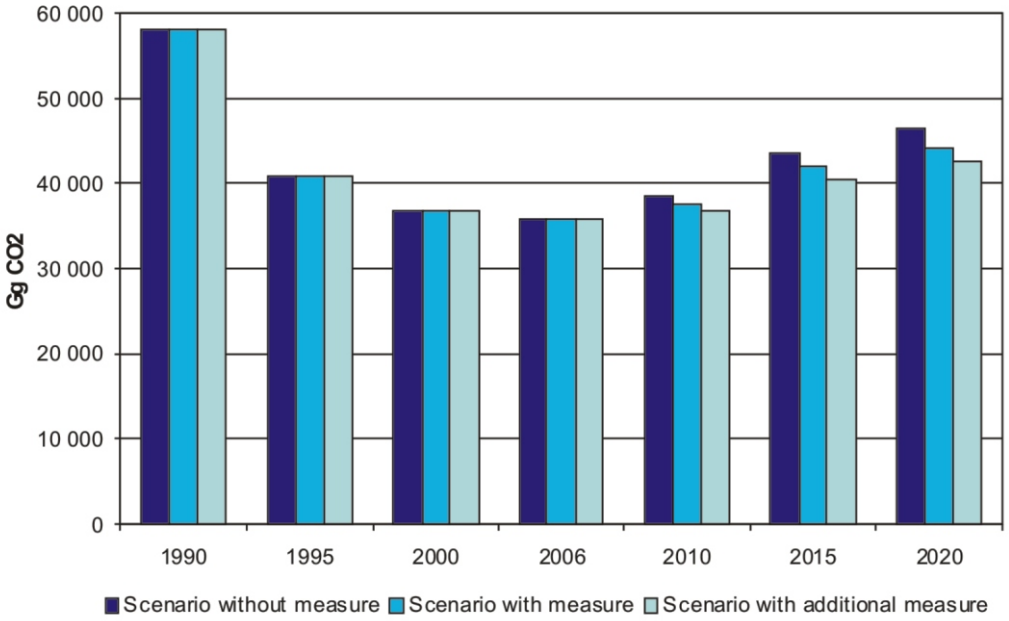


Table 5.12: Projections of CO_2 emissions in sector energy (Gg).

Categories	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	**58,055**	**40,816**	**36,751**	**35,834**	**38,685**	**43,543**	**46,341**
1.A.1 Energy industry	16,091	11,934	12,244	11,192	11,466	13,507	14,534
1.A.2 Manufacturing industries and production	24,291	16,415	12,834	13,338	13,882	15,726	17,405
1.A.3 Transport	4,892	4,259	4,182	5,743	7,546	8,097	7,781
1.A.4 Other sectors	10,908	6,581	5,979	4,507	4,734	5,097	5,457
1.A.5 Others	1,873	1,627	1,512	1,053	1,058	1,117	1,164
Scenario with measures	**58,055**	**40,816**	**36,751**	**35,834**	**37,638**	**41,954**	**44,111**
1.A.1 Energy industry	16,091	11,934	12,244	11,192	11,223	13,178	14,126
1.A.2 Manufacturing industries and production	24,291	16,415	12,834	13,338	13,402	14,997	16,397
1.A.3 Transport	4,892	4,259	4,182	5,743	7,284	7,680	7,151
1.A.4 Other sectors	10,908	6,581	5,979	4,507	4,675	4,993	5,291
1.A.5 Others	1,873	1,627	1,512	1,053	1,054	1,107	1,145
Scenario with additional measures	**58,055**	**40,816**	**36,751**	**35,834**	**36,808**	**40,307**	**42,573**
1.A.1 Energy industry	16,091	11,934	12,244	11,192	10,724	11,929	12,962
1.A.2 Manufacturing industries and production	24,291	16,415	12,834	13,338	13,332	14,901	16,289
1.A.3 Transport	4,892	4,259	4,182	5,743	7,117	7,489	7,012
1.A.4 Other sectors	10,908	6,581	5,979	4,507	4,589	4,892	5,177
1.A.5 Others	1,873	1,627	1,512	1,053	1,047	1,096	1,133

**Emissions in the base year under the KP*

5.2.1.2 Projections of CH_4 emissions

The energy related CH_4 emissions arise from the combustion and transformation of fossil fuel. Fugitive methane emissions arise from the extraction, transport and processing of fuels. The projections of CH_4 emissions from the combustion and transformation of fossil fuels have been modelled by means of the fuel consumption in individual scenarios according to the IPCC method and recommended IPCC aggregated emission factors. In the case of CH_4 emissions in transport, emission factors of the model COPERT IV were applied for individual types of vehicle. Modelling made use of the same scenarios as in the case of CO_2 emissions from the combustion and transformation of fuels (chapter 5.2.1.1). This approach allows finding out the effect of measures aimed for the reduction of CO_2 emissions to the level of CH_4 emissions. The annual fugitive emissions of CH_4 have been calculated for the following activities (table 5.13):

- Underground mining and post-mining activities.
- Transport and processing of oil and oil products.
- Extraction and transport of natural gas.
- Venting and flaring.

Table 5.13: Projections of CH_4 emissions in sector energy (Gg).

Categories	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	**73.439**	**72.458**	**74.500**	**59.220**	**79.825**	**79.777**	**79.555**
1.A From combustion	21.789	13.627	11.617	12.421	27.334	27.707	27.898
of which Transport 1.A.3	1.030	1.139	1.133	1.136	1.378	1.504	1.502
1.B Fugitive emissions - total	51.650	58.831	62.882	46.799	52.491	52.069	51.657
1.B.1.a Mining and handling	27.198	29.704	28.821	14.671	17.159	16.735	16.321
1.B.2.a Transport and processing of oil	0.217	0.209	0.168	0.133	0.147	0.147	0.147
1.B.2.b Extraction and transport of natural gas	21.355	25.339	28.864	29.154	32.108	32.110	32.111
1.B.2.c Venting and flaring	2.877	2.910	2.828	2.841	3.078	3.078	3.078
Scenario with measures	**73.439**	**72.458**	**74.500**	**59.220**	**68.462**	**68.359**	**68.078**
1.A From combustion	21.789	13.627	11.617	12.421	15.971	16.289	16.422
of which Transport 1.A.3	1.030	1.139	1.133	1.136	1.376	1.502	1.500
1.B Fugitive emissions - total	51.650	58.831	62.882	46.799	52.491	52.069	51.657
1.B.1.a Mining and handling	27.198	29.704	28.821	14.671	17.159	16.735	16.321
1.B.2.a Transport and processing of oil	0.217	0.209	0.168	0.133	0.147	0.147	0.147
1.B.2.b Extraction and transport of natural gas	21.355	25.339	28.864	29.154	32.108	32.110	32.111
1.B.2.c Venting and flaring	2.877	2.910	2.828	2.841	3.078	3.078	3.,078
Scenario with additional measures	**73.439**	**72.458**	**74.500**	**59.220**	**68.363**	**68.051**	**67.830**
1.A From combustion	21.789	13.627	11.617	12.421	15.871	15.981	16.174
of which Transport 1.A.3	1.030	1.139	1.133	1.136	1.375	1.501	1.499
1.B Fugitive emissions - total	51.650	58.831	62.882	46.799	52.491	52.069	51.657
1.B.1.a Mining and handling	27.198	29.704	28.821	14.671	17.159	16.735	16.321
1.B.2.a Transport and processing of oil	0.217	0.209	0.168	0.133	0.147	0.147	0.147
1.B.2.b Extraction and transport of natural gas	21.355	25.339	28.864	29.154	32.108	32.110	32.111
1.B.2.c Venting and flaring	2.877	2.910	2.828	2.841	3.078	3.078	3.078

**Emissions in the base year under the KP.*

5.2.1.3 Projections of N_2O emissions

The energy related N_2O emissions arise from the combustion and transformation of fossil fuel. The production of N_2O emissions from transport has also been calculated within this sector. Similarly to methane, the projections of N_2O emissions are calculated by means of IPCC method which makes use of recommended emission factors. In transport the emission factors for individual types of vehicles are used from the model COPERT IV. Scenarios for the calculation of emissions from combustion and transformation of fuels are the same as the scenarios for CO_2 and CH_4 emissions and it allows analysing the effect of measures focused on the reduction of CO_2 emissions and the production of N_2O.

Table 5.14: Projections of N_2O emissions in sector energy (Gg).

Categories	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	**0.924**	**0.660**	**0.698**	**0.883**	**2.909**	**2.976**	**2.979**
1.A.1 Energy industry	0.204	0.116	0.109	0.110	0.097	0.091	0.093
1.A.2 Manufacturing industries and production	0.190	0.119	0.083	0.077	1.936	1.951	1.964
1.A.3 Transport	0.394	0.326	0.415	0.569	0.750	0.807	0.792
1.A.4 Other sectors	0.130	0.094	0.087	0.123	0.124	0.125	0.126
1.A.5 Others	0.006	0.005	0.004	0.004	0.002	0.003	0.004
Scenario with measures	**0.924**	**0.660**	**0.698**	**0.883**	**2.917**	**2.980**	**2.979**
1.A.1 Energy industry	0.204	0.116	0.109	0.110	0.109	0.101	0.102
1.A.2 Manufacturing industries and production	0.190	0.119	0.083	0.077	1.936	1.948	1.959
1.A.3 Transport	0.394	0.326	0.415	0.569	0.748	0.805	0.790
1.A.4 Other sectors	0.130	0.094	0.087	0.123	0.122	0.123	0.124
1.A.5 Others	0.006	0.005	0.004	0.004	0.002	0.003	0.004
Scenario with additional measures	**0.924**	**0.660**	**0.698**	**0.883**	**2.986**	**3.041**	**3.041**
1.A.1 Energy industry	0.204	0.116	0.109	0.110	0.189	0.174	0.177
1.A.2 Manufacturing industries and production	0.190	0.119	0.083	0.077	1.928	1.938	1.951
1.A.3 Transport	0.394	0.326	0.415	0.569	0.746	0.804	0.787
1.A.4 Other sectors	0.130	0.094	0.087	0.123	0.121	0.122	0.123
1.A.5 Others	0.006	0.005	0.004	0.004	0.002	0.003	0.003

**Emissions in the base year under the KP.*

5.2.1.4 Projections of aggregated GHG emissions

Table 5.15 shows aggregated projections of GHG emissions in sector energy. Total aggregated projections of emissions from sector transport are presented individually. Figure 5.2 shows the comparison of projected emissions in sector energy in CO_2 equivalents by 2020 for all scenarios.

Table 5.15: Aggregated projections of GHG emissions in sector energy (Gg CO_2 equivalents).

Scenario	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	59,884	42,542	38,532	37,351	41,264	46,142	48,935
- of which Transport 1.A.3	5,036	4,384	4,359	5,944	7,807	8,379	8,058
Scenario with measures	59,884	42,542	38,532	37,351	39,980	44,313	46,465
- of which Transport 1.A.3	5,036	4,384	4,359	5,944	7,545	7,961	7,427
Scenario with additional measures	59,884	42,542	38,532	37,351	39,170	42,679	44,940
- of which Transport 1.A.3	5,036	4,384	4,359	5,944	7,377	7,770	7,288

**Emissions in the base year under the KP.*

Figure 5.2: Projections of aggregated GHG emissions in sector energy excluding transport (%).

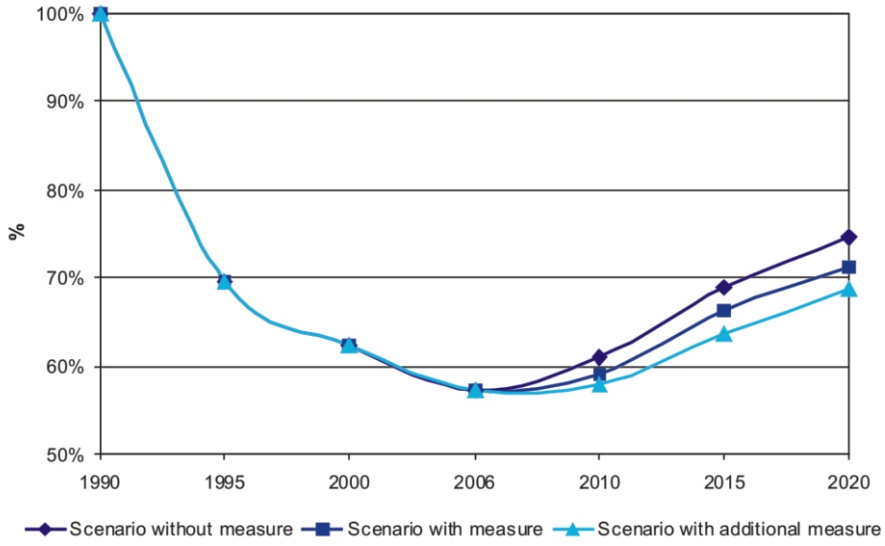
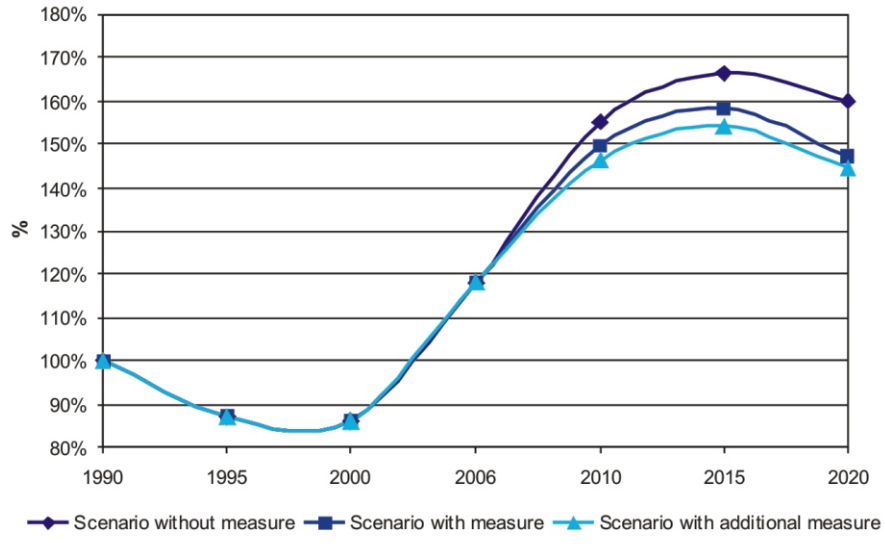


Table 5.16: Aggregated projections of GHG emissions in sector transport (Gg CO_2 equivalents).

Categories	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	**5,036.710**	**4,383.834**	**4,334.675**	**5,943.743**	**7,807.316**	**8,378.672**	**8,058.200**
1.A.3a Civil aviation	8.006	5.676	5.690	12.159	17.606	17.606	17.606
1.A.3b Road transport	4,593.526	4,140.003	4,150.556	5,801.193	7,659.779	8,231.466	7,911.114
1.A.3c Railways	427.583	231.513	176.686	128.466	128.006	127.675	127.675
1.A.3e Other transport	7.256	6.643	1.743	1.925	1.925	1.925	1.925
Scenario with measures	**5,036.710**	**4,383.834**	**4,334.675**	**5,943.743**	**7,545.089**	**7,960.722**	**7,427.247**
1.A.3a Civil aviation	8.006	5.676	5.690	12.159	16.275	16.275	16.275
1.A.3b Road transport	4,593.526	4,140.003	4,150.556	5,801.193	7,400.214	7,817.178	7,283.703
1.A.3c Railways	427.583	231.513	176.686	128.466	126.675	125.344	125.344
1.A.3e Other transport	7.256	6.643	1.743	1.925	1.925	1.925	1.925
Scenario with additional measures	**5,036.710**	**4,383.834**	**4,334.675**	**5,943.743**	**7,376.584**	**7,769.546**	**7,287.548**
1.A.3a Civil aviation	8.006	5.676	5.690	12.159	16.275	16.275	14.497
1.A.3b Road transport	4,593.526	4,140.003	4,150.556	5,801.193	7,233.350	7,627.333	7,145.978
1.A.3c Railways	427.583	231.513	176.686	128.466	125.034	124.013	125.148
1.A.3e Other transport	7.256	6.643	1.743	1.925	1.925	1.925	1.925

**Emissions in the base year under the KP.*

Figure 5.3: Projections of aggregated GHG emissions in sector transport (%).



5.2.2 Sector industrial processes including F-gases

5.2.2.1 Projections of CO_2 emissions

The production of cement, lime and magnesite directly influence CO_2 generation, either the energy or non-energy (technology) origins. The trend in both the production and consumption of cement has been increasing since 2000. Similar trend is expected also in the future. As the trend of activities in this sector influences directly the production of CO_2 emissions of technological origin, projections of emissions reflect gradual increase of the production by 2020. Production of CO_2 emissions in this scenario depends directly on the production of construction materials and the use of mineral raw materials, therefore only the scenario with measure is presented. Measures to reduce CO_2 emissions that relate directly with fuel savings or more intensive utilisation of renewable energy resources, have already been analysed in the scenario with measures within the sector energy, category 1.A.2.f. Table 5.17 shows emission projections of technologic origin in sector industrial processes. Table 5.18 shows data of projected emissions in category mineral products.

Table 5.17: Projections of CO_2 emissions in sector industrial processes (Gg).

Categories	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	**3,840**	**3,158**	**3,501**	**4,124**	**4,739**	**5,852**	**7,239**
2.A Mineral products	2,942	2,342	2,522	3,014	3,577	4,493	5,672
2.B Chemical industry	356	380	399	351	270	313	346
2.C Metallurgy	542	437	580	760	892	1 046	1 221
Scenario with measures	**3,840**	**3,158**	**3,501**	**4,124**	**4,789**	**6,008**	**7,593**
2.A Mineral products	2,942	2,342	2,522	3,014	3,577	4,493	5,672
2.B Chemical industry	356	380	399	351	270	313	346
2.C Metallurgy	542	437	580	760	943	1,202	1,575

**Emissions in the base year under the KP.*

Figure 5.18: Projections of CO_2 emissions in category mineral products (Gg).

Categories	1990*	1995	2000	2006	2010	2015	2020
Scenario with measures	2,942	2,342	2,522	3,014	3,577	4,493	5,672
2.A.1 Cement production	1,438	1,134	1,169	1,364	1,619	2,034	2,567
2.A.2 Lime production	770	575	540	854	1,014	1,273	1,607
2.A.3 Limestone and dolomite use	302	339	404	455	540	678	856
2.A.7 Other	432	294	410	341	404	508	641

**Emissions in the base year under the KP.*

5.2.2.2 Projections of CH_4 emissions

Production of ammonia is the main source of methane emissions in sector industrial processes in the Slovak Republic. The projections are shown in table 5.19.

Table 5.19: Projections of CH_4 emissions from ammonia production (Gg).

Scenario	1990*	1995	2000	2006	2010	2015	2020
Scenario with measures	0.039	0.041	0.043	0.038	0.030	0.034	0.038

**Emissions in the base year under the KP.*

5.2.2.3 Projections of N_2O emissions

Production of nitric acid in two chemical companies is the main source of N_2O emissions in the Slovak Republic. The company, which produces approximately a half of total production, considers to increase the production slightly. At the same time a new technology should be introduced and consequently, the N_2O emissions should be reduced. Only one scenario has been developed for the projection of N_2O emissions from the production of nitric acid. Modelling results are presented in table 5.20:

- Scenario with measures anticipates that maximal capacity of nitric acid production will be reached by 2020 together the implementation of best available techniques in this field.

Table 5.20: Projections of N_2O emissions from HNO_3 production (t).

Scenario	1990*	1995	2000	2006	2010	2015	2020
Scenario with measures	0.777	0.829	0.851	0.768	0.591	0.685	0.759

**Emissions in the base year under the KP.*

5.2.2.4 Projections of PFCs, HFCs and SF_6 emissions

Fluorinated gases (F-gases) belongs to three basic groups of greenhouse gases defined in Annex A to the Kyoto Protocol (HFCs, PFCs and SF_6). These substances have replaced the ozone depleting freons that are monitored under the Montreal Protocol. F-gases contribute by 0.5% to total GHG emissions. The share of F-gases should be reduced due to the phasing out of refrigerant R134 from new mobile air conditioning, reducing the consumption of refrigerants and developing new and efficient equipment that will use natural refrigerants. Projections of F-gases emissions are complicated due to a relatively high number of various mixtures of gases. Some mixtures contain 12 different gases in different proportions (table 5.21). Projections of F-gases emissions have been developed for all three scenarios:

- Scenario without measures represents the current level with respect to legislation. If the expected decrease in emission factor, recovery of refrigerants and slowing down in increasing the amounts of refrigerants in equipment are not succeeded to reach, the emissions will increase more significantly. Only upcoming legislative standards, which should restrict the use of new F-gases and stimulate the introduction of new technologies, will result in gradual reduction of emissions.
- Scenario with measures reflects on the effect of legislative measures restricting the use of refrigerants after the reference year for projections (2006), as well as compulsory inspections with respect to potential leakages, recovery of refrigerants and products. Current trend of rapid increase in F-gases consumption should slow down by 2011 and then should start to drop. The drop after 2011 will result from phasing out of HFCs in new mobile air conditioning and the definitive ban of their use after 2015.
- Scenario with additional measures is similar to the scenario with measures. However, it reflects on further reduction of GHG emissions after the implementation of planned policies and measures for this field (more details in chapter 4).

Table 5.21: Projections of PFCs, HFCs and SF_6 emissions in sector industrial processes (Gg CO_2 equivalents).

Category	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	**271.403**	**136.479**	**87.233**	**251.871**	**364.704**	**474.009**	**468.493**
PFC	271.373	114.325	11.647	35.822	35.822	35.822	35.822
HFC	NA**	22.153	75.586	198.897	310.382	417.887	411.571
SF_6	0.031	0.000	0.001	17.152	18.500	20.300	21.100
Scenario with measures	**271.403**	**136.479**	**87.233**	**251.871**	**362.704**	**392.009**	**351.784**
PFC	271.373	114.325	11.647	35.822	35.822	35.822	35.822
HFC	NA**	22.153	75.586	198.897	308.382	335.887	294.862
SF_6	0.031	0.000	0.001	17.152	18.500	20.300	21.100
Scenario with additional measures	**271.403**	**136.479**	**87.233**	**251.871**	**360.781**	**389.729**	**351.482**
PFC	271.373	114.325	11.647	35.822	35.822	35.822	35.822
HFC	NA**	22.153	75.586	198.897	306.458	333.607	294.560
SF_6	0.031	0.000	0.001	17.152	18.500	20.300	21.100

**Emissions in the base year under the KP. **Not applicable.*

5.2.2.5 Projections of aggregated GHG emissions

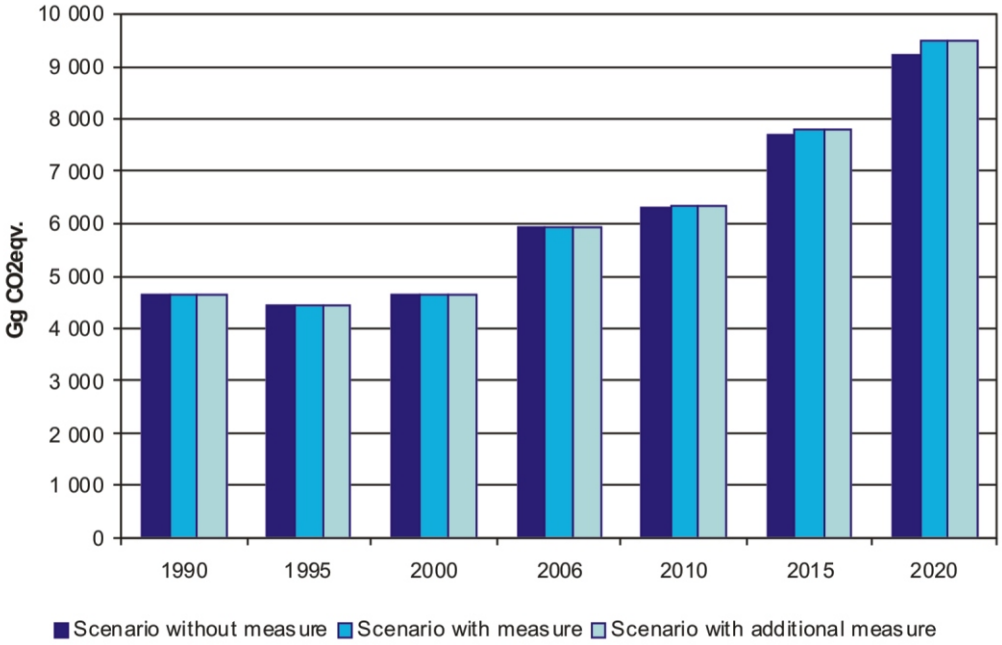
Table 5.22 and figure 5.4 show aggregated data on the projections of technological GHG emissions in sector industrial processes, including F-gases.

Table 5.22: Projections of aggregated GHG emissions in sector industrial processes, including F-gases (Gg CO_2 equivalents).

Scenarios	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	4,617	4,423	4,623	5,925	6,290	7,703	9,233
Scenario with measures	4,617	4,423	4,623	5,925	6,338	7,777	9,471
Scenario with additional measures	4,617	4,423	4,623	5,925	6,336	7,775	9,471

**Emissions in the base year under the KP.*

Figure 5.4: Projections of aggregated GHG emissions according to defined scenarios in sector industrial processes, including F-gases (Gg CO_2 equivalents).



5.2.3 Sector agriculture

Definition of scenarios for modelling emissions came out from, besides the policy and measures described in chapter 4, the measures presented in the Common Agricultural Policy (CAP). Simultaneously, the expected situations in livestock, agricultural waste management, sown areas and management methods on agricultural soil by 2020 were quantified by expert estimations.

Input data on number of livestock used for the projections of GHG emissions in sector agriculture are shown in table 5.23.

Table 5.23: Projections of livestock number in the Slovak Republic by 2020 (thousand of animals).

Indicator	1990	1995	2000	2006	2010	2015	2020
Cattle total	1,563.0	982.7	646.1	507.8	510.4	512.9	515.5
of which:							
Dairy cattle	549.0	355.2	271.2	218.7	219.7	220.8	221.9
Other cattle	1,014.0	627.5	375.0	289.2	290.6	292.1	293.5
Pigs	2,521.0	2,076.4	1,488.4	1,104.8	1,126.9	1,149.5	1,172.5
Sheep and lambs	600.0	427.8	348.0	332.6	339.2	346.0	352.9
Goats	25.0	25.0	51.4	38.4	40.0	40.4	41.0
Horses	14.0	10.1	9.5	8.2	8.1	8.0	6.3
Poultry	16,478.0	13,382.4	12,446.0	13,038.3	13,299.1	13,565.1	13,836.4

5.2.3.1 Projections of CH_4 emissions

Methane sources in agriculture are discussed in details in chapter 3 and chapter 4, together with potential measures to reduce GHG emissions.

As it has already been mentioned, real options to reduce emissions include:

- Reduction in the number of livestock, or changes in the livestock structure with respect to categories (cattle, pigs, poultry, horses, sheep and goats).
- Processing of animal waste and production of biogas.

The following scenarios have been used for modelling projections of methane emissions from enteric fermentation:

- Scenario without measures comes out from the level of emissions directly influenced by the number of livestock.
- Scenario with measures come out from additional legislative measures described in chapter 4 (the Common Agricultural Policy, Regulation no. 1782/2003/EC establishing common rules for direct support scheme under the common agricultural policy and establishing certain support scheme for farmers. This legislative framework has been completed recently by Regulation no. 1009/2008/EC, Directive 91/676/EEC on nitrates from agricultural sources and other regulations).
- No significant changes in the projection of emissions have occurred in modelling of other policies and measures, therefore the results of scenario with measures have been used also for the scenario with additional measures.

Table 5.24: Projections of CH_4 emissions in sector agriculture (Gg).

Category	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	**112.325**	**75.645**	**59.683**	**52.461**	**41.760**	**36.821**	**34.855**
4.A Enteric fermentation	94.770	62.392	50.163	44.972	33.225	28.602	26.789
4.B Manure management	17.555	13.253	9.520	7.489	8.535	8.222	8.085
Scenario with measures	**112.325**	**75.645**	**59.683**	**52.461**	**41.779**	**36.824**	**34.875**
4.A Enteric fermentation	94.770	62.392	50.163	44.972	33.243	28.598	26.770
4.B Manure management	17.555	13.253	9.520	7.489	8.535	8.222	8.085
Scenario with additional measures	**112.325**	**75.645**	**59.683**	**52.461**	**39.590**	**33.203**	**29.947**
4.A Enteric fermentation	94.770	62.392	50.163	44.972	33.225	28.598	26.770
4.B Manure management	17.555	13.253	9.520	7.489	6.365	4.605	3.177

**Emissions in the base year under the KP.*

Table 5.25: Projections of CH_4 emissions according livestock species in category enteric fermentation (Gg).

Category	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	**94.770**	**66.902**	**50.163**	**44.972**	**33.243**	**28.602**	**26.789**
4.A.1 Cattle	85.811	60.057	44.718	39.549	29.741	25.588	23.967
4.A.3 Sheep	4.800	3.423	2.784	3.426	2.001	1.721	1.612
4.A.4 Goats	0.125	0.125	0.257	0.192	0.144	0.124	0.116
4.A.6 Horses	0.252	0.182	0.171	0.148	0.111	0.096	0.090
4.A.8 Pigs	3.782	3.115	2.233	1.657	1.246	1.072	1.004
Scenario with measures	**94.770**	**66.902**	**50.163**	**44.972**	**33.25**	**28.598**	**26.770**
4.A.1 Cattle	85.811	60.057	44.718	39.549	29.724	25.585	23.949
4.A.3 Sheep	4.800	3.423	2.784	3.426	2.000	1.721	1.611
4.A.4 Goats	0.125	0.125	0.257	0.192	0.144	0.124	0.116
4.A.6 Horses	0.252	0.182	0.171	0.148	0.111	0.096	0.090
4.A.8 Pigs	3.782	3.115	2.233	1.657	1.245	1.072	1.004

**Emissions in the base year under the KP.*

The following scenarios have been used for modelling projections of methane emissions from manure management:

- Scenario without measures comes out from the level of emissions directly influenced by the number of livestock.
- Scenario with measures comes out from legislative measures described in chapter 4 (policies and measures are the same as in the case of enteric fermentation).
- Scenario with additional measures comes out from additional measures presented in chapter 4 (policies and measures are the same as in the case of enteric fermentation).

Table 5.26: Projections of CH_4 emissions according livestock species in category manure management (Gg).

Category	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	**16.270**	**12.209**	**8.549**	**6.472**	**7.376**	**7.106**	**6.987**
4.B.1 Cattle	6.049	3.805	2.510	1.973	2.249	2.167	2.131
4.B.3 Sheep	0.114	0.081	0.066	0.063	0.072	0.069	0.068
4.B.4 Goats	0.003	0.003	0.006	0.005	0.005	0.005	0.005
4.B.6 Horses	0.020	0.014	0.013	0.012	0.013	0.013	0.012
4.B.8 Pigs	10.084	8.306	5.954	4.419	5.037	4.852	4.771
4.B.9 Poultry	1.285	1.044	0.971	1.017	1.159	1.117	1.098
Scenario with measures	**16.270**	**12.209**	**8.549**	**6.472**	**7.376**	**7.106**	**6.987**
4.B.1 Cattle	6.049	3.805	2.510	1.973	2.249	2.167	2.131
4.B.3 Sheep	0.114	0.081	0.066	0.063	0.072	0.069	0.068
4.B.4 Goats	0.003	0.003	0.006	0.005	0.005	0.005	0.005
4.B.6 Horses	0.020	0.014	0.013	0.012	0.013	0.013	0.012
4.B.8 Pigs	10.084	8.306	5.954	4.419	5.037	4.852	4.771
4.B.9 Poultry	1.285	1.044	0.971	1.017	1.159	1.117	1.098
Scenario with additional measures	**16.270**	**12.209**	**8.549**	**6.472**	**5.500**	**3.980**	**2.746**
4.B.1 Cattle	6.049	3.805	2.510	1.973	1.677	1.213	0.837
4.B.3 Sheep	0.114	0.081	0.066	0.063	0.054	0.039	0.027
4.B.4 Goats	0.003	0.003	0.006	0.005	0.004	0.003	0.002
4.B.6 Horses	0.020	0.014	0.013	0.012	0.010	0.007	0.,005
4.B.8 Pigs	10.084	8.306	5.954	4.419	3.756	2.717	1.875
4.B.9 Poultry	1.285	1.044	0.971	1.017	0.864	0.625	0.431

**Emissions in the base year under the KP.*

5.2.3.2 Projections of N_2O emissions

The following scenarios have been used for modelling projections of N_2O emissions from agriculture:

- Scenario without measures is defined in the same way as the projections of methane emissions. Therefore, it comes out from the number of livestock and nitrogen inputs into soil. The scenario does not reflect on the use of adaptation measures mitigating the production of N_2O emissions.
- Scenario with measures anticipates the intensification of production with respect to animal nutrition, the use of effective feed mixtures, etc. This scenario anticipates a high dynamics of the intensification of both plant and animal productions, what means increasing consumption of fertilizers within the developing programmes for growing corn, sugar beets, potatoes and oil plants. Higher consumption of fertilizers will result in higher production of post-harvest residues and consequently in higher concentration of mineralized nitrogen in soil. The reduction of costs for animal production on one hand and the manure management on the other hand will lead to the concentration and intensification of crop and corn cultivation in the lowlands. Mountain areas are expected to be used as pastures with extensive forms of management. Based upon these assumptions, the introduction of adaptation measures to reduce N_2O emissions is expected, in particular in lowlands. These techniques will be introduced into all large capacity cattle and pig husbandries by 2015. The scenario anticipates that a part of cattle will graze at large also after the year 2015.
- Scenario with additional measures come out from the assumption of the intensification of both plant and animal productions, where the adaptation measures can be found in the application of mineral fertilisers and manure in the soil. The reduction of N_2O emissions depends on the technical performance of farms. As the final effect depends also on weather conditions, only partial effect on the reduction of N_2O emissions can be expected.

Table 5.27: Projections of N_2O emissions in sector agriculture (Gg).

Category	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	**15.086**	**8.727**	**7.206**	**6.699**	**5.757**	**5.819**	**6.068**
4.B Manure management	3.531	2.359	1.645	1.337	1.337	1.957	1.880
4.D Agricultural soil	11.555	6.368	5.561	5.362	5.362	3.862	4.188
Scenario with measures	**15.086**	**8.727**	**7.206**	**6.699**	**4.430**	**4.502**	**4.692**
4.B Manure management	3.531	2.359	1.645	1.337	0.843	0.640	0.504
4.D Agricultural soil	11.555	6.368	5.561	5.362	3.587	3.862	4.188
Scenario with additional measures	**15.086**	**8.727**	**7.206**	**6.699**	**3.712**	**3.502**	**3.402**
4.B Manure management	3.531	2.359	1.645	1.337	0.843	0.640	0.504
4.D Agricultural soil	11.555	6.368	5.561	5.362	2.869	2.862	2.898

**Emissions in the base year under the KP.*

Table 5.28: Projections of N_2O emissions in the category direct and indirect emission from agricultural soil (Gg).

Category	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	**11.555**	**6.368**	**5.561**	**5.362**	**3.587**	**3.862**	**4.188**
4.D.1 Direct emissions	7.787	4.385	3.963	3.877	2.593	2.793	3.028
4.D.2 Pasture, Range and Paddocks	0.715	0.471	0.356	0.298	0.199	0.215	0.233
4.D.3 Indirect emissions	3.053	1.512	1.243	1.187	0.794	0.855	0.927
Scenario with measures	**11.555**	**6.368**	**5.561**	**5.362**	**3.587**	**3.862**	**4.188**
4.D.1 Direct emissions	7.787	4.385	3.963	3.877	2.593	2.793	3.028
4.D.2 Pasture, Range and Paddocks	0.715	0.471	0.356	0.298	0.199	0.215	0.233
4.D.3 Indirect emissions	3.053	1.512	1.243	1.187	0.794	0.855	0.927
Scenario with additional measures	**11.555**	**6.368**	**5.561**	**5.362**	**2.869**	**2.862**	**2.898**
4.D.1 Direct emissions	7.787	4.385	3.963	3.877	2.075	2.070	2.096
4.D.2 Pasture, Range and Paddocks	0.715	0.471	0.356	0.298	0.160	0.159	0.161
4.D.3 Indirect emissions	3.053	1.512	1.243	1.187	0.635	0.633	0.641

**Emissions in the base year under the KP.*

5.2.3.3 Projections of aggregated emissions

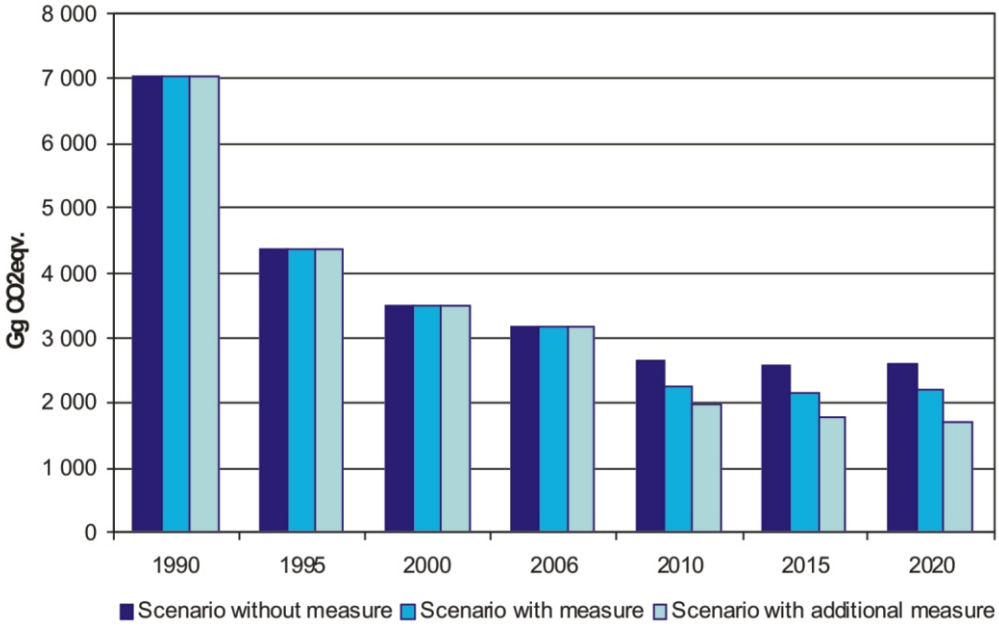
Table 5.29 and figure 5.5 show aggregated data on the projections of GHG emissions in sector agriculture.

Table 5.29: Projections of aggregated emissions in sector agriculture (Gg CO_2 equivalents).

Category	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	**7.036**	**4.389**	**3.487**	**3.178**	**2.662**	**2.577**	**2.613**
4.A Enteric fermentation	1.990	1.405	1.053	944	698	601	562
4.B Manure management	1.463	1.010	710	572	852	779	753
4.D Agricultural soil	3.582	1.974	1.724	1.662	1.112	1.197	1.298
Scenario with measures	**7.036**	**4.389**	**3.487**	**3.178**	**2.251**	**2.169**	**2.187**
4.A Enteric fermentation	1.990	1.405	1.053	944	698	601	563
4.B Manure management	1.463	1.010	710	572	441	371	326
4.D Agricultural soil	3.582	1.974	1.724	1.662	1.112	1.197	1.298
Scenario with additional measures	**7.036**	**4.389**	**3.487**	**3.178**	**1.982**	**1.783**	**1.684**
4.A Enteric fermentation	1.990	1.405	1.053	944	698	601	562
4.B Manure management	1.463	1.010	710	572	395	295	223
4.D Agricultural soil	3.582	1.974	1.724	1.662	889	887	898

**Emissions in the base year under the KP.*

Figure 5.5: Projections of aggregated GHG emissions according to defined scenarios in sector agriculture (Gg CO_2 equivalents).



5.2.4 Sector land use, land use change and forestry (LULUCF)

Projections of CO_2 sinks in sector LULUCF were modelled based upon the measures applied in this sector. The measures include the following activities:

- Afforestation of non-forest areas.
- Grassing of arable soil.
- Increasing protection against forest fires.

Based upon the analysis of policies and measures, only two scenarios have been developed for the projections of CO_2 sinks in forestry and land use. Results of modelling are shown in table 5.30 in conformity with IPCC categories. Projections of sinks in this sector have been developed for the following scenarios:

- Scenario without measures takes into account the current status of forest management and land use in conformity with the effective legislation and the estimated development of forests according to effective forest management plans without the introduction of any specific measures. In 2004 – 2006, only minimal specific mitigating measures were implemented in forest management and land use. In 2004 – 2006, afforestation of agricultural soil was supported by the Rural Development Programme and Sector Operational Programme Agriculture and Rural Development. 15 projects covering total forested area with classical trees of 100 ha were approved within these programmes.
- Scenario with measures represents the effect of considered measures after the year 2006. No measures have been proposed and modelled within this scenario up to 2010, as they have not been planned in strategic documents either. The scenario is practically identical with the scenario with additional measures. The Rural Development Programme for the period of 2007 – 2013 can be considered as the main instrument for mitigation measures, which plans the measures that have been reflected in the scenario, as follows:
  - Afforestation of 800 ha of low productive soil by fast growing trees and the first afforestation of 600 ha of agricultural soil by 2015.
  - Grassing of 50,000 ha of arable soil by 2015.
  - Afforestation of 23,000 ha of agricultural soil by 2020.
  - Effect of Regulation no. 2152/2003/EC Forest Focus in relation to forest fires estimates the reduction of risk of forest fires to 90% compared the period of 2000 – 2003.

5.2.4.1 Projections of CO_2 sinks

Table 5.30 shows the results of modelling CO_2 sinks in sector land use, land use change and forestry.

Table 5.30: Projections of CO_2 sinks in sector LULUCF (Gg).

Category	1990*	1995	2000	2006	2010	2015	2020
Scenario without measure	**-2,406.6**	**-2,696.0**	**-2,403.4**	**-3,050.8**	**-3,121.9**	**-2,716.9**	**-2,793.9**
5.A Forest land	-4,454.0	-4,399.4	-4,318.4	-3,096.8	-3,209.0	-2,826.0	-2,927.0
5.B Cropland	3,286.7	2,062.6	4,394.2	1.1	1.1	1.1	1.1
5.C Grassland	535.9	256.3	-797.4	-439.5	-477.0	-477.0	-477.0
5.F Other land	-1,775.1	-615.5	-1,681.9	484.4	563.0	585.0	609.0
Scenario with measure	**-2,406.6**	**-2,696.0**	**-2,403.4**	**-3,050.8**	**-3,121.9**	**-2,930.9**	**-3,506.9**
5.A Forest land	-4,454.0	-4,399.4	-4,318.4	-3,096.8	-3,209.0	-2,834.0	-3,263.0
5.B Cropland	3,286.7	2,062.6	4,394.2	1.1	1.1	1.1	1.1
5.C Grassland	535.9	256.3	-797.4	-439.5	-477.0	-802.0	-446.0
5.F Other land	-1,775.1	-615.5	-1,681.9	484.4	563.0	704.0	201.0

**Sinks/Emissions in the base year under the KP.*

5.2.4.2 Projections of CH_4 emissions from forest fires

The same procedure was used in modelling CH_4 emissions as it was used in the projections of CO_2 sinks. The projections of CH_4 emissions from forest fires are shown in table 5.31.

Table 5.31: Projections of CH_4 emissions in sector LULUCF from forest fires (Gg).

Scenario	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	0.439	0.459	0.670	0.900	0.923	0.923	0.923
Scenario with measures	0.439	0.459	0.670	0.900	0.883	0.873	0.873

**Emissions in the base year under the KP.*

5.2.4.3 Projections of N_2O emissions from forest fires

Projections of N_2O emissions have been modelled similarly to the projections of CO_2 sinks. The results are shown in table 5.32.

Table 5.32: Projections of N_2O emissions in sector LULUCF from forest fires (Gg).

Scenario	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	0.011	0.007	0.01	0.010	0.012	0.012	0.012
Scenario with measures	0.011	0.007	0.01	0.010	0.011	0.011	0.011

**Emissions in the base year under the KP.*

5.2.4.4 Projections of aggregated sinks

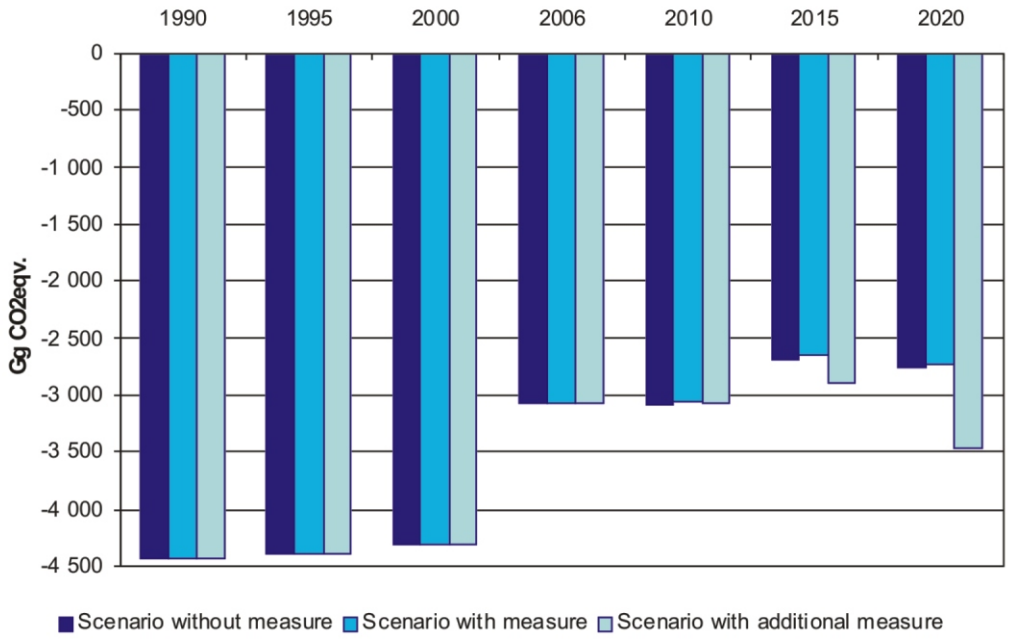
Table 5.33 and figure 5.6 show aggregated projections of GHG emissions and sinks in sector LULUCF.

Table 5.33: Projection of aggregated emissions and sinks in sector LULUCF (Gg CO_2 equivalents).

Scenario	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	-4,436	-4,387	-4,301	-3,075	-3,099	-2,694	-2,771
Scenario with measures	-4,436	-4,387	-4,301	-3,075	-3,100	-2,909	-3,485

**Sinks in the base year under the KP.*

Figure 5.6: Projections of aggregated GHG emissions and sinks according to defined scenarios in sector LULUCF (Gg CO_2 equivalents).



5.2.5 Sector waste management

Projections of emissions in sector waste management have been modelled for the following scenarios:

- Scenario without measures come out from current status and complies with measures required by the legislation adopted before 2006.
- Scenario with measures models the effect of measures required by the legislation adopted after 2006. These measures are as follows:
  - Decrease in volumes of municipal waste disposed of in landfills in compliance with Directive 2006/12/EC on landfill of waste.
  - Increase in the number of landfills utilising landfill gas by one landfill per year on average.
  - Increase in composting of municipal waste in compliance with Directive 2006/12/EC on landfill of waste.
  - The number of waste incineration plants is not expected to be increased.
  - Increase in composting of industrial waste by 1% per year on average.
  - Treatment of municipal and industrial waste water at the level of current status.
  - Waste generation is expected to decrease at the level of 5 kg/person/year by 2020.

In relation to considered legislation, the scenario with measures is identical with the scenario with additional measures.

5.2.5.1 Projections of CO_2 emissions

CO_2 Emissions are generated only from category waste incineration. Results of modelling are shown in table 5.34. Scenario with measures and scenario with additional measures do not anticipate the construction of new incineration plants, therefore the results of modelling are identical in both scenarios.

Table 5.34: Projections of CO_2 emissions from waste incinerations (Gg).

Scenario	1990*	1995	2000	2006	2010	2015	2020
Scenario with measures**	66.700	66.700	66.580	22.500	10.000	10.000	10.000

**Emissions in the base year under the KP. **Concurrently also scenario with additional measures.*

5.2.5.2 Projections of CH_4 emissions

CH_4 Emissions are generated from ladfilling of solid waste and waste water treatment. The implementation of measures presented in sector waste allows to define projections of CH_4 emissions for two scenarios. The scenario with measures is identical with the scenario with additional measures.

Table 5.35: Projections of CH_4 emissions in sector waste (Gg).

Category	1990*	1995	2000	2006	2007	2010	2015	2020
Scenario without measures	42.076	47.520	76.239	108.700	103.789	107.983	113.565	119.556
6.A Solid waste disposal sites	22.370	30.850	57.470	90.660	85.830	90.191	95.723	101.712
6.B Wastewater treatment	19.706	18.670	18.769	18.040	17.959	17.792	17.841	17.844
Scenario with measures**	42.076	47.520	76.239	108.700	103.789	106.858	106.179	104.960
6.A Solid waste disposal sites	22.370	30.850	57.470	90.660	85.830	88.271	86.372	84.470
6.B Wastewater treatment	19.706	18.670	18.769	18.040	17.959	18.586	19.807	20.489

**Emissions in the base year under the KP. **Concurrently also scenario with additional measures*

5.2.5.3 Projections of N_2O emissions

N_2O emissions are generated from waste water treatment, waste incineration and other waste and waste composting. The implementation of measures presented in sector waste allows to define projections of N_2O emissions for two scenarios. The scenario with measures is identical with the scenario with additional measures.

Table 5.36: Projections of N_2O emissions in sector waste (Gg).

Category	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	**0.341**	**0.297**	**0.255**	**0.237**	**0.428**	**0.497**	**0.529**
6.B Wastewater treatment	0.316	0.267	0.225	0.201	0.354	0.356	0.359
6.C Waste incineration	0.019	0.019	0.019	0.021	0.005	0.005	0.005
6.D Other waste	0.006	0.011	0.011	0.016	0.070	0.136	0.166
Scenario with measures**	**0.341**	**0.297**	**0.255**	**0.237**	**0.381**	**0.382**	**0.382**
6.B Wastewater treatment	0.316	0.267	0.225	0.201	0.354	0.354	0.354
6.C Waste incineration	0.019	0.019	0.019	0.021	0.005	0.005	0.005
6.D Other waste	0.006	0.011	0.011	0.016	0.023	0.023	0.023

**Emissions in the base year under the KP. **Concurrently also scenario with additional measures.*

5.2.5.4 Projections of aggregated GHG emissions

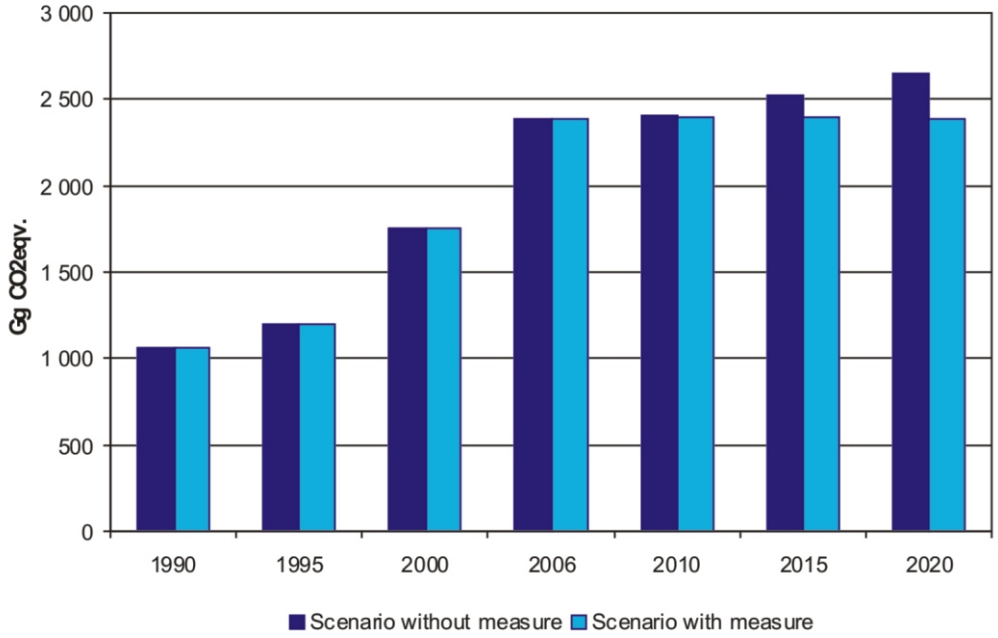
Table 5.37 and figure 5.7 show aggregated data on projections of GHG emissions in sector waste management.

Table 5.37: Projections of aggregated GHG emissions in sector waste management (Gg CO_2 equivalents).

Category	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures	**1,057.775**	**1,198.690**	**1,746.849**	**2,383.049**	**2,402.143**	**2,519.525**	**2,645.355**
6.A Landfills of solid waste	469.770	647.850	1,206.870	1,903.860	1,894.003	2,010.185	2,135.947
6.B Waste water total	511.813	474.840	463.899	441.048	483.316	484.515	484.582
6.C Waste incineration	72.652	72.590	72.670	29.010	11.550	11.550	11.550
6.D Other waste	3.540	3.410	3.410	9.131	13.275	13.275	13.275
Scenario with measures	**1,057.775**	**1,198.690**	**1,746.849**	**2,383.049**	**2,393.114**	**2,400.266**	**2,384.544**
6.A Landfills of solid waste	469.770	647.850	1,206.870	1,903.860	1,853.693	1,813.819	1,773.876
6.B Waste water total	511.813	474.840	463.899	441.048	499.923	526.405	541.497
6.C Waste incineration	72.652	72.590	72.670	29.010	11.550	11.550	11.550
6.D Other waste	3.540	3.410	3.410	9.131	27.948	48.492	57.621

**Emissions in the base year under the KP.*

Figure 5.7: Projections of aggregated GHG emissions according to defined scenarios in sector waste management (Gg CO_2 equivalents).



5.2.6 Projections of aggregated GHG emissions in monitored sectors

The projections of GHG emissions recalculated to equivalents of CO_2 according to valid values GWP have been developed for all IPCC sectors, defined years and relevant scenarios. Table 5.44 shows the results of modelling data in summary.

GHG emissions from international aviation and navigation have been developed only for the scenario with measures and they are not included in the national balance. From the data in tables 5.38 – 5.40 it is obvious, that projected GHG emissions from these transports are negligible in comparison with other sources.

Table 5.38: Projections of GHG emissions from international aviation for scenario with measures (Gg).

Category	1990*	1995	2000	2006	2010	2015	2020
CO_2	70.840	54.847	54.985	112.828	148.377	150.581	155.801
N_2O	0.003	0.006	0.007	0.005	0.005	0.007	0.008
CH_4	0.002	0.005	0.005	0.003	0.003	0.004	0.005

**Emissions in the base year under the KP.*

Table 5.39: Projections of GHG emissions from international navigation for scenario with measures (Gg).

Category	1990*	1995	2000**	2006	2010	2015	2020
CO_2	65.354	57.594	0	30.506	32.435	32.455	33.455
N_2O	0.002	0.002	0	0.013	0.014	0.014	0.015
CH_4	0.005	0.003	0	0.002	0.002	0.002	0.002

**Emissions in the base year under the KP. **Navigation and sale of fuel were stopped in 2000 due to war conflict in Balkan.*

Table 5.40: Aggregated data on the projections of GHG emissions from international aviation and navigation for scenario with measures (Gg CO_2 equivalents).

Category	1990*	1995	2000	2006	2010	2015	2020
International transport:	**137.875**	**115.131**	**57.26**	**148.922**	**186.786**	**189.376**	**196.232**
Aviation	71.778	56.812	57.26	114.314	150.123	152.694	158.239
Navigation	66.097	58.319	0	34.608	36.662	36.682	37.993

**Emissions in the base year under the KP.*

Table 5.41: Projections of total CO_2 emissions in monitored sectors (Gg).

Category	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures:							
CO_2 without LULUCF	**61,962**	**44,041**	**40,319**	**39,980**	**43,434**	**49,406**	**53,590**
CO_2 with LULUCF	**59,555**	**41,345**	**37,915**	**36,930**	**40,313**	**46,689**	**50,796**
Energy	58,055	40,816	36,751	35,834	38,685	43,543	46,341
of which Transport	4,892	4,259	4,182	5,743	7,546	8,097	7,781
Industrial processes	3,840	3,158	3,501	4,124	4,739	5,852	7,239
LULUCF	-2,407	-2,696	-2,403	-3,051	-3,122	-2,717	-2,794
Waste	67	67	67	23	10	10	10
Scenario with measures:							
CO_2 without LULUCF	**61,962**	**44,041**	**40,319**	**39,980**	**42,437**	**47,972**	**51,714**
CO_2 with LULUCF	**59,555**	**41,345**	**37,915**	**36,930**	**39,316**	**45,255**	**48,920**
Energy	58,055	40,816	36,751	35,834	37,638	41,954	44,111
of which Transport	4,892	4,259	4,182	5,743	7,284	7,680	7,151
Industrial processes	3,840	3,158	3,501	4,124	4,789	6,008	7,593
LULUCF	-2,407	-2,696	-2,403	-3,051	-3,122	-2,717	-2,794
Waste	67	67	67	23	10	10	10
Scenario with additional measures:							
CO_2 without LULUCF	**61,962**	**44,041**	**40,319**	**39,981**	**41,608**	**46,326**	**50,176**
CO_2 with LULUCF	**59,555**	**41,345**	**37,915**	**36,930**	**38,486**	**43,395**	**46,669**
Energy	58,055	40,816	36,751	35,834	36,808	40,307	42,573
of which Transport	4,892	4,259	4,182	5,743	7,546	8,097	7,781
Industrial processes	3,840	3,158	3,501	4,124	4,789	6,008	7,593
LULUCF	-2,407	-2,696	-2,403	-3,051	-3,122	-2,931	-3,507
Waste	67	67	67	23	10	10	10

**Emissions in the base year under the KP.*

Table 5.42 Projections of total CH_4 emissions in monitored sectors (Gg).

Category	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures:							
CH_4 without LULUCF	**227.839**	**197.623**	**210.418**	**220.381**	**229.568**	**230.162**	**233.966**
CH_4 with LULUCF	**227.839**	**197.623**	**210.418**	**220.381**	**229.568**	**230.162**	**233.966**
Energy	73.439	72.458	74.500	59.220	79.825	79.777	79.555
Agriculture	112.325	75.645	59.683	52.461	41.760	36.821	34.855
Waste	42.076	49.520	76.236	108.700	107.983	113.565	119.556
Scenario with measures:							
CH_4 without LULUCF	**227.839**	**197.623**	**210.418**	**220.381**	**217.098**	**211.362**	**207.913**
CH_4 with LULUCF	**227.839**	**197.623**	**210.418**	**220.381**	**217.098**	**211.362**	**207.913**
Energy	73.439	72.458	74.500	59.220	68.462	68.359	68.078
Agriculture	112.325	75.645	59.683	52.461	41.779	36.824	34.875
Waste	42.076	49.520	76.236	108.700	106.858	106.179	104.960
Scenario with additional measures:							
CH_4 without LULUCF	**227.839**	**197.623**	**210.418**	**220.381**	**214.810**	**207.433**	**202.737**
CH_4 with LULUCF	**227.839**	**197.623**	**210.418**	**220.381**	**214.810**	**207.433**	**202.737**
Energy	73.439	72.458	74.500	59.220	68.363	68.051	67.830
Agriculture	112.325	75.645	59.683	52.461	39.590	33.203	29.947
Waste	42.076	49.520	76.236	108.700	106.858	106.179	104.960

**Emissions in the base year under the KP.*

Table 5.43: Projections of total N_2O emissions in monitored sectors (Gg).

Category	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures:							
N_2O without LULUCF	**16.596**	**9.803**	**8.243**	**8.162**	**13.207**	**13.958**	**14.693**
N_2O with LULUCF	**16.607**	**9.810**	**8.253**	**8.173**	**13.224**	**13.975**	**14.711**
Energy	0.924	0.660	0.698	0.883	2.909	2.976	2.979
of which Transport	0.394	0.326	0.415	0.569	0.750	0.807	0.792
Industrial processes	0.190	0.119	0.083	0.077	3.883	4.504	4.989
Solvents and other products use	0.055	0.010	0.065	0.266	0.276	0.276	0.276
Agriculture	15.086	8.727	7.206	6.699	5.757	5.819	6.068
Waste	0.341	0.297	0.256	0.237	0.381	0.382	0.382
Scenario with measures:							
N_2O without LULUCF	**16.596**	**9.803**	**8.243**	**8.162**	**11.816**	**12.641**	**13.347**
N_2O with LULUCF	**16.607**	**9.810**	**8.253**	**8.173**	**11.879**	**12.705**	**13.410**
Energy	0.924	0.660	0.698	0.883	2.917	2.980	2.979
of which Transport	0.394	0.326	0.415	0.569	0.748	0.805	0.790
Industrial processes	0.190	0.119	0.083	0.077	3.883	4.504	4.989
Solvents and other products use	0.055	0.010	0.065	0.266	0.158	0.158	0.158
Agriculture	15.086	8.727	7.206	6.699	4.430	4.502	4.692
Waste	0.341	0.297	0.256	0.237	0.428	0.497	0.529
Scenario with additional measures:							
N_2O without LULUCF	**16.596**	**9.803**	**8.243**	**8.162**	**11.167**	**11.786**	**12.203**
N_2O with LULUCF	**16.607**	**9.810**	**8.253**	**8.173**	**11.183**	**11.801**	**12.218**
Energy	0.924	0.660	0.698	0.883	2.986	3.041	3.041
of which Transport	0.394	0.326	0.415	0.569	0.746	0.804	0.787
Industrial processes	0.190	0.119	0.083	0.077	3.883	4.504	4.989
Solvents and other products use	0.055	0.010	0.065	0.266	0.158	0.242	0.242
Agriculture	15.086	8.727	7.206	6.699	3.712	3.502	3.402
Waste	0.341	0.297	0.256	0.237	0.428	0.497	0.529

**Emissions in the base year under the KP.*

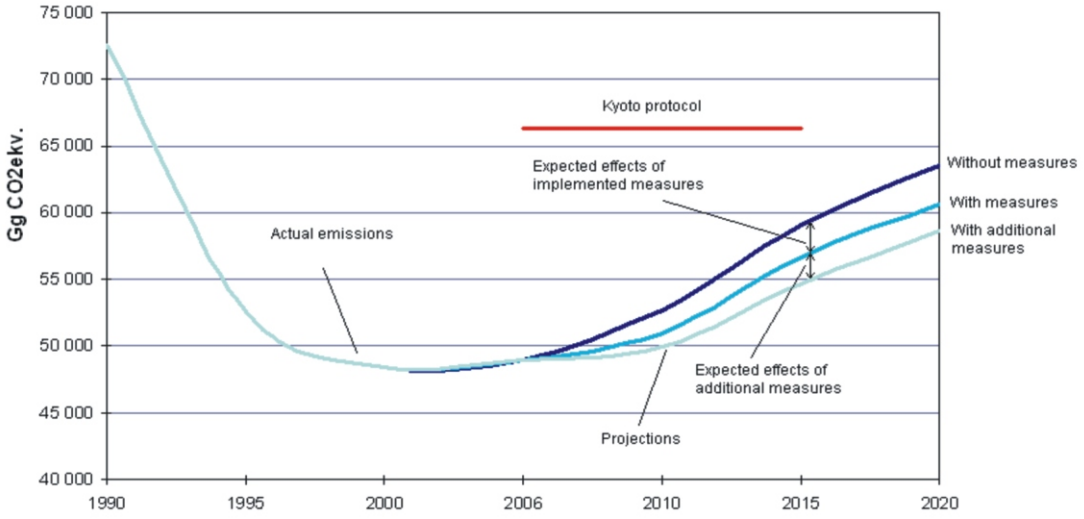
Table 5.44: Projection of aggregated GHG emissions in monitored sectors (Gg CO_2 equivalents).

Category	1990*	1995	2000	2006	2010	2015	2020
Scenario without measures:							
CO_2 eq. without LULUCF	**72,611**	**56,979**	**52,759**	**48,920**	**52,703**	**59,027**	**63,513**
CO_2 eq. with LULUCF	**70,222**	**54,295**	**50,373**	**45,914**	**49,619**	**56,348**	**60,757**
Energy	59,884	42,542	38,532	37,351	41,264	46,142	48,935
of which Transport	5,036	4,384	4,335	5,944	7,807	8,379	8,058
Industrial processes	4,617	4,431	4,635	5,925	6,290	7,703	9,233
Solvents and other products use	17	31	20	82	85	85	85
Agriculture	7,036	4,389	3,487	3,178	2,662	2,577	2,613
LULUCF	-2,388	-2,684	-2,386	-3,006	-3,084	-2,679	-2,756
Waste	1,058	1,202	1,750	2,383	2,402	2,520	2,645
Scenario with measures:							
CO_2 eq. without LULUCF	**72,611**	**56,979**	**52,759**	**48,920**	**51,011**	**56,708**	**60,556**
CO_2 eq. with LULUCF	**70,222**	**54,295**	**50,373**	**45,914**	**47,948**	**54,051**	**57,821**
Energy	59,884	42,542	38,532	37,351	39,980	44,313	46,465
of which Transport	5,036	4,384	4,335	5,944	7,545	7,961	7,427
Industrial processes	4,617	4,431	4,635	5,925	6,338	7,777	9,471
Solvents and other products use	17	31	20	82	49	49	49
Agriculture	7,036	4,389	3,487	3,178	2,251	2,169	2,187
LULUCF	-2,388	-2,684	-2,386	-3,006	-3,063	-2,658	-2,735
Waste	1,058	1,202	1,750	2,383	2,393	2,400	2,385
Scenario with additional measures:							
CO_2 eq. without LULUCF	**72,611**	**56,979**	**52,759**	**48,920**	**49,930**	**54,712**	**58,554**
CO_2 eq. with LULUCF	**70,222**	**54,295**	**50,373**	**45,914**	**46,850**	**51,823**	**55,089**
Energy	59,884	42,542	38,532	37,351	39,170	42,679	44,940
of which Transport	5,036	4,384	4,335	5,944	7,377	7,770	7,288
Industrial processes	4,617	4,431	4,635	5,925	6,336	7,775	9,471
Solvents and other products use	17	31	20	82	49	75	75
Agriculture	7,036	4,389	3,487	3,178	1,982	1,783	1,684
LULUCF	-2,388	-2,684	-2,386	-3,006	-3,079	-2,889	-3,465
Waste	1,058	1,202	1,750	2,383	2,393	2,400	2,385

**Emissions in the base year under the KP.*

Aggregated data on projections of GHG emissions according to three modelled scenarios in the period of 1990 – 2020 are summarised in figure 5.8. Their trend show that the reduction target under the Kyoto Protocol can be achieved also by the scenario without measures during the first binding period with the prospective until 2020.

Figure 5.8: Projections of aggregated GHG emissions according to defined scenarios in the monitored sectors.



5.3 SUPPLEMENTARITY RELATING TO MECHANISMS UNDER ARTICLES 6, 12 AND 17 OF THE KYOTO PROTOCOL

The Slovak Republic submitted the national inventory of GHG emissions for the period of 1990 – 2007 to the UNFCCC on 15th April 2009. In 2007, total GHG emissions were 46,950.67 Gg CO_2 equivalents without sinks from LULUCF. It means that the Slovak Republic achieved over 35% reduction of GHG emissions compared to the base year 1990 and the achievement of adopted reduction target is realistic. According to actual trends, GHG emissions have been decreased in spite of the dynamic growth of GDP (decoupling). Therefore, the Slovak Republic does not plan to use mechanisms JI and/or CDM to achieve the national reduction target[3].

The Slovak Republic is currently the beneficiary for only one potential JI project ERUPT no. 2002/CC/01 „Disposal of landfill gas in the Slovak Republic". The objective of this project is to catch and dispose of or to recover for energy methane from eight landfills in the country.

Considering the composition of landfills, the collected gas is incinerated, its energy recovery is limited by specific composition of landfills. For that reason, the expected decrease in emissions determined within the preparatory phase of the project was not reached in 2007 and 2008.

The Slovak Republic has not developed the rules for the selection and approval of JI projects in compliance with the requirements of paragraph 20 of Decision 9/CMP.1. In spite of complying with all other requirements, the SR is the country which has to use procedures according to Track 2 (paragraph 21 of the Decision).

Different situation is in the case of installations in the scheme of emission allowance trading within the Community. According to the Article 17 (1)(k) of the Act 572/2004 Coll. on trading with emission quotas as amended all installations in the EU emission trading scheme can also use during the second trading period the CER and ERU up to the level of 7% of total quantity to meet their commitment of surrendering allowances for verified carbon dioxide emissions.

There is no time limit for using of CERs and ERUs except for lasting of trading period and the subject of our control will be the only the total volume of these units when after reaching of 7% level the Slovak National Register of Emission Allowances shall not accept other CER and ERU units.

Considering current trend in the generation of emissions and existing surplus of AAUs units, and in conformity with Act 572/2004 Coll., the Slovak Republic is making use of the trading mechanism according to Article 17 (emission trading). In 2008, the sale of 15 million tons of AAUs was realised and the revenues were used for

[3] *8% Decrease in total aggregated emissions compared to 1990 in the period of 2008 – 2012.*

thermal insulation of residential buildings. In the same year, the transfer of 150 thousand of AAUs was realised through projects on the reduction of emissions to company Sumitomo within the contract signed in 2002.

In December 2009, the Green Investment Scheme (GIS) was formally approved as the instrument supporting projects and programmes aiming at further reduction of GHG emissions funded through the revenues from the sale AAUs surplus.

5.4 METHODOLOGY USED FOR THE PRESENTED GHG EMISSIONS PROJECTIONS

Various procedures and software modules for particular sectors were used in the projections of GHG emissions:

- Energy (except of transport) and industry – model MESSAGE.
- Transport – model COPERT IV and expert estimation.
- Solvents – expert approach.
- Agriculture – expert approach
- LULUCF – expert approach.
- Waste – expert approach.

5.4.1 Model COPERT IV

GHG emissions from road transport in annual inventory are calculated by method of EMEP/CORINAIR, which is included in the programme product for the calculation of emissions from road transport COPERT IV. Therefore, the name of method is the same as the name of model COPERT. This method calculates 15 different emissions from road transport, including GHG emissions. Determination of CO_2 emissions is in principle identical with the method of IPCC tier 2 according to Good Practice Guidelines 2000.

CH_4 and N_2O emissions are calculated for individual categories of vehicles and then they are summarised in order to calculate the total amount. Emission factors for CH_4 and N_2O according to model COPERT IV are different for different fuels, different vehicles and different levels of technology. In case of CH_4 emissions depend also the average speed. Vehicle park of road vehicles is divides in six basic categories and 83 sub-categories according to the scale of city/town, road and motorway operation. The calculation method makes use of technical data on individual categories and sub-categories of vehicles in combination with several parameters specific for particular country, which makes use of this method.

These characteristics are as follows:

- Vehicle park structure.
- Age of vehicles.
- Prevailing character of the operation.
- Fuel parameters.
- Climate conditions.

The calculation of emissions is based on five basic parameters:

- Total fuel consumption.
- Vehicle park.
- Driving conditions.
- Emission factors.
- Other parameters.

Exhaust emissions from road transport are divide in two types: “hot emissions” produced by the engine of vehicles heated on the operational temperature, and “cold emissions” from starting cold engine. These emissions are additional. The calculation of the emissions, including CO_2 and partially also N_2O, is based on fuel consumption.

Complete set in MS Excel according to requirements of the user is the output of the model. The user can process the information in standard formats.

5.5 SENSITIVITY ANALYSIS

Sensitivity analysis has been developed for two parameters, that can influence significantly the future production of GHG emissions:

- Inter-annual increase in added value of industrial production.
- The share of renewable energy resources in total energy consumption.

The increase in value added is a driving force for the final consumption of energy and so also for the generation of GHG emissions. Dynamic changes in economy caused by economic crisis have not been taken into account in basic assumptions of the increase in value added. Even today, it is not possible to anticipate either the revival in economy and or the total economic decrease in the period of 2008 – 2009.

Potential impact of economic changes on the production of GHG emissions was examined within the sensitivity analysis for particular scenarios on the base of the increase of the Value Added (table 5.47). Different increase/decrease between the years 2006 – 2010 is anticipated in the scenarios with the assumption that further inter/annual increase in value added will be the same as the increase in basic scenario, i.e. the scenario with measures. Regarding energy intensive productions, i.e. refinery, steel production together with coke production, it is assumed that maximal production capacity will be reached in 2020. Therefore, individual scenarios consider different annual increase in Value Added in the period of 2006 – 2010 as the scenario with measures (Scen.1) anticipates that the stabilisation of the increase in VA will be reached. In scenarios 2 and 3 (Scen.2, Scen.3) the annual decrease to 2% and 6% will be reached. The increase in VA is expected after the year 2010 as it is in the original scenario with measures.

Table 5.45: Interannual increase in Value Added in sector industrial processes (%).

Period	2010/2006				2015/2010	2020/2015	>2020
Sector/Scenario	WM*	Scen. 1	Scen. 2	Scen. 3			
Minerals	7.24	0.00	-2.00	-6.00	5.90	4.60	4.60
Foods	6.06	0.00	-2.00	-6.00	5.35	4.62	4.62
Textile, leather, shoe-making	0.23	0.00	-2.00	-6.00	1.84	1.70	1.70
Pulp and paper	8.21	0.00	-2.00	-6.00	6.33	5.07	5.07
Chemical production	-0.88	-0.88	-2.00	-6.00	7.92	5.12	5.12
Metallurgy	4.39	0.00	-2.00	-6.00	3.89	2.54	2.54
Engineering	13.37	0.00	-2.00	-6.00	7.13	3.66	3.66
Other sectors	7.68	0.00	-2.00	-6.0	6.60	4.86	4.86

**Scenario with measures.*

Figure 5.9: Sensitivity analysis of the potential impact of changes in VA increases on the GHG emissions.

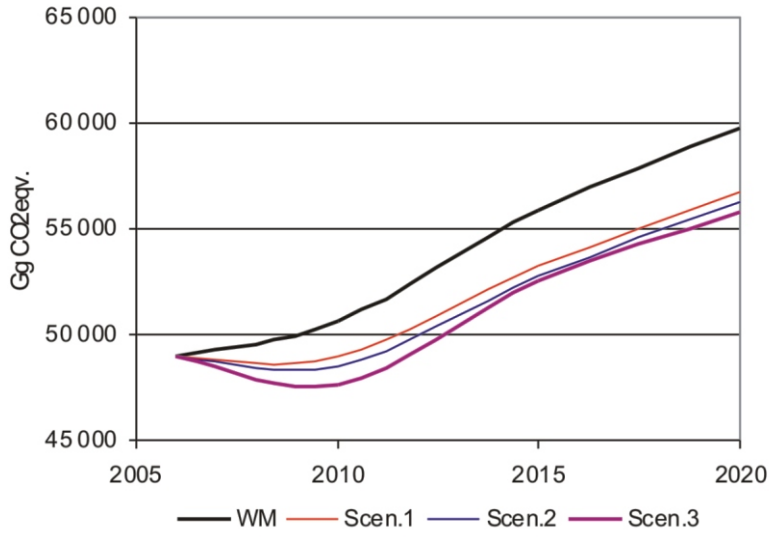


Table 5.48 shows how the decrease or stabilisation of the increase in Value Added can influence the reduction of GHG emissions in 2020 in contrary to the scenario with measures.

Table 5.46: Increase in VA and decrease of GHG emissions comparable to 2006 (%).

	Annual increase in 2010/2006	Decrease in GHG emissions in 2020
Scen.1	0.000	5.040
Scen.2	-2.000	5.840
Scen.3	-6.000	6.570

It is obvious that the stabilisation of economic activities in 2010 at the level of 2006 can cause approximately 5% decrease in GHG emissions in 2020.

The increase in share of renewable energy resources in final consumption of energy represents one of the targets of environmental and energy policies also within the Climate and Energy Package. Besides the reduction of CO_2 emissions, another positive impact can be the reduction of energy dependence of the Slovak Republic on the import of primary energy sources. The final share of renewable sources in fuel balance will depend, besides technical potential, legislation and other parameters, also on:

- Availability of investments and technologies for their better utilisation.
- Rate of cost on renewable energy resources (e.g. biomass) and fossil fuels.
- Marker prices of emission allowances within current EU ETS, as well as on future prices of auctioned emissions.

The balance does not contain the consumption of energy in oil refinery, steel production in large enterprise and transport and distribution of natural gas. This assumption comes out from real technical restrictions of biomass utilisation in these technologies. Furthermore, final consumption of heat in individual heating system has not been balanced.

The share of renewable energy resources in final consumption in case of biomass is defined as follows:

$$X_{REN} = \zeta_{REN} * \eta_{conv}$$

where:

X_{REN} – the share of biomass in final consumption of energy,

ζ_{REN} – the share of biomass in fuel mixture,

η_{conv} – the efficiency of energy conversion from fuels to final consumption,

Sub-scenarios for the scenario with measures have been defined within the sensitivity analysis:

- Scen.1: 8% share of renewable energy resources in final consumption of observed sources.
- Scen.2: 12% share of renewable energy resources in final consumption of observed sources.
- Scen.3: 17% share of renewable energy resources in final consumption of observed sources.
- Scen.4: 23% share of renewable energy resources in final consumption of observed sources.

Figure 5.10: Trend in the generation of GHG emissions for different shares of renewable energy resources in final consumption.

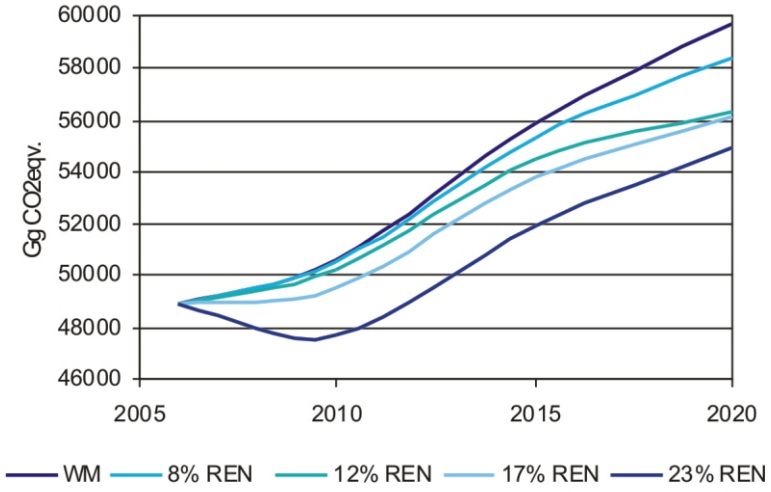
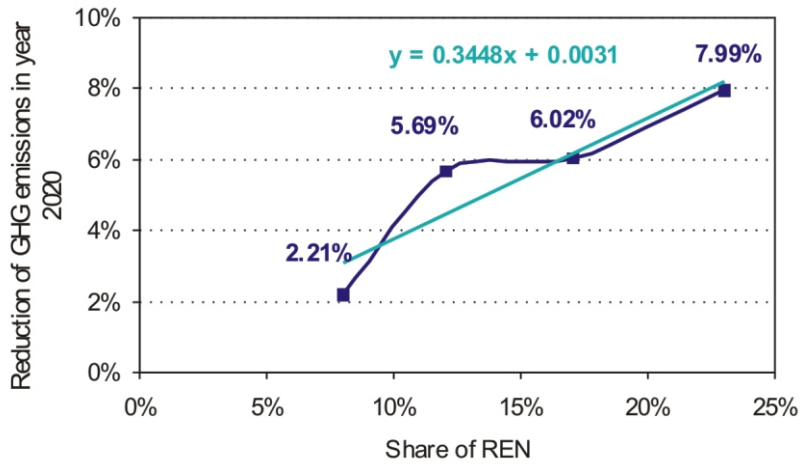


Figure 5.11: Reduction of GHG emissions in 2020 in relation to the share of renewable energy resources in final consumption.



The figure illustrates potential reduction of GHG emissions for various shares of renewable energy resources in final consumption. At 8% increase in the share of renewable energy resources compared to the level in 2006, GHG emissions will be decreased by 2.2%, at 23% increase in the share of renewable energy resources, GHG emissions will be decreased by 7.99%.

06

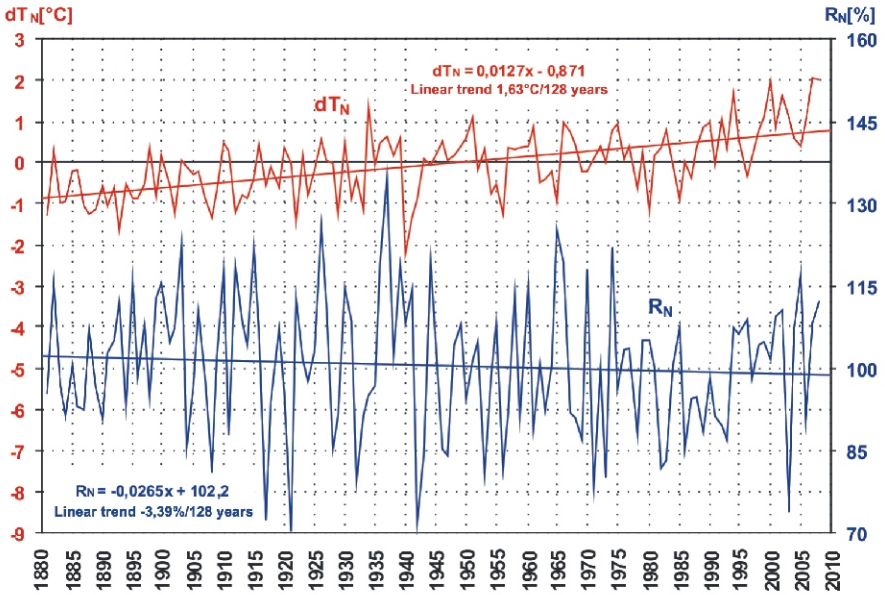
Vulnerability assessment, climate change impacts and adaptation measures

This chapter deals with brief evaluation of climate change and the variability of climate in the Slovak Republic for the period of 1881 – 2009 and new regional scenarios of climate change till 2100. Furthermore, the chapter contains impacts of climate change on selected social and economic sectors, assessment of vulnerability in the sectors and proposals of adaptation measures to mitigate negative impacts and utilization of positive consequences of climate change in the Slovak Republic. The data presented here link to the Fourth National Communication of the Slovak Republic on Climate Change (2005). Details come from the National Climate Program of the Slovak Republic, as well as from the results of research projects tackled this topic in the Slovak Republic, the reports of the IPCC and other relevant sources. Analysis of all documents confirms again that climate change and climate variability might result in a number of negative impacts that presumably will be on increase during next decades. The analysis also shows that there are several effective solutions to mitigate potential damage caused by climate change.

6.1 EXPECTED IMPACTS OF CLIMATE CHANGE

From 1881 to 2008, the average annual air temperature had increased by about 1.6°C (more in the season from January to August) and the annual atmospheric precipitation totals decreased by about 3.4%, in Slovakia (in the south of the territory the decrease was more than 10%; in the north and northeast of the territory the increase was sporadically up to 3%). A significant decrease in the relative air humidity was recorded (in the south of the territory it had been by about 5% from 1900 and less than 5% elsewhere in Slovakia), as well as the decrease in snow cover at altitude up to 1,000 m almost over the whole territory (the increase in higher altitude). Also the characteristics of potential and actual evapotranspiration, soil humidity and net radiation confirm a gradual desertification, in particular in the south of Slovakia (the increase in potential evapotranspiration and the decrease in soil moisture). However, characteristics of sun radiation did not change significantly (except for a transitional decrease in the period from 1965 to 1985). Similar trend continues also after 2000.

Figure 6.1: Deviations of the mean annual air temperature (dT_N) from the normal of 1951 – 1980 and annual areal atmospheric precipitations (R_N) in Slovakia as a percentage of normal of 1901 – 1990 in the period of 1881 – 2008 and a linear trend.



The air temperature in figure 6.1 is characterised as the deviation from the normal of 1951 – 1980 (8.2°C) of the average of three representative stations at Hurbanovo, Košice and Liptovský Hrádok. Hurbanovo is one of the best meteorological stations in the Central Europe having adequately long and high-quality time series of monitoring. In the period of 1881 – 2008, a linear trend of the increase in average annual air temperature was about 1.7°C. The temperature trends of the warm half-year and the cold half-year in the period of 1881 – 2008 are similar to the annual trend. The trend in areal atmospheric precipitation totals in Slovakia, here presented as standard annual totals (percentage of long-term average precipitation total in the period of 1901 – 1990, which is 751.3 mm), has been calculated from the data of 203 stations in the period of 1881 – 2008. Also this trend is

similar both in the warm half-year and the cold one. Precipitation trends differ slightly between the south and the north of the territory; or more precisely between the southwest and the northeast of the territory. The extraordinary trends of the air temperature and atmospheric precipitation totals in Slovakia during latest decades are obvious also from this brief evaluation. It is necessary to remind that the mean difference of annual air temperature between Komárno and Trenčín is 1°C and between Komárno and Poprad it is 4°C. If the temperature in the warm half-year increases by 1°C, the annual increase in total atmospheric precipitations by approx. 100 mm is needed in order to preserve the same moisture of lowland soils in Slovakia.

6.2 CLIMATE CHANGE SCENARIOS IN THE SLOVAK REPUBLIC

So far the outputs of ten general circulation models (GCMs) from four world climate centres have been used in Slovakia, where models CGCM 1 - 3 and GISS 1998 have been utilised mostly. Two emission scenarios IPCCP SRES were used, specifically A2 and B1. The pessimistic scenario SRES A2 is based on the significant increase in greenhouse gas emissions till 2100, while the optimistic scenario SRES B1 anticipates the implementation of extensive measures to reduce greenhouse gas emissions. The development has indicated that the emissions have exceeded even the pessimistic scenario SRES A2. The method of statistical downscaling is used in regional modification of GCMs outputs. This means that the modification of outputs of global climate models to individual selected points in the Slovak Republic territory is carried out by statistical methods using sets of measured data from the period of 1951 – 1990. The climate change scenarios have been applied not only to the annual course of individual climate variables for certain time horizons, but also to the time series and extremes of these variables up to 2100. The scenarios have been developed for several climate variables, such as air temperature, atmospheric precipitations, global solar radiation, and air humidity. Scenarios for other climatic variables can also be developed using various methods. For example, physically reasonable preconditions exist increasing significantly the risk of the occurrence of autumn and winter massive air temperature inversions up to the altitude of 1,500 m that create dangerous fog and icing, as well as significantly higher risk of frosts at the beginning of growing season. The Fourth National Communication of the Slovak Republic on Climate Change (2005) presents still actual scenarios of monthly average air temperature changes and monthly precipitation total changes for central parts of Slovakia and 50-year time horizons 2010 (1986 – 2035), 2030 (2006 – 2055) and 2075 (2051 – 2100) according to outputs of three GCMs models. While temperature scenarios might be used for the whole Slovakia, precipitation scenarios vary at individual stations by more than 10% (in winter, there is a higher increase in precipitation totals in the north, in summer, there is a higher decrease in the south). The set of scenarios is completed by new variables and characteristics, in particular saturation deficit, relative air humidity and evapotranspiration. Also some selected scenarios of expected weather extremes till 2100 are presented in the National Communication. Natural climate variability in conjunction with anthropogenic climate change will create the future climate conditions in Slovakia.

Figure 6.2: Scenarios of annual course of average saturation deficit (D) for Hurbanovo (HU) and Štrbské Pleso (SP) according to CGCM3.1 model and the emission scenario IPCC SRES A2 for periods 2001 – 2030 and 2071 – 2100 in comparison with the period 1961 – 1990.

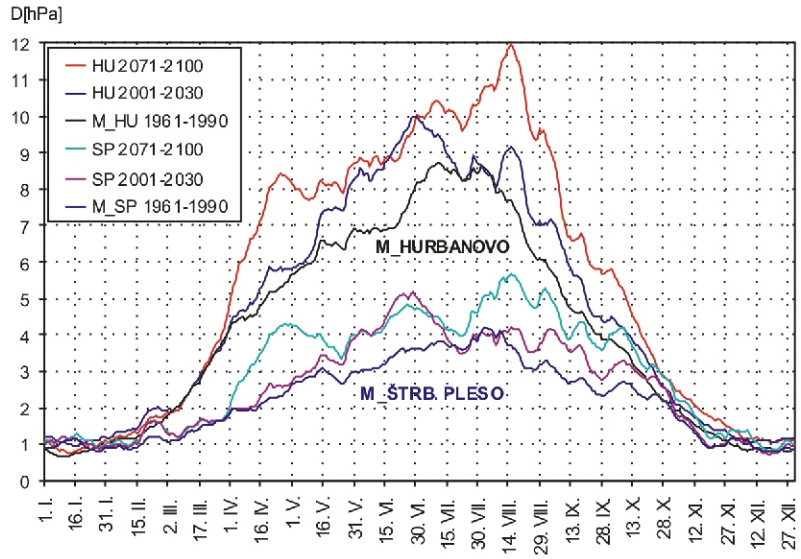


Table 6.1: Comparison of scenarios of air temperature changes (T), water vapour pressure changes (e) and relative air humidity changes (U) for vegetation period (IV-IX) according to CGCM3.1 model, emission scenarios IPCC SRES A2 and SRES B1, and according to measurements in 1961 – 1990 (M) in various periods until 2100.

Station	Element	Unit	1961-1990	1991-2020	2021-2050	2051-2080	2071-2100	1996-2025	2016-2045	2061-2090
Hurbanovo	T (A2-B1)	[°C]	0.0	0.2	0.0	1.1	1.7	0.2	0.2	1.0
Hurbanovo	T (A2-M)	[°C]	0.0	0.7	1.8	2.8	3.9	1.0	1.7	3.2
Hurbanovo	e (A2-B1)	[hPa]	0.0	0.0	0.1	0.8	1.5	0.0	0.0	1.0
Hurbanovo	e (A2-M)	[hPa]	0.1	0.6	1.5	2.5	3.5	0.7	1.3	2.9
Štrbské Pleso	U (A2-B1)	[%]	0.0	-0.9	0.0	-0.9	-1.0	-0.6	-0.9	0.0
Štrbské Pleso	U (A2-M)	[%]	0.6	0.4	-0.2	0.5	-0.2	0.0	-0.5	0.7
Hurbanovo	U (A2-B1)	[%]	0.0	-1.1	0.2	-0.6	-0.7	-1.2	-0.8	0.2
Hurbanovo	U (A2-M)	[%]	-1.0	-1.8	-1.5	-1.4	-1.6	-2.1	-1.9	-0.9

Table 6.2: Scenarios of changes in monthly average saturation deficit (D) in % during 30 years time horizons with the mid-points in years 2010, 2030 and 2075 in comparison with the average values in 1961 – 1990 according to the modified outputs of CGCM3.1 model and emission scenarios IPCC SRES A2 and SRES B1.

	A2			B1			A2			B1		
Month	Hurbanovo						Sliač					
	2010	2030	2075	2010	2030	2075	2010	2030	2075	2010	2030	2075
I	9.7	4.9	4.4	5.7	6.9	-0.5	16.0	5.4	3.2	9.8	10.5	-2.1
II	7.6	5.8	4.4	5.8	7.5	-1.3	15.0	8.6	9.0	11.3	13.5	2.2
III	4.9	9.2	12.7	4.1	7.8	5.3	7.3	8.9	13.9	5.9	10.1	5.7
IV	6.3	15.8	25.1	5.7	12.2	15.7	4.6	12.6	21.5	4.3	10.6	12.2
V	10.7	18.7	24.5	7.2	15.3	17.1	10.0	18.0	22.7	7.4	14.8	15.1
VI	13.1	16.7	15.9	5.5	13.6	11.1	13.5	18.3	14.6	7.3	13.9	9.8
VII	9.1	13.7	17.4	4.3	10.8	8.9	7.4	13.5	13.4	4.1	8.8	6.1
VIII	9.4	15.6	28.1	5.4	10.9	13.5	6.4	14.1	23.0	3.5	7.3	10.1
IX	15.5	18.9	32.9	6.0	13.5	17.0	14.3	19.0	30.7	4.9	10.7	16.6
X	14.0	15.9	28.0	5.8	13.2	14.7	14.9	16.7	27.6	5.6	11.9	15.8
XI	7.7	8.8	19.8	4.5	9.5	10.2	9.2	7.7	17.5	4.4	8.6	7.4
XII	7.2	4.4	10.3	3.7	6.3	4.3	10.1	2.3	5.5	4.6	6.4	-1.3

Table 6.1 briefly indicates the main features of changes in air temperature (T), water vapour pressure (e) and relative humidity (U) according to the outputs of the latest Canadian model CGCM3.1 and two emission scenarios SRES A2 and B1. It is understood that while significant increase in T and e is expected till 2100, averages of U will be changed slightly. Emission scenario SRES B1 (the optimistic one) represents minor change of all elements in comparison with SRES A2 (the pessimistic one). Table 6.2 presents the scenarios of saturation deficit changes (D), (D is the difference between the saturation vapour pressure and the actual vapour pressure at the existing temperature) for time horizons with the mid-points in 2010, 2030 and 2075. The highest increase of D is expected in spring (IV-V) and in autumn (IX-X), which relates to the development of circulation conditions resulted from the given model. The potential evapotranspiration ($E_o = k \cdot D$) should also be increased by approximately the same value (in %). This is a very important increase E_o in the season of lower values of precipitation totals, which can finally be resulted in the increased risk of drought for agricultural crop-plants during critical period. The increase of D and small changes, as well as the decrease in precipitation totals, will be evidently the main cause of the extension and the deepening of drought periods.

Heat waves (series of days with the mean daily temperature above 24°C) also belong to considerable extremes. In past decades, such days were recorded sporadically even in the south of Slovakia and their annual number oscillated about six days. The number of such days has already increased twice or three times. In the south of the territory, it is expected further increase up to about 45 such days by the end of this century.

The increase in air temperature during the period of cyclonic weather will induce significant increase in the water vapour pressure (including the water vapour available for condensation in the atmosphere). This will cause substantial and extreme increase in precipitation totals during strong thunderstorms in the warm half-year and also during cyclonic situations lasting several days, all the year round. It is supposed that the totals of extremely heavy precipitation events (repeating more rarely than once per 50 years) will be higher than in past decades by 25–50%. Presumably, the highest precipitation totals will exceed 150 mm every year and 400 mm once per 50 years in one of localities in Slovakia. This assumption has resulted directly from the physical theory of atmospheric precipitations.

In winter, the increase in precipitation totals is expected (by 30% in the north of Slovakia and in highlands), and simultaneously the increase in the air temperature by 4°C. By the end of the century, this phenomenon will cause the significant increase in precipitation totals up to the altitude of 800 – 1,000 m, but the precipitations will be mainly liquid, with negative impact on snow conditions. Furthermore, winter floods will be more frequent due to warming. The occurrence of snow and snow cover will not be endangered by the increase in the temperature by 4°C at the altitude over 1,200 m. Therefore, peak snow cover (new snow cover and total snow cover) can be expected more often. This fact will certainly increase the risk of avalanches in mountainous regions also in Slovakia.

In addition to the significant change of snow conditions, when much more snow is expected at the altitude over 1,200 m as before and far less snow as before at the altitude below 800 m, the temperature and humidity conditions will be changed, too. In the period of 1951 – 1980, at Hurbanovo there were 20 days on average with the mean daily temperature -3°C and less, in winter (XII – II) and 48 days on average with the mean temperature over the freezing point. In the period of 2071 – 2100 (according to CGCM3.1 a SRES A2), only 2 cold days will be in winter and the number of the days with the mean temperature over the freezing point will increase up to 78.

6.3 SECTOR OF HYDROLOGY AND WATER MANAGEMENT

Potential changes in runoff, caused by the expected changes of climate, represent one of the main sources of uncertainty in the management of water resources today. They can be demonstrated as the decrease in the yield of water resources, the increase of the extremity of floods and droughts, the change of runoff regime in Slovakia. The implementation of Water Framework Directive of the EU and the Directive 2007/60/EC on the assessment and management of flood risks require to asses the impact of climate change and to predict the state of water bodies and require long-tern planning for the utilization of water resources and flood risk reduction.

6.3.1 Expected impacts of climate change on sector hydrology and water management

The assessment of climate change impact on the change of long-term average runoff and the change of the intra-annual runoff distribution was carried out using the climate scenarios CCCM97, GISS98 and the alternative analogue scenarios WP and SD. Years 1951 – 1980 were taken as a reference period. Expected runoff changes were calculated for time horizons 2030 and 2075.

The change of annual runoff was assessed by the TURC model, which was modified for the climatic and physiographic conditions of Slovakia. According to the climate scenario CCCM97, the decrease in runoff from a large part of the Slovak territory can be expected, despite of the possibility of a slight increase in annual precipitation totals. In 2030, compared with the reference period, it can be expected that 21% of the territory and in 2075 84% of the area of Slovakia will be in the zone of the decrease in long-term average runoff from -5 to -20%. Two percent of the area of Slovakia will be in the zone of decrease from -20 to -40% in 2075.

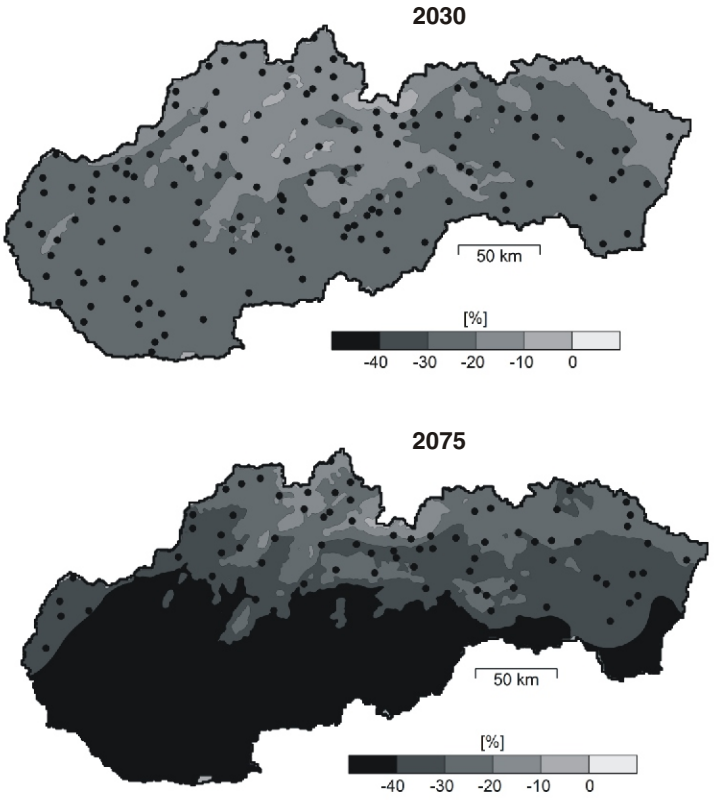
The WP climate change scenarios, similarly to the SD scenarios, anticipate decreasing annual average precipitation totals over the whole territory of Slovakia, and an increase in the annual average temperature for all considered time horizons. As for runoff, according to these scenarios, in 2030 32% of the area will be in the category of the decrease from -5 to -20% and 65% of the area will be in the category of the decrease from -20 to -40%. In the time horizon of 2075, 47% of the territory of Slovakia will be in the zone of the decrease in long-term annual average of runoff from -20 to -40% and the decrease in the runoff will be higher than 40% at 49% of the territory of Slovakia. The decrease will manifest itself mostly in lowlands, where average decreases in long-term average runoff by -29% are expected in the horizon 2030 and by -45% in the time horizon 2075.

Slighter decrease in runoff is expected in mountains in the horizon 2030 (-8%) and by -14% in 2075. The largest decreases are expected in the south of central Slovakia (by -35% (2030) and by -50% (2075)).

The assessment of scenarios of the intra-annual runoff distribution indicates that in the future, the changes in the distribution of the long-term average monthly flows can be expected over the whole territory of Slovakia. In western Slovakia, an increase in both winter and spring runoffs can be expected in December and January (from 30 to 60% in 2075). Maximal decrease in runoff can be expected in July (from -20 to -40%). In the north part of central Slovakia, an increase in winter and spring runoff can be expected in the period from November to March, with the maximal increase in February or in January (from 80% to 120%, for the Poprad basin from 20% to 40%) in 2075. Decrease can be expected in the period from April to September, with the maximum in May (April, July for the Poprad basin) by -20% to -40%. The southern part of central Slovakia will be characterized by shorter periods of the increase in winter and spring runoffs in comparison with the situation in the north and, vice-versa, the period of the decrease in long-term average monthly flows will be longer. Maximal winter increases will be observed in February (from 20 to 90%) in 2075 and maximal decreases in August – July (from 30 to 70%) in 2075. Increases in winter and spring runoffs from November (December) to February (March) can be expected in future in the east of Slovakia. Maximal increases in long-term average runoff, compared to the reference period, can occur mainly in January – from 25% to 100% (in eastern basins from 60% to 200%) in 2075. Maximal decreases could be in April, from -10% to -40% (further to the east from -25% to -50%) for the same time horizon.

These results should be interpreted very carefully and it is necessary to take into account the uncertainties of the methodological approaches and of the scenarios. However the trends of changes can be considered as highly probable. They are in compliance with all impact studies concerning Slovakia and they are in compliance with the results of studies carried out in neighbouring countries.

Figure 6.3: Spatial distribution of changes (%) of long-term average annual runoff according to climate scenario WP for time horizons 2030 and 2075.



6.3.2 Vulnerability assessment in sector hydrology and water management

In general, climate change may have different impacts on runoff in the southern and the northern regions of Slovakia. Even if only small increases in precipitation are anticipated in northern basins, the extremes of runoff could increase depending on the increase in air temperature. Increase in flows can be expected in northern mountain regions during the winter months. On the other hand, a considerable decrease in flows will be typical for the late spring. Relatively balanced and moderate decrease in flows can be expected in the summer months. Autumn will be probably the least impacted period, as it will be the transition period from the summer decrease of runoff to increase of runoff in the winter. This winter increase in runoff will have an equalizing impact on the fluctuation of runoff within the year. The opposite of these trends will presumably occur in summer-autumn period, when the prolongation of periods of low flows needs to be considered. The fact that the increases of runoff will be realised also in the form of floods and that the summer drought will be interrupted by extreme floods needs to be taken into account, too.

All these phenomena would affect water supplies and hydroenergy production directly. Predicted trends in the changes of hydrological regimes indicate an increased need for man-made redistribution of runoff between the north and the south (or between the higher and lower parts of the territory). Runoff would need to be re-allocated also between individual years and within the year. Possible compensation of lower yields of the water resources must also be taken into account, in particular in Central and Eastern Slovakia and in the in summer time.

Regarding large water reservoirs and large hydroelectric power stations, the decrease in water supplies and energy production should be taken into account. In small water reservoirs, river and small hydroelectric power stations, the shifts of temporal and territorial distribution of the runoff will manifest themselves in changes in the water supply and energy production in accordance with the change of the flow regime. Due to more frequent and more extreme floods, retention volumes and dam safety will have to be re-assessed. Apparently, the proportion of so called idle discharge of water during floods will be increased from the both types of hydroelectric power stations. This water will not be used for energy production or the efficiency will be lower due to the decrease in the hydraulic head.

At the same time, the pressure will grow to conserve biological flows in river reaches below the reservoirs in the periods of droughts, which can happen to conside with the higher water and electric energy consumption needs. This pressure will be related to the efforts to strengthen the protection of the decreasing water resources (both groundwater and surface water) and water related ecosystems. From the perspective of water utilisation and hydro-energy potential, the growing pressure resulting from Water Framework Directive to maintain continuity of flows must also be taken into account. This pressure certainly will not go down in coming period with more extreme hydrological conditions. All these effects should in sum lead to the decrease in the water withdrawals and of the hydroenergetic potential as quantified today.

The increase of areas with water deficit and the needs of covering increased water demands influenced by climate change can bring new views on the ecological limits water uses and water resources. With regards to exploited water resources, it will be necessary to review their sustainable exploitation in the new conditions. Therefore, more rigorous legislation to protect water resources in localities, where the water resources will be presumably less affected by climate change needs to adopt (including the protection of localities where large reservoirs were planned in the past). Such protection could limit commercial and energetic exploitation of rivers and mountain regions, which could call for compensations. The change in the hydrological cycle may also impact the relationships between Slovakia and neighbouring countries caused by the expected higher degree of regulation of runoff from territory of Slovakia.

6.3.3 Adaptation measures in sector of hydrology and water management

Adaptations have been included into the governmental document Water Management Policy of the Slovak Republic until 2015, which stipulates principles of the state water policy for competent bodies and organisations (including administrative regions and municipalities). The policy warns the competent authorities that expected climate change may significantly impact the change of total runoff, as well as its distribution within the year. Adaptation is based on the principle of so called “no-regret” policy, which was formulated in several reports of research projects and the National Climate Programme.

The recommendations of the policy document have been transferred into several other conceptual documents of the water management sector. The updated conception on flood defence accounts for climate change and considers the investments of finances from the EU funds. In order to maintain the sustainable and optimal use of the resources, the Plan of the Development of Public Water Supplies and Public Sewage Systems for the Slovak Republic has introduced the principle of re-evaluation of usable groundwater reserves with the goal to achieve good state (ecological, chemical and quantitative) of these taking into account climate change impacts according to river basins. Moreover, the plan requires carrying out the detailed hydro-geological exploration focused on passive areas in conformity with the requirements of the development of the public water supply systems.

Adaptation measures were also included into the Strategy of Water Framework Directive implementation in the Slovak Republic and in to the new Flood Protection Act. According to the Strategy a working group for priority substances, floods and climate change was established. Concerning the International Basin of the Danube River, it is recommended to withdraw only usable quantities of water and take into account the impacts if future climate change. This is in conformity with the conception of the International Commission for the Protection of the Danube River. The re-evaluation of usable groundwater quantities in particular formations is expected in relation to ecological limits and climate change. It will result in the identification of prospective and supplementary sources of water supply and risk localities for the purpose of decision making of the state administration. For adaptation and for the first National Plan of River Basin Management some additional measures at national level are required:

- Re-evaluate the estimation of design floods and reassess the safety of dams and water structures.
- Re-evaluate future water needs.
- Re-evaluate the safety of existing water withdrawals from reservoirs for water supply and energy production and low flow augmentation.
- Developing methodologies for drought assessment and to introduce new indicators into the current practice.
- Investigate droughts and their impacts the on ecological conditions of water bodies.
- Increase of climate change impact research.

6.4 SECTOR AGRICULTURE

Current agricultural production of the Slovak Republic is about 60-80% of the production in 1990. The increase by 15-40% is expected till 2010 in comparison with the year 2001. Agriculture generates only small part of GDP, so total vulnerability of economy by the changes affecting agriculture is underestimated and considered as minor. The sector is endangered by serious problems caused by the distribution of precipitations during a year and by the increase in risk of water stress occurrence during vegetation period. Apart from that, the sector performs also extra-productive tasks in landscape.

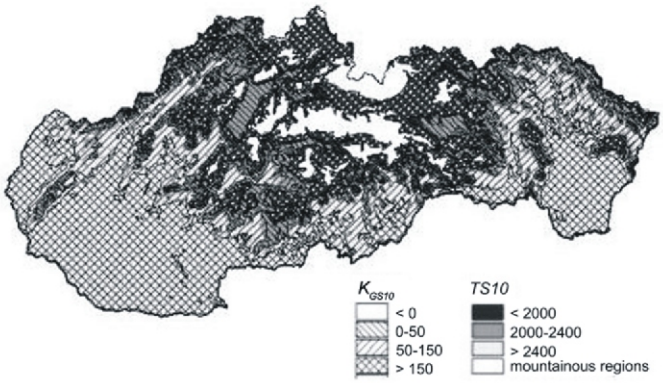
6.4.1 Expected impacts of climate change on sector agriculture

New agro-climatic regionalisation of Slovakia for the period of 1961 – 1990 is based on the evaluation of the temperature sums during the growing season with the mean daily air temperature T>10°C (TS10). Humidity conditions of the territory is characterised by climate water balance during growing season ($K_{GS10}=E_o-R$), where E_o is potential evapotranspiration and R is rainfall total during period mentioned above. Based on the current regionalisation, also potential changes of production regions can be defined in relation to climate change conditions.

Table 6.3: Agro-climatic and agricultural production regions in the Slovakia.

Region	Sub-region	TS10 (°C)	$K_{GS10}=E_o-R$ (mm)	Production type
Cold	Humid	<2 000	<0	Mountain
Mild warm	Normal	2 000-2 400	0–50	Potatoes
Warm	Mild dry	2 400-2 800	50–150	Beets
Warm	Dry	>2 800	>150	Maize

Figure 6.4: Agro-climatic regionalisation of Slovakia for the period of 1961 – 1990.



The changes of agro-climatic characteristics in production regions of Slovakia in relation to climate change have been evaluated for two types of growing season: GS10 (limited by mean air temperature T>10°C) and GS5 (limited by mean air temperature T>5°C) for the reference period of 1961 – 1990 ($1xCO_2$) and the projected period of 2061 – 2090 ($2xCO_2$). GS5 is the period of biomass and yield production of agricultural crops as grassland, some fodder crops and cereals except the maize in the Slovak Republic. Onsets of the GS5 period will continuously accelerate and can be expected by about 28 days earlier in the whole altitudinal profile at climate conditions of $2xCO_2$. This fact shifts winter field crops to the months with lower radiation input which has negative impact on the potential of biomass production. GS10 period is the period of biomass and yield production of thermophilic crops (maize, sugar beet, vine and others). Mean daily air temperature T>10°C is necessary for formatting of generative parts of plants. Onsets of the GS10 period will also accelerate continuously and can be expected by about 28 days earlier in the whole altitudinal profile at climate conditions of $2xCO_2$. The end of the GS10 period at $2xCO_2$ will be by about 14 days later, in comparison with the climate conditions of $1xCO_2$. This fact supports the expansion of thermophilic crops growing, in particular some sorts of maize with higher FAO number and sugar beet.

During GS10 period at $2xCO_2$ climate conditions, the potential evapotranspiration (E_o) will increase by 160-170 mm (27-30%) in lowlands and up to 106 mm (34%) in mountains. E_o>450 mm can be expected in almost the whole agricultural land of Slovakia, E_o will be higher than 750 mm in the warmest localities. High E_o totals in relatively short duration of the GS10 period anticipate the occurrence of drought periods. Climate water balance $K_{GS10}=E_o-R$ (R=rainfall totals) will be changed significantly during this period in the whole altitudinal profile. At $2xCO_2$ climate conditions, KGS10 will increase in warmer conditions of southern Slovakia by 90-110 mm on average. So the area of regions sufficiently supplied by water will be reduced markedly.

Evapotranspiration deficit E_o-E (E=actual evapotranspiration) determines water availability for plants; it takes into account also the water supplies in soil profile. According to this indicator, the territory of Slovakia is even more sensitive to the drought occurrence. Presumably, the significant area of agricultural soil with the evapotranspiration deficit below 50 mm during the GS5 period will be lost completely at the expense of worse supplied areas. The acreage of these sufficiently water supplied regions was almost 15,500 km^2 in the reference period 1961 – 1990. New very dry regions will appear in projected period and they will cover more than 19,000 km^2.

Climate change impacts on the water regime of soil and the production of field crops have been simulated for various time horizons by agro-ecologic model DAISY. Emission scenarios SRES A2 and B2 were applied and results were compared with simulations for the reference period of 1966 – 1985. Sensitivity of different agro-ecologic areas have been analysed: Podunajská nížina (the Danube lowland), Východoslovenská nížina (the Eastern Slovakia lowland) and foothill represented by the Liptov basin.

The main limiting factor for spring barley yields in lowlands seems to be water; the increase in variability of yields can be expected from non-irrigated soil of lowlands. At the simulations with crops that were not stressed by nutrients and water up to time horizon 2075, the increase in biomass was by 27% and the increase in yields was by 24%. Fertilizing effect of CO_2 is adequately less when the irrigation is limited. Phenophases in the decade of 2041 – 2050 will be shifted by 10-13 days due to warming.

In climate conditions of Slovakia and the reference period, the best yields of wheat (*Triticum aestivum*) were achieved from fertilized and irrigated soils. Due to warming, the phenophases will be shifted to the period of lower global and photosynthetic active radiation, what will affect the production of wheat yields. The flowering in the decade of 2041 – 2050 will be accelerated by 9-13 days and the yield by 17 days. The impact of fertilization and irrigation on the yield above 5 $t.ha^{-1}$ will be significantly higher.

Maize (*Zea mays*) is less sensitive to the changes of CO_2 concentration. The yield is strongly influenced by water sufficiency. Due to warming, the beginning of maize phenophases will be earlier in the horizon of 2050; the flowering will begin earlier by 11-14 days on the average and the maturity will begin earlier by 22-27 days. Fertilizing effect of higher concentration of CO_2 was not found in simulated crops.

Grapevine in simulations shows the acceleration of the beginning of individual phenophases equally, but also the shortening of vegetation period by 18-28 days. Similar situation can be observed in relation to the start of germination of oospores of *Plasmopara viticola* and conidiospores of *Uncinula necator*. The change of temperature provides conditions for the shift of wine production also to higher areas of foothills. But poor production efficiency of soils in these localities does not allow it. Therefore climate change will presumably change the types of vine species (*Vitis vinifera*) cultivated in the Slovak Republic.

6.4.2 Vulnerability assessment in sector agriculture

Agricultural production regions are getting more sensitive to the drought in climate change conditions, particularly in actual maize production region, where gradual aridification of territory has been found and the occurrence of drought can be more frequent. Presumably, this fact will affect seriously growing of thermophilic crops, but not only it. This fact needs to be taken into account in the cultivation of new field and horticultural crops in future and their suitable selection for different regions of Slovakia, as they will be agro-climatically more diversified than today. Vineyards in Slovakia are not irrigated and consequently, the decrease both in the quality and quantity of grapes is expected.

At the same time, climate change can create better conditions for the occurrence and spread of diseases and pests. For example, this is the case of the life cycle development of *Plasmopara viticola* and *Uncinula necator* as grapevine pathogens. The cases of more frequent and intensive precipitations create better conditions for the development of some fungi diseases than for others. Evolution cycle of the most known pest of apple tree (*Malus domestica*) – codling moth (*Laspeyresia pomonella*) will be changed, too. According to model simulations, the number of generations of codling moth should be increased to 2-3 generations at lowlands and to 1 generation at the altitude of 500 m in future due to the increase in air temperature.

6.4.3 Adaptation measures in sector agriculture

The use of new varieties of *Zea mays* (higher FAO number in regions, where maize was grown) has been shown as the real option. The potential of this crop plant to overcome the periods of moisture deficiency during vegetation period is the precondition for its growing importance in plant production in climate change conditions in Slovakia. Cereals dominating today in plant production will also require the change of varieties. Current winter wheat species would maturate by approx. 4 weeks earlier due to climate change. This shift is reflected in lower sun radiation input during growing season and hence the potential of yield production.

Winter period could also become risky as this period will be shorter in warmer climate and young plants will not be prepared for this change. Frost during growing season will be presumably more often and consequently the damage by frost and cold will have to be taken into account in the selection (refining) of new species.

The model simulations have shown that in agro-climate conditions of Slovakia, the date of spring barley sowing should be adapted to the onset of the mean daily air temperature T>5°C. Keeping conventional dates of sowing could result in the risk of heath stress during ontogenesis of barley, particularly during sensitive phenophasis. The dried up surface of sowing bed could result in significant reduction of germinated seeds followed by random germination and adverse growth of crops. According to climate change scenarios, the onset of spring will be very rapid in comparison with nowadays. Utilization of solar radiation can be improved also by the selection of varieties with longer growing season. Another risk is associated with the shift of growing season to the months with high frequency of the heath stress occurrence that can restrain the transfer of substances from plants to grain.

The precondition to expand irrigation systems is today one of the most frequently discussed adaptation measures to mitigate negative impacts of climate change. The use of irrigation systems requires sufficient water supplies and probably, the needs of plants will be satisfied only partially. Interactive impact of irrigation and fertilization on yield is more intensive than the impact of one of the factors.

Especially in horticulture, it has been shown that mulching plastics and fibres are suitable means to increase water use efficiency. This measure allows the regulation of weed growth, protects the soil against water and wind erosions within the anti-erosion measures.

6.5 SECTOR OF FOREST MANAGEMENT

Long-distance transport of air pollutants causes significantly higher acid depositions and tropospheric ozone concentrations in highland forests of the Western Carpathians than, for example, in urban and industrial centres. This fact along with global climate change and disruption of protective attributes of the atmosphere will have a conjoint impact on forest ecosystems.

6.5.1 Expected impacts of climate change on sector forest management

Drought is a stress factor for forest ecosystems. In the period of 1951 – 2005, a significant trend towards aridity was identified in the south parts of Slovakia, in lowlands and highlands of the 1st and 2nd vegetation stages. This fact leads also to the increase in the risk of forest fires. Statistically significant trend to humidity was identified in the northeast of Slovakia, as well as in highlands of the 7th vegetation stage of the north (windward) side of the Tatra Mountains.

Relatively substantial increase in aridity can be expected in the lower vegetation stages according to the values of relative evapotranspiration E/E_o for the 1st to the 5th vegetation stage. It is shown that even the moderate increase in precipitations in the period of 2030 – 2075 will not cover the increasing demands of "new" climate for the evaporation. Presumably, the shift of bioclimatic conditions, with regard to moisture balance, will occur by one or one and half stage up. It is expected that even in the conditions of warming climate, the evapotranspiration will not be limited by the water scarcity in the north of Slovakia, in Orava and in the north sites of the Tatra Mountains.

When evaluating expected climate change in respect to drought index E_o/P (P=precipitation totals), slightly different drought projections are found. The increase in drought is evident in the scale from the 1st to the 7th vegetation stage, but the sharpest increase will be up to the 5th vegetation stage. It has resulted from the precondition that potential evapotranspiration will be higher in warmer atmosphere, but the increase in precipitation will be relatively small. In broken orographic conditions of north Slovakia, local differences in the moisture of upper soil layer will be caused mainly by the influence of windward increase or leeward decrease in precipitation totals.

Several significant windthrow disasters were occurred in Slovakia in the nineties of the 20th century and at the beginning of the 21st century. Their occurrences were recorded mainly in the forests of the Tatra Mountains (High Tatras, West Tatras, Belianske Tatras and Low Tatras), in higher vegetation stages. Future projections of windstorm occurrence in the Central Europe present many uncertainties; however, the increase in the damage of forests by wind can be anticipated. Large-scale windthrow damages have been occurred also in beech forests during the last decade.

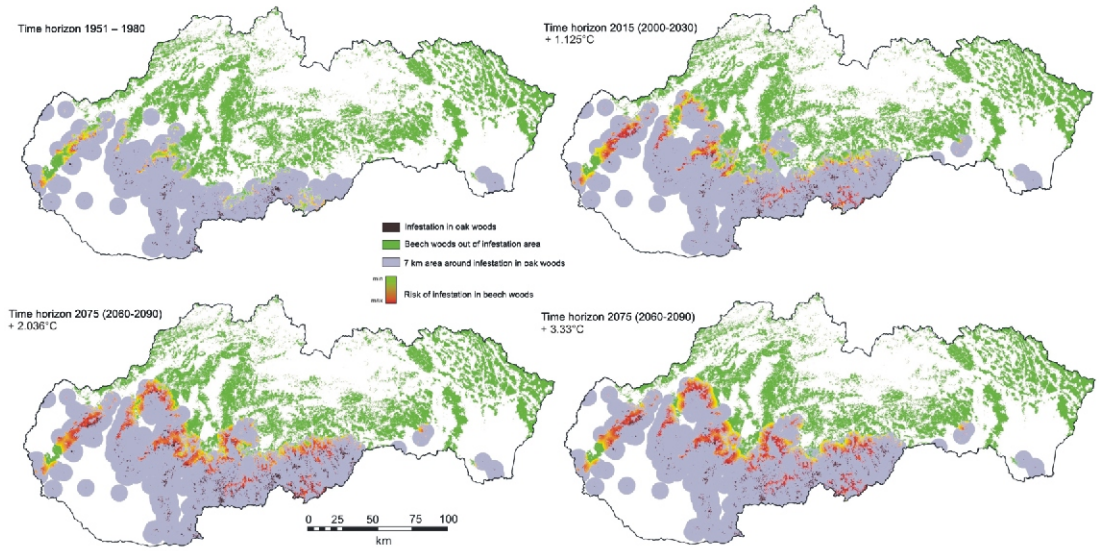
Snow, in particular heavy and wet snow (so called sticky snow) means a relevant dangerous factor in the forests of Slovakia. The warming in winter, as a result of climate change, will cause the shift of sticky snow occurrence line to higher altitudes. The zone of the most damaged forests by snow has been shifted to higher altitudes in comparison with the situation in the past. They are the altitudes above 1,000 m, in particular from 1,300 m to 1,400 m (i.e. the 6th and the 7th vegetation stages).

Pests of forests react on changing conditions of the environment directly by changing the dynamics of their population, and indirectly, through the changes in the structure of forests and resistance of trees. It means that the impacts of climate change could result in changing behaviour of relatively unimportant pests, which can cause large damages in the future. Insects are physiologically extremely sensitive to temperature and even

small oscillations in temperature might have extensive impacts on forests. Besides the changes in distribution sites of pests, the climate influences also the number of realised generations within one year. If warming prolongs vegetation period, the number of generations of several species is expected to be higher in the direction to the north, as well as to higher altitudes.

According to current significant indices, the gypsy moth (*Lymantria dispar*) will use beech as the alternative host wood, in particular near to infestations seen in oak forests. It can be expected that till 2015, the area of endangered beech forests will be doubled in comparison with the reference period of 1951 – 1980. If it is supposed that the pest is propagated despite the locations of areas of infestation in oak forests, its propagation will be limited only by the upper distribution border of beech and the temperature.

Figure 6.5: Expected changes in niche space of the gypsy moth infestation in oak forests and the potential risk for beech forests in proximity to the predicted infestation in oak forests at suitable temperature limit.



6.5.2 Vulnerability assessment in sector forest management

In the Slovak Republic, the major attention is paid to the research of climate adaptability of Norway Spruce (*Picea abies*) and European Beech (*Fagus sylvatica*). Spruce is the tree with shallow root system and therefore, it is more sensitive to climate change in comparison with other species. We have already faced to massive destruction of spruce forests. The proportion of spruce in total composition of forests in Slovakia will decrease from current 27% to less than half of it due to climate change. On the other hand representation of the beech will substantially grow, at least in middle-term horizon. Due to relatively good adaptability and stress tolerance, beech will be used in the reconstructions of non-native coniferous forests into more stable forest stands.

Further occurrence and growing of forests in the Western Carpathian have been investigated for three the most important species – oak, beech and spruce from the perspective of projected climate change. Expected development and vulnerability of forest have been referred to vegetation stages representing the basic units characterising the altitudinal climate conditions (vertical differentiation) through vegetation (biocenoses). Their diversity results from the climatic differences owing to the altitude, exposure and topography. The bio-geocenoses resulting from variability of these three factors can be classified into 8 forest vegetation stages. Categories of suitable conditions for individual trees have been determined on the base of the frequency of current occurrence and the growth response of individual tree species in individual vegetation stages, using results from growth simulation by means of the forest growth simulator SIBYLA. Furthermore, the analysis of climate change impacts on production, ecological stability, tree vitality and forest structure was used, whereby climate change models were used for selected tree species.

Table 6.4: The synthesis of results on expected development of oak, beech and spruce growing in individual vegetation stages (VS) according to growth response, climate water balance, change of site and growth simulation.

VL	Growth response	Climate water balance	Change of site	Growth simulations
Oak				
1.	Suitable conditions for the growth of oak xerophytes Conditions for "Balkan type" forests	Slightly limited conditions for the growth of domestic oak Entry of oak xerophilic forests	No change is taken into account	Significant decrease in oak production
2.	Suitable or essentially non-changed conditions for the growth of oak	Suitable conditions for the growth of oak	Slight enlargement of the site	Slight, non-significant decrease in production
3.	Suitable conditions for the growth of oak	Suitable and improving conditions for the growth of oak	The expansion of oak up to 20 % of vegetation level area	No changes in production
4.	Improving conditions for the growth of oak	Improving conditions for the growth of oak	Creating conditions for oak communities	Non-tested
5.	Creating conditions for the growth of oak	Creating conditions for the growth of oak	Minimal changes	Non-tested
6.	Unsuitable conditions	Improving conditions for the growth of oak	Minimal, almost no changes of current status	Non-tested
7.	Unsuitable conditions	Unsuitable conditions	No changes	Non-tested
8.	Unsuitable conditions	Unsuitable conditions	No occurrence	Non-tested
Beech				
1.	Negatively expressed the response on the growth of 56% of beech	Rapidly deteriorative conditions for the growth of beech	Endangered occurrence of beech at 90% of the site	Non-tested
2.	Deteriorative conditions for the growth of beech but not dramatically	Deteriorative conditions for the growth of beech	Impaired conditions for beech for almost 60% of occurrence	Significant decrease in the growth of beech
3.	Moderately impaired conditions	Moderately impaired conditions in relation to lack of moisture	Moderate decrease in the area	Significant decrease in the increase of beech by 20%
4.	Suitable but deteriorative conditions for the growth of beech	Deteriorative conditions suitable for the development of mixed communities of beech containing also valuable broadleaves	Impairment of conditions for beech at 35% of area of vegetation stage	Significant decrease in the increase of beech by 17%
5.	Suitable and improving conditions for the growth of beech	Suitable conditions for beech	Expansion of beech at the expense of spruce	No changes in production and the share of beech
6.	Significantly improving conditions for beech	Suitable conditions for beech	Moderate expansion of beech	Statistically non-important changes
7.	Creating conditions for the growth of beech	Gradual and fast creation of conditions for beech.	Diffusion of beech to the 7th vegetation level	Non-tested
8.	Unsuitable conditions for beech	Unsuitable conditions for beech	No occurrence	Non-tested
Spruce				
1.	Absence of conditions for spruce occurrence	Destruction of societies containing spruce	Destruction of conditions for the occurrence of spruce	Non-tested
2.	Absence of conditions for spruce occurrence	Unsuitable conditions for spruce occurrence	Destruction of conditions for the occurrence of spruce	Non-tested
3.	Absence of conditions for spruce occurrence	Absence of conditions for spruce occurrence	Unsuitable conditions for spruce occurrence	Non-tested
4.	Restricted conditions for spruce demonstrating trough its health and vitality	Restricted conditions due to a lack of water	Impairment of conditions for spruce up to 80% of vegetation level	Non-tested
5.	Increasing problems in the growth of spruce	Impairment of conditions for spruce, competitive pressure of beech and fir	Impairment of conditions for spruce up to 50% of vegetation level	Significant decrease in production
6.	Slightly changing conditions foe spruce	Improving conditions for spruce	Big changes are not expected	Significant decrease in monoculture production by 22%; no problems in mixtures
7.	Significant improvement of the conditions for spruce growth	Sufficient amount of precipitation for spruce existence	Expansion of spruce, conditions improvement within the whole vegetation level	Signi cant increase in spruce production by 7%
8.	Creation of growth conditions for spruce	Creation of growth conditions for spruce	Shift of upper border of forest	Non-tested

6.5.3 Adaptation measures in sector forest management

Climate change impacts on forest ecosystems are more significant due to the fact that mitigation and adaptation measures cannot be developed and applied as quickly as climate change requires. The adaptation to changes in the regime of climate extremes, e.g. drought, windthrow damages, extreme heats or frosts, is very complicated because of a great uncertainty in climate extremes projections along with a high variability of their impacts on forest. Climate change is manifested extremely dynamically in the changes of distribution areas and population dynamics of biotic pests.

In the conditions of Slovakia, the adaptation and mitigation measures have been proposed for following forest domains:

- Genetics and cultivation of trees.
- Forest cultivation and forest management (composition of trees, farming methods).
- Forest protection (biotic, abiotic and anthropogenic dangerous factors).
- Forest policy and legislation.

The review of proposed adaptation measures focused on risk minimisation in relation to climate change impacts can be divided into two basic groups, as follows:

- General
- Specific

The first category includes all measures in relation to the strengthening of biological and genetic diversity, nature friendly forest management and the principles of sustainable development of forests. The second category includes specific measures focused on all aspects of anticipated impacts of climate change on forests.

In forest management, there are several different options to mitigate climate change impacts. These options have been developed mainly from basic balance categories and related processes. In general, the measures can be defined as follows:

- Reduction of permanently deforested areas.
- Increase in forested areas – afforestation of wasteland.
- Increase in carbon storage in existing forests.
- Increase in the effective use of wood.

6.6 SECTOR BIODIVERSITY (FAUNA)

Climate change impacts on the biota in the Central European region have not been explicitly proven. The wide complex of both biotic and abiotic factors, natural or anthropogenic origins work as a whole. The complex behaves as a system and it hardly allows analysing particular components separately. Synergic influences of the whole spectrum of factors in ecologic systems will not allow declaring explicitly the impact of climate change on the structure and dynamic of biota.

6.6.1 Expected impacts of climate change on sector biodiversity

Besides the impacts of climate change on fauna, several natural factors (fluctuation) and anthropogenic factors play an important role. In particular, they include the following: market globalization, changes in the character of agriculture, new dimensions of tourisms and more intensive breeding of exotic animals. Several specific cases regarding the change in biological diversity have been recorded in Slovakia during recent years, which can relate, into some extent, to global climate trends. There are different reasons for this situation. It could be the displacement of some species, e.g. scorpiones (*Euscorpius carpathicus*) or turtles from domestic breeding, which can survive in warmer conditions also in wild nature. The displacement of some species as vectors of some pathogens, which could occur in Slovakia, but due to cold winters, they could either disappear or live in isolated habitats of urbanised country. Warmer climate can support either their survival in wild or successful migration between originally isolated populations. Special attention must be paid to the species living in the proximity of humans, for example cockroaches (*Blattaria*) that are important from medical and hygienic aspects.

Gradual infiltration of so called "south" elements to the Central Europe is more important phenomenon, as regards both terrestrial and water ecosystems. Vast spectrum of animal species is among the infiltration. In terrestrial ecosystems, there are several bird species, e.g. *Buteo rufinus* or *Merops apiaster* and also other species. Mediterranean species of spiders, *Lycosa singoriensis* and insetcs, *Mantis religios* and *Oecanthus pellucens* occupy gradually new habitats in the south of Slovakia. Their dispersion depends on the change of farmland into steppe. The increase in the population density of dragonfly *Crocothemis erythraea* has been recorded.

Expansion of the thermophilic mosquitoes is a very good indicator of the change of air temperature. The occurrence of the thermophilic species *Uranotenia unguiculata* has been identified. Calamity infestation of some mosquito species is spatially much more important than in the past. Warming causes the shortening of the development of some mosquito generations and influences their quantity. Expending malaria due to global warming means a big risk for Slovakia. It has been confirmed by new records of several species of genus *Anopheles* as a malaria vector. Six species of genus *Anopheles* found at the territory of Slovakia represent a real threat of this disease in future also due to spontaneous people migration between different countries and continents. Mosquitoes are vectors of dirofilaria disease caused by parasitic worms, which is being distributed also at the territory of Slovakia and South Moravia. The final host is the dog but it can infect also other carnivores and even, under very rare circumstances, humans.

In the recent years, *Diuraphis noxia* has become a significant pest of crops in Central and Eastern Europe. It was found in Slovakia in 2000 for the first time, and since 2001 it has become a dominant pest of crop plants. *Cameraria ohridella* is another example of non-original species. These insects damage leaves of horse chestnut.

Warming is demonstrated also by the activity of important species of acarids (*Acarina*). Their borderline has been shifted significantly to the north or to higher altitudes. In warm winters, active individuals of *Ixodes* and *Dermacentor* can be found already in January in the south of Slovakia. According to monitoring results, vertical borderline of the occurrence of sheep tick *Ixodes ricinus* has been shifted by 300-400 m at minimum in comparison with the situation up to 1980. Eggs of many parasites can be transported at long distances. For example, *Echinococcus multiocularis*, the species important from health and epidemiological aspects, is distributed by foxes from endemic localities in the Alps to Slovakia.

In water ecosystems, a rapid accession of several invasive and thermophilic species has been occurred also in invertebrates (e.g. shell *Anodonta woodiana*). Presumably, they came to Europe on branchiae of grass carp (*Ctenopharyngodon idella*). The shell has been spread very quickly through the south Danube route to the mouth of the Ipeľ River, where it has suppressed original species of genus *Anodonta*. The share of 50% of this shell was found out, what is the evidence of its great ecological plasticity and expansion.

Expansion of invasive fish species is another serious problem. They come from lower part of the Danube up the river and they are being gradually occurred in the rivers of Eastern Slovakia (Tisa, Latorica, Uh). They belong mainly to *Gobiidae.* In 1996 – 1997 a new species *Neogobius kessleri* was found in the Danube and today the fish lives in all the Danube River and in lower parts of its inflows (Ipeľ, Hron, Váh, Malý Dunaj). Recently, the other species - *Neogobius fluviatilis* has been found. It is unknown, where to the fish has already come against the stream of the Danube, but current knowledge indicates that the fish will cover all the Danube River and its inflows.

In future, the impacts of climate change can be expected in several dimensions (including social sector), as follows:

- Expansion of new pathogens and their vectors, including quarantine pests in agriculture and forest management.
- Infiltration of parasites and their vectors in human health and animal health.
- Enrichment of biota by new species with a negative potential of ecological stability conservation (for example invasive trees and bushes) within the whole chain of complex mechanisms, i.e. competition, predatory, parasitism, etc.
- Changes in diversity and potentials of agricultural and forest plants within commercial activities.
- Infiltration of new species of biota living close to human beings with negative impacts on human health in some cases (poisonous species, vectors of illnesses).

6.6.2 Vulnerability assessment in sector biodiversity

Expansion and invasions of several insects as agricultural pests is an actual problem in the Slovak Republic, particularly in localities that allow secondary but still suitable conditions for the pests. Tropic and sub-tropic elements are dangerous especially for greenhouses. They are very specific type of urban and cultural biotope, settled by characteristic communities, the structure of which relates to the species of growing plants. The expansion of quarantine pests, supported by the increase in annual temperature, belongs to the most important risks for future.

6.6.3 Adaptation measures in sector biodiversity

- Assessment of the spectrum of pests in agriculture, forestry and gardening, with a special attention paid to quarantine pests (*Thrips palmi, Frankliniella occidentalis, Scirtothrips aurantii*), or plant louses *Diuraphis noxia*, which are significant pests in vineyards.
- Identification of risk areas which are dangerous due to real or potential infiltration of pathogenic species into the rest of Slovakia as the result of global climate change.
- Drafting basic mechanisms of expansion, invasion and infiltration of pathogenic species into the territory of Slovakia in a way of proposing both legislative and practical phytopathological measures.
- Providing European phytopathological institutions, in particular the European and Mediterranean Plant Protection Organization (EPPO), with information in order to coordinate common and complex monitoring of agricultural pests in Europe and throughout the world.
- Drafting impacts and effects of global trends (global market, warming and aridity) on the structure and dynamics of fauna of pathogenic species in the Slovak Republic.
- Monitoring of expansion of important parasites and their vectors due to global climate change.
- Monitoring and research of ecology of new terrestrial and aquatic species' expansion, their connection to original communities and potential risks.
- Monitoring of changes in the structure of communities in terrestrial and aquatic ecosystems.
- Adaptation of new and invasive species to the climate conditions in the SR.
- Proposals and measures to protect original species spectra of biodiversity in the SR.
- Proposals and measures to protect extra endangered species and communities.
- Proposals and measures to prevent drying-up of wetlands and water biotopes, to prevent the decrease in flows of rivers.

Figure 6.6: Distributions of Encephalitis foci depending on the altitude in the SR in the periods of 1980 – 1985 and 2000 – 2004.

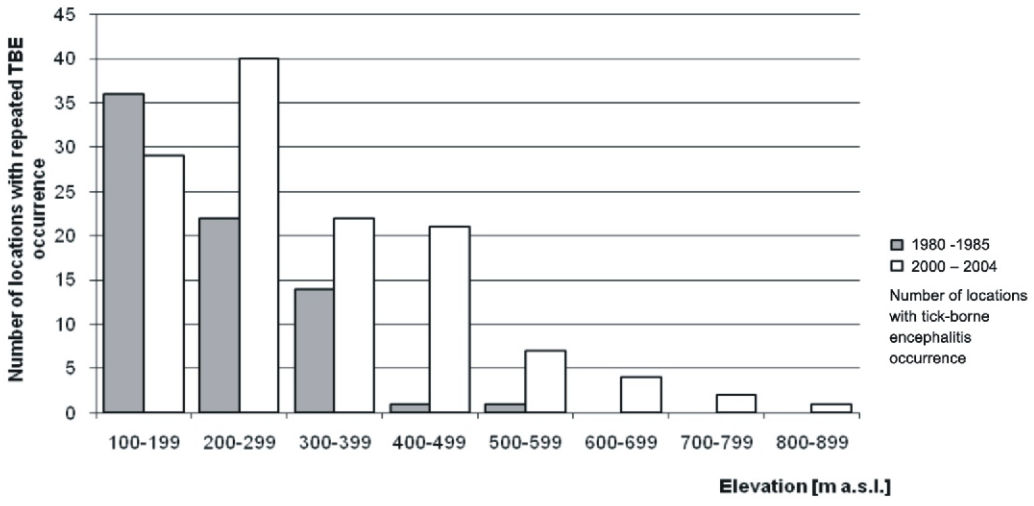
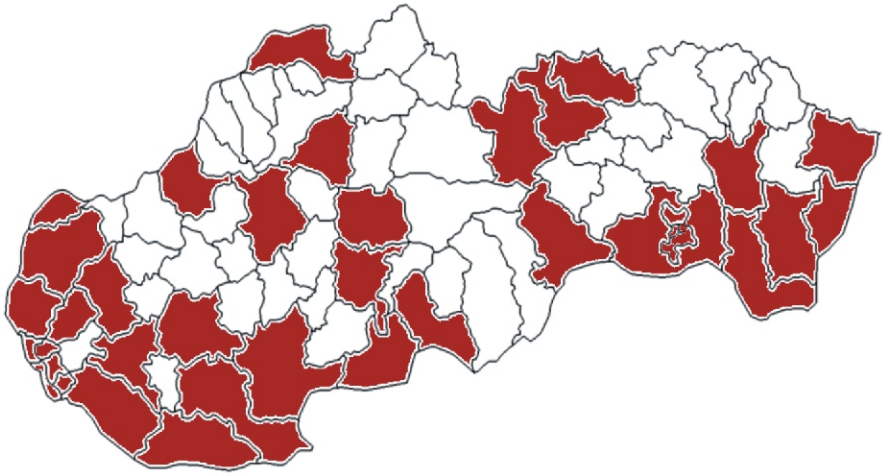


Figure 6.7: Slovak districts where the occurrence of Dirofilaria disease *in dogs was confirmed in 2007 and 2008.*



6.7 SECTOR TRANSPORT

Basic kinds of transport are influenced negatively by climate extremes and dangerous meteorological phenomena. In case of railways and roads, they are influenced primarily by the extremes of air temperatures, abundant and long-lasting precipitations, high snow cover and dangerous events, like glaze, fog and windstorm. Inland water transport is influenced negatively by very low air temperature in winter, drought and high speed of wind. Air transport is influenced primarily by low temperature together with precipitation, fogs and high wind speed, what makes the operation of airports more difficult. Special transport (cable cars, ski lifts) is influenced primarily by icing, glaze and strong wind.

6.7.1 Expected impacts of climate change on sector transport

The assessment of the impacts of climate and its variability on particular types of transport at expected climate change in future is based on the Fourth National Communication of the Slovak Republic on Climate Change from 2005 according to GCMs model CCCM 2000. Expected climate change will affect basic types of transport as follows:

- General increase in air temperature will affect positively the transport types that are the most sensitive and vulnerable to frost and snow, i.e. road transport, inland water transport and partially air transport.
- The decrease in atmospheric precipitation totals during summer months will affect inland water transportation, which is concentrated in hot lowlands and where the biggest decrease in atmospheric precipitation is expected during summer. The increase in air humidity in colder seasons may have negative impacts due to more frequent creation of fog, icing and black ice. In particular, road transport will be affected negatively by these effects, but partially also air transport, especially in moderately warm and cold climate regions.
- Warming causes the increase in number and intensity of extreme meteorological phenomena that relate to the increased accumulation of heat in the atmosphere (thunderstorms, heavy rains, windstorms and tornados) and can affect directly all kinds of transport.
- It is expected that in the Slovak Republic, road transport and inland water transport will be affected the most and railways and pipelines seem to be affected the least by climate change.

6.7.2 Vulnerability assessment in sector transport

Main corridors of road transport will affected negatively also in future, particularly in winter (snow cover, fog, icing, black ice and wind). The increase in snow precipitation totals can be expected during winter in mountain areas and passes in the central and south of Slovakia, for example in Donovaly, Čertovica, Besník, Šturec, Cesta Slobody (Road of Liberty) in the area of the Tatra Mountains, in particular in its part western from Smokovec to Podbánske. The decrease in snow precipitation totals, number of frost days, or days with glaze, can be expected in lowlands. Overall variability of climate impacts on road transport will increase.

More positive impacts of climate change, as regards air temperature in highlands, are expected in railway transport; more negative impacts can occur as episodes with extremely high air temperature in lowlands during summer. The increase in atmospheric precipitation totals can negatively affect also the railway transport in highlands during colder seasons.

Inland water transport on the Danube, the Morava and lower part of the Váh rivers will be affected negatively by the decrease in flows during summer, but also by heavy rains in summer along with steep increase in water level up to flooding activity level. Water transportation on the Danube depends on expected climate change in localities of its upper flow and the right tributaries in the Alp.

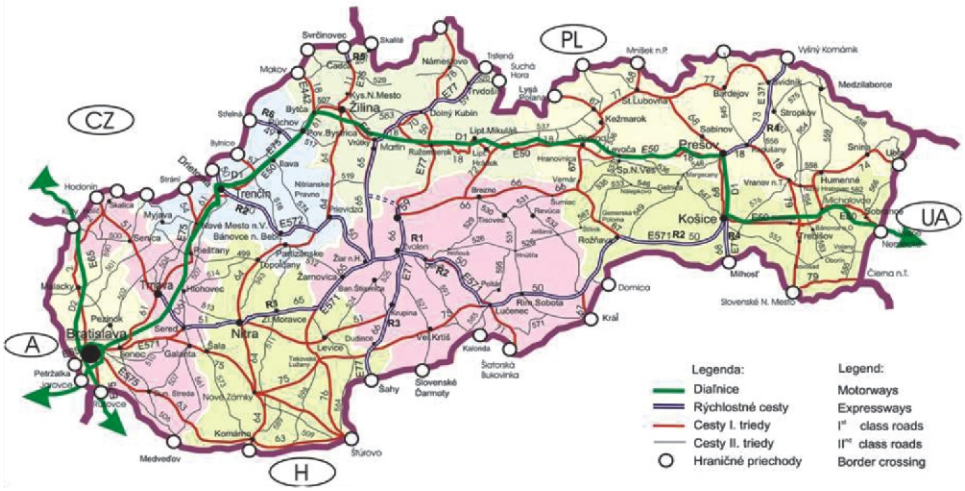
Air transport will be more sensitive to extreme meteorological phenomena. Airports in Bratislava and Košice will be affected especially in winter (glaze, snow), but also by dangerous meteorological phenomena, like strong thunderstorms and wind all the year round.

6.7.3 Adaptation measures in sector transport

Due to major climate impact on road transport, it would be better to support the development and modernisation of railway transport, i.e. electrification, double tracks, high speed lines, etc.

In road transport, it will be more important to improve and modernise the infrastructure in dangerous sections (road broadening, improving maintenance and road signs, and tunnel construction), diverting goods transportation, etc. In this regard, Donovaly, Vernár, Čertovica and Šturec are the most important sections. It is necessary to continue in the construction of motorways, to support the construction of new corridors and to modernise present corridors, that must be oriented into borders of highlands, as these are less affected by water flows (fogs, icing, black ice) and temperature inversions.

Figure 6.8: Planned construction of motorways and roads in the Slovak Republic till 2015.



Furthermore, it is important to continue in supporting internal air transport in relation to passenger transport in the most frequent sections, e.g. Košice – Bratislava, Poprad – Bratislava, to develop and broaden storage areas of airports in order to develop cargo transportation as the alternative to truck transport.

Completing the Váh transport route and making navigable the Bodrog, the Laborec and the Latorica is the priority in water transportation due to the cross connection of the Baltic Sea and the Balkan as the alternative to truck transport. This solution will allow permanent using existing water route of the Danube, the Váh and the Bodrog. Stream-beds of the rivers must be adapted in order to provide suitable navigation conditions during the whole year. It is also necessary to harmonise and adapt the construction of new corridors not only to the needs of Slovak economy, but also to actual commercial and transport trends in Europe and the orientation to the construction of multi-modals corridors.

6.8 SECTOR TOURISM

According to the Regionalisation of Tourism in the Slovak Republic (2005), tourist activities or holiday/leisure activities are divided into the activities related to natural or anthropogenic environment.

6.8.1 Expected impacts of climate change on sector tourism

According to the climate impact, tourism activities can be divided as follows:

- Activities markedly affected by climate, i.e. staying and relaxation at the water, water sports, cycling, paragliding, skiing, snowboarding, ski tourism, cross-country skiing and water tourism.
- Activities less affected by climate, i.e. walking, visiting historical sites and events (culture, sport, churches), country tourism, staying and relaxation in forests or mountains, in spa (thermal water), hunting, recognition of local traditions, shopping, participation in and visits of exhibitions and fairs, conference attendance, visits of museums and art galleries, caves, speleology, mountain climbing and fishing.

Table 6.5: Activities the most affected by climate change and their potential development in the regions of the Slovak Republic.

	Bratislavský	Podunajský	Záhorský	Dolnopovažský	Stredopovažský	Nitriansky	Hornonitriansky	Severopovažský	Turčiansky	Oravský	Liptovský	Ipeľský	Gemerský	Horehronský	Pohronský	Tatranský	Spišský	Košický	Šarišský	Hornozemplínsky	Dolnozemplínsky
Ski tourism and cross-country skiing											X			X		X					
Staying and relaxation at water	X	X																			X
Cycling tourism	X	X	X								X					X					
Staying and relaxation at thermal water		X		X	X						X					X					
Water sports	X	X		X						X	X										X
Downhill skiing								X	X	X	X			X		X					
Water tourism	X	X	X			X		X			X			X	X	X					

6.8.2 Vulnerability assessment in sector tourism

According to the Regionalisation of Tourism in the Slovak Republic (2005), the most vulnerable activities are the following:

- Ski tourism and cross-country skiing

Lower located centres (up to the altitude of 1,000 m) will be more vulnerable – les snow, irregularity in the occurrence of snow cover, shorter skiing season. On the other hand, positive impact is expected at higher localities (above 1,200 m) – more snow, longer skiing season, strong frost reduction.

- Staying and relaxation at water

Higher air temperature and less precipitation in summer positively affect this activity as the summer season will be longer; negative impact can be expected due to higher intensity of dangerous meteorological phenomena as a result of higher energy in the atmosphere (strong thunderstorms, heavy rainfalls, tornadoes).

- Cycling tourism

In the Danube basin region and Záhorie region, cycling tourism season is expected to be longer (positive impact). On the other hand, extreme heat waves and dangerous meteorological phenomena can negatively affect this activity during the warmest months. In Liptov and Tatras regions, expected climate change may have positive impact on this activity through better temperature conditions in spring, summer and autumn.

- Staying and relaxation at thermal water

Positive impact is expected due to warming, in particular in spring months (March, April, May), as well as the prolongation of the season of summer thermal swimming pools. The increase in the intensity of dangerous meteorological phenomena and followed-up damages may have negative impacts.

- Water sports

Positive impacts and season prolongation are expected in all regions. The increase in the intensity of dangerous meteorological phenomena may have negative impacts.

- Downhill skiing

In the Slovak Republic there is 76% of ski centres located up to 1,000 m. More significant warming during winter months will affect these centres as skiing conditions will become worse – unstable occurrence and height of snow cover, shortening of skiing season. On the other hand, a positive impact can be expected in higher altitudes (over 1,200 m), where the increase in precipitation totals at minus temperature will result in more snow and season prolongation despite the warming. But only some centres are affected by this effect (Chopok, Čertovica, Štrbské pleso, Skalnaté pleso – Lomnické sedlo, Zverovka – Spálená, Martinské hole, Vrátna - Chleb).

- Water tourism

Negative impacts are expected due to the decrease in atmospheric precipitation totals and their non-uniform distribution in Bratislava region, Danube region, Záhorie and Nitra regions in summer. Positive impact of the increase in atmospheric precipitation totals on this activity is expected in the highlands of Central and North Slovakia, particularly in Liptov region, the Tatra Mountains and the north parts of the river Váh basin and the Hron Basin.

6.8.3 Adaptation measures in sector tourism

- Supporting the development of tourism in lowlands of Slovakia that have a high potential for the development of several activities, like staying and relaxation at water, water sports, cycling tourism, water tourism, staying and relaxation at thermal water, staying and relaxation in spa, as these activities are less vulnerable to expected climate change.
- Supporting the development of tourism in mountains that have a high potential for the development of staying and relaxation in forest, mountains and in the country, walking, cycling, mountain climbing, visits of caves, where no significant impact of climate change is expected.
- Making efforts to prolong winter season and compensate the lack of natural snow by technical snow in ski centres up to 1,000 m.
- Reorienting ski centres in lower mountains (e.g. the Malé Karpaty mountains) to the activities that are less vulnerable to expected climate change, e.g. cycling and walking. Neither the construction of new ski centres, nor the investments in existing ski centres are recommended.

Activities connected mainly with the anthropogenic environment, where the direct impact of expected climate change is not significant, should be developed in all regions. These are staying and relaxation in spa, staying and relaxation at thermal water, staying and relaxation in the countryside, visits of fairs, exhibitions, congresses, conferences, seminars and caves. Development or improving quality of existing infrastructure (roads, hotels and restaurants), improving marketing and advertising are the proposed measures to enhance the potential of these activities.

6.9 SUMMARY AND CONCLUSION

Climate change impacts in the Slovak Republic are linked very closely primarily with the increase in air temperature. These are the most important in the change of agricultural regions, spreading several plant and animal species towards the north and higher altitudes. Further important impacts are linked with slight decrease in precipitation totals and the increase in evapotranspiration, particularly in the south of Slovakia. This change of water balance causes upper soil layers drying, as well as the change of water regimes of rivers. Therefore the water resources in the south of Slovakia are more vulnerable with many impacts on water management, agriculture and forest management, as well as on biodiversity and transportation. Adaptation measures have been incorporated into several sector politics and measures. Recently, preparatory works have begun in order to elaborate the National Adaptation Strategy, including social and economic factors.

Table 6.6: Summary of information on vulnerability and adaptation to climate change.

Vulnerable field	Examples/Comments/Adaptation measures
Hydrology and water management	Vulnerability: - Threat of water resources for water supply and electric energy production - Decrease in water resources in the south and east of Slovakia - Decrease in the electric energy production from big water power stations - Increase in the occurrence of drought and floods - Change of hydrologic cycle, possible influence on foreign relations. Adaptation: - Water resources protection - Increased need to redistribute runoff between the north and the south - Identification of prospective and supplementary resources for water supply and their utilisation - Effective water management in the country - Re-evaluation off big and small flood control reservoirs storage - Utilization of new energy sources (bio-fuels, wind energy, small hydropower stations)
Agriculture	Vulnerability - Creeping aridification of maize production area - Occurrence and spread of pests and diseases of agricultural plants, trees and animals Adaptation: - Cultivation and introduction of new agricultural and horticultural species - Development of irrigation systems. - Mulching.
Forest management	Vulnerability - Adverse influence of drought on forest ecosystems in the south of Slovakia - Increased risk of forest fires - Damage to forest ecosystems by new dynamics of pests - Destruction of spruce forests - Shift of wet snow zone to higher altitudes resulting in snowbreak and rooting out trees Adaptation: - Cultivation of new and more resistant species and the change of tree composition - Forest protection against biotic pests - Replacement of spruce by beech - Reduction of permanently deforested areas
Biodiversity	Vulnerability - Invasions of some species of insects as agricultural pests - Invasions of vector diseases threatening human health - Decrease in biodiversity Adaptation: - Phytopathological measures in legislation and in practice - Conservation of original species spectrum of biodiversity in Slovakia - Protection of extra endangered species and communities - Prevention of drying of wetlands and water biotopes
Transportation	Vulnerability - Affecting road transport by higher precipitations and snow in mountains - Affecting air transport by dangerous meteorological phenomena - Negative impact of the decrease in precipitation totals on inland water transport Adaptation - Support of railway transport - Improvement of quality of road corridors and their enlargement, construction of motor-ways and tunnels - Support and development of national air transportation - Completing the Váh river route and making rivers navigable to the Baltic Sea
Tourism	Vulnerability: - Less snow and irregular occurrence of snow cover in lower localities - Winter season shortening in lower localities - Restriction of water tourism in the south of Slovakia Adaptation: - Transfer of skiing activity to higher centres - Reorientation of threaten winter centres to other activities - Supporting development of winter sport centres in higher altitudes

6.10 REFERENCES

AUER, I., BÖHM, R., JURKOVIC, A., KVĚTOŇ, V., BOCHNÍČEK, O., ŠŤASTNÝ, P., LAPIN, M., NIEPLOVÁ, E., 2007: HISTALP-historical instrumental climatological surface time series of the Greater Alpine Region. In: Internat. Journal of Climatology, 27, 1, 17-46.

BELADIČOVÁ, V., VALENTOVÁ, D., 2005.: Prvý záchyt dirofilarií na Slovensku. In: Holková, R., Totková, A., Klobušický, M. (eds.), XII. Aktuálne problémy humánnej parazitológie. PAU LFUK Bratislava, 11-12. ISBN 80-969426-3-8.

BULÁNKOVÁ, E., 1999: Zmeny v druhovom zložení vážok (Odonata) Podunajskej roviny za posledných tridsať rokov. Entomofauna Carpathica, 11, 1, 1-5.

BULLOVÁ, E., LUKÁŇ, M., STANKO, M., PEŤKO, B., 2009: Spatial distribution of Dermacentor reticulatus tick in Slovakia in the beginning of the 21st century. Veterinary Parasitology, in Press.

ČABOUN, V, MINĎÁŠ, J., PRIWITZER, T., ZUBRÍK, M., MORAVČÍK, M., 2008: Vplyv globálnej klimatickej zmeny na lesy SR. Správa pre záverečnú oponentúru úlohy výskumu a vývoja. Národné lesnícke centrum, Lesnícky výskumný ústav, Zvolen, 306 s.

ČUKA, P., 2004: Stručný prehľad problematiky geografie nevýrobnej sféry. 1. vyd. Banská Bystrica: FPV UMB, 2004, 62 s. ISBN 80-8055-998-8.

ČUKA, P., 2007: Priestorová dynamika infraštruktúry cestovného ruchu v Banskej Bystrici a jej rekreačnom zázemí. Geografické štúdie Nr. 14. 1. vyd. Banská Bystrica: FPV UMB, 2007, 100 s. ISBN 978-80-8083-417-3.

DAVID, S., 2000: Stav a příčiny očekávaných změn biodiverzity vážek (Insecta: Odonata) na Slovensku. Acta environmentalica Universitatis Comenianae, 10, 163-169.

DUBINSKÝ, P., 2000: Cezhraničný prenos helmintozoonóz. Aktuálne problémy humánnej parazitológie. Bratislava, 12-14.

DUBINSKÝ, P., 2003: Globálne klimatické zmeny a ich vplyv na parazitárne choroby. Aktuálne problémy humánnej parazitológie, Bratislava, 7-10.

DUBROVSKÝ, M., TRNKA, M., SVOBODA, M., HAYES, M., WILHITE, D., ŽALUD, Z., SEMERÁDOVÁ D., 2005: Drought Conditions in the Czech Republic in Present and Changed Climate. In: Proceedings of the European Geophysical Union. Vienna, 25-29.

FABRIKA, M., 2008: Modelovanie produkcie lesa pod vplyvom klimatických zmien pomocou modelu SIBYLA. Národný klimatický program SR, 7, zv. 12, 143-149.

FAŠKO, P., GAÁL, L., LAPIN, M., PECHO, J., ŠŤASTNÝ, P., 2006: Príspevok k problematike odhadu návrhových hodnôt denných úhrnov zrážok. In: Nedožité osemdesiatiny profesora Milana Dzubáka. Bratislava. Slovenský hydrometeorologický ústav, 19-26.

FENDEKOVÁ, M., FENDEK, M., 2006: Factors affecting the groundwater regime in the High Tatra Mountains, Climate Variability and Change-Hydrological Impacts, Wallingford: International Association of Hydrological Sciences, 617-622. ISBN 1-901502-78-7.

GAÁL, L., SZOLGAY, J., LAPIN, M., FAŠKO, P., 2007: Process-based delineation of regions for a regional frequency analysis of multi-day precipitation totals in the cold season in Slovakia. In: Contributions to Geophysics and Geodesy, 37, 3, 197-225.

GÖMÖRY, D., LONGAUER, R., PAULE, L., KRAJMEROVÁ, D., PACALAJ, M., 2008: Je lokálny reprodukčný materiál vždy najvhodnejší? In: T. Hlásny (ed.), Lesy a lesníctvo Riziká, výzvy, riešenia. NLC, Zvolen, 73-78. ISNB 978-80-8093-056-1.

HALGOŠ, J., BENKOVÁ, I., 2004: First record Anopheles hyrcanus from Slovakia. Biológia 59., 15, s. 67.

HALGOŠ, J., 1999: Hromadný výskyt lastúrnika Anodonta woodiana (Lea, 1834) na Slovensku. Folia faunistica Slovaca 4, 5, 25-55.

HALMOVÁ, D., 2005: Vplyv klimatickej zmeny na využitie zásobného objemu vodnej nádrže Orava. In: P. Pekárová, J. Szolgay, eds.: Scenáre zmien vybraných zložiek hydrosféry a biosféry v povodí Hrona a Váhu v dôsledku klimatickej zmeny. Veda Vydavateľstvo SAV, Bratislava, 253-282.

HLÁSNY, T., BALÁŽ, P., 2008: The climatic water balance of Slovakia based on the FAO Penman-Monteith potential evapotranspiration. Geografický časopis 60, 1, 15-30.

HLÁSNY, T., TURČÁNI, M., 2009: Insect pests as climate change driven disturbances in forest ecosystems. In: Střelcová, K., et al. (eds), 2009: Bioclimatology and natural hazards, Vydavateľstvo Springer, s. 165-178. ISBN 978-1-4020-8875-9.

HLAVČOVÁ, K., KOHNOVÁ, S., 2005: Návrh rámcových adaptačných opatrení. In: Pekárová, P., Szolgay, J., eds.: Scenáre zmien vybraných zložiek hydrosféry a biosféry povodí Hrona a Váhu v dôsledku klimatickej zmeny. Veda Vydavateľstvo SAV, Bratislava, 419-492. ISBN 80-224-0884-0.

HLAVČOVÁ, K., LAPIN, M., SZOLGAY, J., KOHNOVÁ, S., 2007: A simple model for estimation of climate change induced extreme daily precipitation changes. In: Heinonen, M., ed.: Proceedings of the Third international conference on Climate and Water. Finish Environment Institute SYKE. Helsinki, 188-193.

HLAVČOVÁ, K., SZOLGAY, J, KOHNOVÁ, S., HLÁSNY, T., 2008: Simulation of hydrological response to the future climate in the Hron river basin. Journal of Hydrology and Hydromechanics 56, 3, 163-175, ISSN 0042-790X.

HRÍBIK, M., ŠKVARENINA, J.,KYSELOVÁ, D., 2008: Hydrofyzikálne vlastnosti snehovej pokrývky v horských ekosystémoch Poľany, Nízkych a Západných Tatier v zimách rokov 2005/06-2007/08, In: Šír, M., Tesař, M., Lichner, Ľ., (eds): „Hydrológie malého povodí 2008". Praha 23.-24.4. 2008, 341-348. ISBN 978-80-87117-03-3.

07

Financial resources and transfer of technology

including information under Articles 10 and 11, of the Kyoto Protocol

This chapter provides an overview of the relevant projects within the Official Development Assistance dealing with renewable energy sources (RES), energy savings, adaptation measures and capacity building in the selected target countries. This information is provided although the Slovak Republic is not among the countries of the Annex II to the Convention.

The Slovak Republic has gone through the challenging process of transformation from an aid recipient country to a donor country since 2003. Main steps to develop the governance and implementation capacities in the SR to face its donor role have been made in 2005.

Since 2005 the Slovak Republic has entered into a partnership with UNIDO. Its main role has been to promote the two-way transfer of investments and technologies. In the year 2007, the Act 617/2007 Coll. on Official Development Assistance (ODA) came into force. Ministry of Foreign Affairs has become the main coordinating body and in the similar vein the Slovak Agency for International Development Cooperation has become the main body in charge of implementation. In addition to the projects being implemented in Africa, mainly focused towards provision of to the medical and food aid, different projects in the selected target countries, such as the Balkan region, former Soviet Republics and Mongolia have been initiated.

During the period 2004 – 2007 a number of projects have been implemented:

- 199 Development and humanitarian aid projects.
- 34 Thematic projects (capacity building, raising of public awareness, education).
- 49 Projects focused on support for RES, energy saving and energy efficiency improvement, water management and resource treatment, building of warming systems, waste management, forest conservation projects and specific capacity building projects to develop UNFCCC and KP infrastructure (Serbia, Kazakhstan).

Table 7.1 provides an overview of the projects dealing with technology and investments transfer carried out within the official Slovak ODA. Projects typically focus on RES, energy savings, adaptation measures and support for capacity building for UNFCCC and KP.

Table 7.1: The overview of the development projects dealing with transfer of technology in the Slovak Republic.

Development projects Slovak Aid 2004 – 2006			
Target Country	**Contactor**	**Project title**	**Contracted USD**
Bosnia and Herzegovina	Energo Controls	Sustainable energy for Banja Luka	90,603
Bosnia and Herzegovina	Microstep - MIS spol. s r.o.	Automatic Weather Stations Network	100,000
Bosnia and Herzegovina	Termosolar Ziar, s.r.o.	Solar energy for House of Health Banja Luka	0
Kazakhstan	ELTECO, a.s.	Restructure and improvements of the energy supply system in health care objects	99,999
Kazakhstan	SHMÚ	Groundwater management and its transboundary aspects in Kazakhstan	100,000
Kazakhstan	Profing, s.r.o.	Support of Kazakhstan in Kyoto Protocol ratification process and capacity building in order to implementation of Kyoto flexible mechanisms	131,901
Kenya	Slovenské centrum čistejšej produkcie, s.r.o.	REAK - Resources efficiency assessment in Kenya	123,156
Kyrgyzstan	Martimex a.s.	Rivers from Gabion	100,000
Kyrgyzstan	Energy Consulting, s.r.o.	Promotion Development of the Energy Service Company in Kyrgyzstan: "ESCO-KYR"	75,230
Kyrgyzstan	Výskumno-vývojový ústav pozemných stavieb, s.r.o.	Energy certification of buildings in Kyrgyzstan - BUILDCER	99,583
Kyrgyzstan	Nawitas AAE, s.r.o.	Slovak-Kyrgyz Partnership on Fostering Market Penetration of Renewable Energy Sources in Kyrgyzstan – FoRES	125,872
Kyrgyzstan	CENAA - Centre for European and North Atlantic Affairs	Radiation Monitoring System	179,024
Former Yugoslav Republic of Macedonia	Microstep - MIS spol. s r.o.	Aeronautical Climatological Database	80,000
Former Yugoslav Republic of Macedonia	Geofyzikálny ústav SAV	Development of infrastructure for rapid earthquake data collection and exchange	85,932
Mongolia	Štátny geologický ústav Dionýza Štúra	Platinum group and rare-earth element mineralizations of Western Mongolia: a regional resource assessment	100,000
Mongolia	E-Est, s.r.o.	Water for herdsmen and their herds in the steppe	99,495
Mongolia	SES Energy, a.s.	Development of power generation infrastructure based on combustion of local coal	199,315
Mongolia	Grasrenov, s.r.o.	Green Mongolia	197,970
Sudan	Sigmatech, a.s. - SYNECTA, a.s.	Khartoum North Water Treatment Plant Rehabilitation – Pumping Section rehabilitation	196,430
Uzbekistan	Slovenské centrum čistejšej produkcie, s.r.o.	Cleaner Production and Energy Efficiency: Developing and improving competitiveness and environmental performance in	92,780

Development projects BBF 2003 – 2006			
Target Country	Contactor	Project title	Contracted USD
Montenegro	Thermosolar, s r.o.	Solar energy for clinic center in Podgorica	89,896
Montenegro	Rudný projekt, s r.o.	Secondary gravitational sewage system in Tivate	228,505
Serbia	Energo Controls, sr.o.	Smart energy for Kikinda	105,348
Serbia	Geofyzikálny ústav SAV	Infrastructure for quick data collection about earthquake	111,499
Serbia	Profing, s r.o.	Capacity building for climate change in Serbia	77,177
Serbia	Slovenská agentúra životného prostredia	Support and development of environmental education	62,734
Serbia	Mestský úrad Galanta	Clean water of artesian spring for people of Bečeja	94,458
Serbia	Gramont, s r.o.	Sewer revitalisation Begej	114,448
Serbia	Zvarmont, s r.o.	Utilization of geothermal energy for spa heating Kaniža	114,452
Serbia	SHMÚ	Institution support for the intergrated water protection and water management in line with the EU directives in Vojvodina	97,658
Serbia	Energo Controls, s r.o.	Drinking water for Zrenjanin	114,483
Serbia	SHMÚ	Analysis of the need for the integrated monitoring system in the field of data collection and natural disaster warning	13,740
Serbia	PIPECO, s r.o.	Reconstruction of the heat distribution systems and energy savings in Subotica	227,603
Serbia	Energo Controls, s r.o.	Detection for Sombor – energy savings	218,677
Serbia	MFF UK	Meteorological, hydrological and radiative monitoring in Serbia	228,955
Serbia	Výskumný ústav vodného hospodárstva	Integrated water sources management in Vojvodina	112,859
Serbia	Národné lesnícke centrum	Protection support and regeneration of forest in Serbia	114,312
Development projects Slovak Aid 2007			
Kazachstan	Ústav informatiky SAV	Creation of infrastructure for environmental monitoring networks	
Macedonia	Rudný projekt s.r.o.	Practical solution of waste water processing	266,399
Mozambique	Detone s.r.o.	Improvement of public living standards – clean water	
Serbia	Obec Oslany	Sewerage system for Novo Miloševo	229,810
Serbia	Mesto Myjava	Waste water system for Jánošík	271,259
Serbia	EKOSAL trading s.r.o.	Central, progressive way of heating - utilizing renewable resources	
Serbia	Dekonta s.r.o.	Capacity building for implementation of EU Dir. of water environment pollution	99,917
Serbia	Fakulta matematiky, fyziky a informatiky UK	Expansion of the network of meteorological and radiation stations, systems of data collection and climatological database	273,211
Serbia	AISA s.r.o.	Reconstuction of water-supply network in region Báč	273,008
Serbia	ZVARMONT s.r.o.	Reconstruction of heating infrastructure	268,451
Serbia	PIPECO Slovakia s.r.o.	Reconstruction of infrastructure – long distance heating system	273,054
Serbia	Gramont s.r.o.	Development and modernization of infrastructure through renewable resources – wind power plants	264,927

08

Research and systematic observation

The goal of this chapter is to introduce national and international activities in research and development and in the climate change domain especially within the context of general conditions supporting science and research in the Slovak Republic. It includes also systematic monitoring of climate system in the Slovak Republic in relation to international activities and the research of climate change impacts in this region.

8.1 GENERAL POLICY ON RESEARCH AND SYSTEMATIC OBSERVATION

8.1.1 General policy on research

The Slovak Republic has developed an integral Conception of state scientific and technical policy. The Ministry of Education of the Slovak Republic is the authority with full competences and administration skills to manage research and development in the Slovak Republic according to Act 172/2005 Coll. on the organisation of the State support of research and development. In 2007, the Government of the Slovak Republic approved "Long-term plan of the state science and technology policy by the year 2015", which specifies the objectives and targets in research, human resources development and international co-operation. It includes also the themes of State programmes of research and development. Similarly, ministries, central bodies of state administrations and the Slovak Academy of Science have developed their sector conceptions supporting research and development. One of the substantive priorities of research and development is "Environment protection", which is, among other things, focused on the research and development in the field of measures to mitigate negative impacts of climate change.

In 2008, the State support of research and development was adapted. Research is supported mainly from public funds (the State budget and the EU funds) in conformity with the principles applied within the European research area. Research activities are funded from the budget of the Ministry of Education and they are partly realised in common competitive environment through several grant agencies. The Scientific Grant Agency of the Ministry of Education and the Slovak Academy of Science (VEGA) supports the basic research carried out at universities and the Slovak Academy of Science. Slovak Research and Development Agency (APVV) supports research and development projects and projects on the development of research and development infrastructure through the fund of the Ministry of Education. The Grant Agency of the Ministry of Education for applied research (GAAV) supports projects in applied research.

In addition to the budget of the Ministry of Education, research is funded also from budgets of other ministries, central bodies and the Slovak Academy of Science.

8.1.2 General policy on systematic observation

Hydrometeorological observations and measurements in the Slovak Republic are guaranteed by Act 201/2009 Coll. on the State hydrogeological service and the State meteorological service. These observations and measurements are carried out by the Slovak Hydrometeorological Institute (SHMÚ), which is responsible for gathering, processing and administration of meteorological and hydrological data. It covers also the set of basic climate variables according to FCCC/SBSTA/2007/L.14/Add.1. SHMÚ manages the data according to Quality Management System in compliance with STN EN ISO 9001:2001. The data are used for the assessment of current state and trends in climate and hydrologic systems in the SR. SHMÚ is active in the implementation of homogenisation applications to reduce data uncertainties and also in the digitalisation of old archived data in order to provide more precise description of climate system in the SR for the last 100 years. SHMÚ has research capacities of good quality at its disposal for the assessment of current state and trends in climate and hydrologic systems, as well as an excellent co-operative potential for research projects. Data are communicated to Word Data Centres or are provided for several projects (e.g. HISTALP).

8.2 RESEARCH

Better management of research and development and the prioritisation of climate change have resulted in the increase of research activities in climate change in comparison with the previous period. International research has been realised particularly within the structures of conjoint European research in COST projects (Cooperation in Science and Technology) and Framework Programmes (FP6 and FP7). A large number of research and development projects within national research activities have been funded mainly from the State budget and Structural funds of EU. The incorporation of national research teams into international research structures is another asset of international projects. National projects are as important as the international ones and their scopes and results are comparable with the European standards. There are fewer projects in basic research. The research on climate change impacts and vulnerability was the most frequent. Many of research activities did not deal directly with climate change, but the development and improvement of models of physical and biological processes served as a valuable research instrument.

Institutions involved in research projects in climate change:[1]

- Slovak Hydrometeorological Institute, Bratislava (SHMÚ)
- Faculty of Mathematics, Physics and Informatics of the Comenius University in Bratislava (FMFI UK)
- Faculty of Natural Sciences of the Comenius University in Bratislava (PriF UK)
- Faculty of Civil Engineering of the Slovak Technical University in Bratislava (SvF STU)
- Faculty of Forestry of the Technical University in Zvolen (LF TU)
- National Forest Centre in Zvolen (NLC)
- Slovak University of Agriculture in Nitra (SPU)
- Parasitological Institute of the Slovak Academy of Science (PAÚ SAV)
- Institute of Landscape Ecology of the Slovak Academy of Science (ÚKE SAV)
- Institute of Botany of the Slovak Academy of Science (BOÚ SAV)
- Geological Institute of the Slovak Academy of Science (GEOÚ SAV)
- Institute of Zoology of the Slovak Academy of Science (ÚZ SAV)
- Institute of Hydrology of the Slovak Academy of Science (ÚH SAV)
- University of Veterinary Medicine in Košice (UVL)
- Science and Research Institute of Matej Bel University in Banská Bystrica (UMB)
- Soil Science and Conservation Research Institute in Bratislava (VÚPOP)

8.2.1 Climate process and study of climate system (including paleoclimatic system)

The National Climate Programme of the Slovak Republic (NPK) deals with the theme by studying long-term series of climatic and hydrologic elements, in relation to the investigation of the status, development and variability of climate and hydrologic systems of the SR, as well as their mutual interrelationships.

Paleoclimatic research is focused on the ecosystems of upper Miocene, Pliocene and Quaternary as the indicators of climate change (PriF UK), as well as on freshwater Crustaceans in Neogene (GEOÚ SAV).

8.2.2 Modelling and predictions, including GCMs

There is no basic research in the development and the applications of climate models in the Slovak Republic. Procedures of statistics and dynamic downscaling for outputs of global atmospheric models have been developed to be used for modelling various scenarios. These outputs are used also in this report. The sensitivity of climate system in Slovakia on climate change by statistics and dynamic downscaling of GCM outputs was investigated at FMFI UK.

[1] *List of projects on climate change in the SR in the period of 2006 2009 is available from:*
http://www.shmu.sk/sk/?page=1537

8.2.3 Research on climate change impacts

Several Slovak institutions participate or used to participate in international projects on the above mentioned theme as partners. These projects are in the sectors of forestry, agriculture, water and soil, as follows:

- CC-TAME: Climate Change: Terrestrial Adaptation & Mitigation in Europe; 2008 – 2011; EU FP7, (http://www.cctame.eu/).
  Partners: VÚPOP and PriF UK.
- CECILIA: Central and Eastern Europe Climate Change Impacts and Vulnerability Assessment; 2006 – 2010; EU FP6, (http://www.cecilia-eu.org/).
  Partner: NLC.
- WATCH: Water and Global Change; 2007 – 2011; EU FP6, (http://www.eu-watch.org/).
  Partner: PriF UK.
- BurnOut: Greenhouse-gas budget of soils under changing climate and land use; 2006 – 2009, COST 639, (http:/www.cost639.net).
  Partner: NLC.
- CLIVAGRI: Impact of Climate Change and Variability on European Agriculture; 2006 – 2010 COST Action 734, (http:/www.cost734.eu).
  Partners: SHMÚ, SPU and VÚPOP.

In period of 2006 – 2009, several large national projects on climate change impacts on particular sectors have been implemented at several institutions.

Climate change impacts on forests in Slovakia, including primeval forests, their water balance, transport of chemical substances and energy, have been the subjects of several projects at NLC and LF TU. Impacts on the biodiversity of forest ecosystems were researched within projects at NLC and ÚKE SAV. Impacts on natural risks, diversity and vitality of plants in forest ecosystems were researched at LF TU. Impacts on forest soil and genetic and productive characteristics of forest soil, as well as economic aspects of forest management were researched at LF TU. Optimisation of forest management in relation to climate change was researched at LF TU.

In hydrology and water management, national research was concentrated on the analysis of anthropogenic impacts on water cycle together with impacts of changes in the exploitation of landscape on the quantity and quality water in water flows (ÚH SAV and SvF STU). The assessment of extreme hydrological situations in water flows and the drought behaviour were also researched at ÚH SAV and SvF STU. Hydrological drought was investigated in the basin of the Danube River, soil drought in lowlands of Slovakia (ÚH SAV). The impact of hydrological drought on groundwater supplies was researched at PriF UK. Several projects were focused on climate change impacts on water supplies in soil (ÚH SAV). Analyses of vulnerability were elaborated for selected basins (ÚH SAV).

In biota sector, climate change impacts on parasite and infectious diseases of animals were investigated within several projects (PAÚ SAV), as well as the expansion of ticks (PAÚ SAV and ÚZ SAV). Impacts on the circulation of important pathogens in nature in relation to the quality and safety of meat from animals and fish, as well as bee products were investigated (UVM). Other projects were focused on changes of biodiversity of scarce biotopes and plant communities (BOÚ SAV). The other projects have investigated climate change impacts on water organisms and researched the ecology and epidemiologic importance of small mammals in relation to climate change (ÚZ SAV). Several other projects deal with changes in landscape diversity, with particular attention to smaller areas (the Tatra Mountains) or ecological integrity of landscape (UMB).

In agriculture, a new agro-climatic regionalisation of plant production was done in relation to changing climate (VÚPOP and SPU) and the primary production of ecosystems was estimated (SPU). In relation to agricultural soil, some proposals for targeted regulation of soil resources were developed (VÚPOP and SPU), as well as the impact assessment on the content of soil substance and organic carbon sequestration. The research was focused also on the impacts of drought on agricultural production, as well as on the impacts of agricultural landscape use on the relation between precipitations and runoff (SPU). At the assessment of vulnerability, the risks of climate change impacts on selected product were researched (apricot, peach, vine, endives, sugar beet and sunflower), as well as their pests and diseases (e.g. apple tree) (SPU).

8.2.4 Socio-economic analyses, including analysis of impacts and response abilities

The research in this theme was realised particularly through the participation in international projects, as follows:

- INSEA: Integrated Sink Enhancement Assessment; 2004 – 2006; EU FP7 was on of the projects supporting the European Commission (http://eusoils.jrc.ec.europa.eu/projects/insea/index.htm). Partners: VÚPOP.
- BIOSTRAT: Developing the EU Biodiversity Strategy; 2006 – 2009; EU FP6 (http://www.biostrat.org/). Partner: ÚKE SAV.
- MASCAREF: Developing harmonized Methods for Assessing Carbon sequestration in European Forests; Study under EEC 2152/2003; 2007 2009, http://afoludata.jrc.ec.europa.eu/v2007/MASCAREF_Interim_Report_final.pdf. Participation of NLC.

8.3 SYSTEMATIC OBSERVATIONS

The framework for complex environmental monitoring has been determined by the Resolutions of the Government of the Slovak Republic No. 623/1990, No. 449/1992 and No. 620/1993. Monitoring subsystems are fundamental units of the national monitoring system of the Slovak Republic. Some of them are operated by the Slovak Hydrometeorological Institute. The Monitoring Subsystem of Meteorology and Climatology is one of them and it includes a network of monitoring stations, distance measurements and observation of some biological subjects (phenology). This subsystem collects data on weather conditions and on the state and the development in climate system. Monitoring Subsystem Air ensures monitoring of air quality with continual measuring gaseous pollutants and atmospheric aerosol. The subsystem monitors also the chemistry of atmospheric precipitations. Monitoring Subsystem Water monitors the quantity and quality of surface water and groundwater in the SR. SHMÚ provides the data gathered through the monitoring subsystems for decision making, management and research and development, as well as for public.

Observation networks and objects of SHMÚ are owned by the State according to Act 201/2009 Coll. on the State Hydrological service and the State meteorological service. SHMÚ operates 76 classic climatologic stations and 567 precipitation stations. Additional 8 automatic weather stations and 330 automatic rain gauge stations are the part of the Flood Warning System. Selected stations are included in GCOS programme. Besides these activities, SHMÚ operates also the network of phenologic stations. Remote sensing includes 2 Doppler radars, 1 upper air station and a lightning detection system. The membership of the SR in the European Meteorological Satellite Organisation (EUMETSAT) allows receiving satellite images in real time. The air quality network consists of 33 automatic stations in most polluted regions and 4 background stations. The hydrological network consists of 419 stations measuring surface water quantity and 314 stations measuring surface water quality. The quality and quantity of groundwater and springs are measured by 1,497 objects. SHMÚ has introduced the Quality Management System according to ISO 9001:2001 for monitoring, evaluating and interpreting data. The System is properly maintained and operated.

09

Education, training and public awareness

Legal framework in the Slovak Republic with respect to collection, assessment and release of environmental information to the public, including the information on climate change, is covered by Act 211/2000 Coll. on the free access to information, Act 205/2004 Coll. on collection, storage and dissemination of environmental information, Act 478/2002 Coll. on air protection and Act 572/2004 Coll. on emission trading with CO_2 allowances. These regulations provide for dissemination of information to the public. Several documents on the environmental education and public relation have been developed. Based on the National Environmental Action Plans I, II and III, the Concept of Environmental Education has been developed for primary and secondary schools. The Ministry of Education of the Slovak Republic has developed the National Education Programme – Millennium that involves principles of sustainable development and creates a space to implement these issues in the long term education.

Education and public awareness activities with respect to climate change are neither legally nor 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 – SAŽP (www.sazp.sk), which is a partner institution to the European Environmental Agency (www.eea.eu.int). SAŽP operates centres of environmental education.

An increase in public awareness was significantly improved by new information technologies and the Internet. However, the information technologies are still utilised less than in other European countries on average. The SAŽP 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 conditions 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. This sub-system is concerned the information generated by the Ministry of Environment, district and regional environmental offices and the Slovak Environmental Agency. The system requires the automation of activities related to the environmental impact assessment process.

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 SHMÚ (www.shmu.sk) and other governmental agencies. The web page of the Ministry of Environment contains also the Third and the Fourth National Communications (in the Slovak language), the National Inventory Report 2009 on the GHG emissions inventory and the National Allocation Plan for the trading with GHG emissions and emission quotas in the European Community.

The Faculty of Mathematics, Physics and Informatics of the Comenius University (FMFI UK) provides scientific information on climate change and climate system of the Earth at web page www.dmc.fmph.uniba.sk. In the Slovak Republic, this is the most watched web page on climate change and climate system. Theories of climate system of the Earth, climate change in the past, today and in future are the fundamental topics of curriculum at FMFI UK.

A separate web page Information system on greenhouse gas emissions in the Slovak Republic: www.ghg-inventory.gov.sk was established in conformity with Decision 20/CP.7 of the Kyoto Protocol. The page brings detailed information on inventories and projections of greenhouse gas emissions, including a brief description of the methodology for their determination.

9.1 PUBLICATIONS

Fruitful publication activities in climate change and air protections are described in several sectoral reports, periodic journals and expert papers, of which the most important are listed as follows:

- Enviromagazín is a periodical journal having tradition in the Slovak Republic. It has been issuing from 1996 by the Slovak Environmental Agency in cooperation with the Ministry of Environment in Slovak language. The interval of issuing is two months.
- Meteorological Journal is a specialised scientific and expert journal issued by the Slovak Hydrometeorological Institute in the area of meteorology, climatology, air pollution and other related sciences. The journal publishes original scientific papers, reviews and short expert papers of Slovak and foreign authors. All papers are read by lectors. The contributions are issued in English, Slovak and Czech languages.

- State of the Environment Report in the Slovak Republic is the report annually published by the Ministry of Environment since 1993. The report presents review of current situation in air, water, soil, rock environment and biota. It evaluates the situation in nature conservation, describes factors and their impacts on the environment.
- Report on the air quality and share of individual sources of pollution in the Slovak Republic is published annually by the SHMÚ, Department of Air Quality, in two languages. The report describes immission and emission situations in the Slovak Republic, the most important sources of air pollution and the trend in most important pollutants. It is available at the Internet page of SHMÚ. A separate chapter deals with the inventory of greenhouse gas emissions that are classified according sectors and gasses.
- In 2008, the 12th scientific proceeding of the National Climate Programme of the Slovak Republic was issued. It contains ten contributions, read by lectors, from eight institutions on climate change.
- Journal of Hydrology and Hydromechanics (issued by the Institute of Hydrology of the Slovak Academy of Science and the Institute of Hydrodynamics of the Czech Academy of Science), Acta Hydrologica Slovaca (issued by the Institute of Hydrology of the Slovak Academy of Science), Geographic Journal (issued by the Geographic Institute of the Slovak Academy of Science), Vodohospodársky spravodajca (i.e. Water Rapporteur, issued by the Association of water companies), Životné prostredie (i.e. Environment, issued by the Institute of Landscape Ecology of the Slovak Academy of Science), are the other scientific, expert and educational journals dealing with climate change.

9.2 CONFERENCES, WORKSHOPS, SEMINARS

The number of activities focused on providing experts and public with the information on climate change projects and research has been increasing year after year. Several conferences, workshops and conferences are organised, of which the most important are listed as follows:

- Conference Enviro-i-forum has been organised yearly by the Slovak Environmental Agency and the Ministry of Environment since 2005. Its objective is to present the availability of environmental information and the use of information technologies to process the information. Experts, officers of the state administration and self-governments, scientific institutions, universities, private companies, developers of information systems on the environment and the users of these systems are the target groups of this conference. The conference provides the space for the exchange of information and the presentation of both the ongoing and the prepared projects aimed on environmental data collection, processing, analysing, publishing and making available.
- Climate change (Slovak vision) is a discussion forum connected with the presentation of thematic billboards and publications on climate change. The last discussion took place in November 2008 under the auspices of the French Embassy in the Slovak Republic (within the French EU Presidency) and the Slovak Technical University. Professor Milan Lapin from the Comenius University, Professor Jan Szolgay from the Slovak Technical University and RNDr. Pavol Nejedlík from the Slovak Hydrometeorological Insitute took part in professional discussion.
- International Conference on Air Protection has been organising annually since 1985 under the auspices of the Ministry of Environment of the Slovak Republic. It is open to public and it allows the discussion on actual topics, such as greenhouse gas trading, up-to-date techniques in air protection, reduction of emissions, actual problems and experience in air quality monitoring.
- Seminars organised at the occasion of the World Meteorological Day and the World Water Day are organised annually by the the Slovak Hydrometeorological Insitute and are focused on actual topics, taking into account acute problems and challenges.
- Conference on the Slovak National Emissions Registry has been organising regularly since 2005 for the stakeholders of trading scheme, operators and verifiers of the CO_2 emission reports, experts and the state administrators. It provides actual information on the national register of emission quotas and changes in legislation.
- Conference on the Environment is organised regularly as the meeting of experts, officers of state administration and public in order to receive information on up-to-date trends in the environment. Speakers talk not only about environmental legislation, but there is also the opportunity for managers from industry and experts from various institutions who are obliged to implement and enforce the legislation, to present their experience.

- Social Development and Bio-climate is an international conference organised regularly under the auspices of the Slovak Academy of Science and the Slovak Bio-climate Society. The conference deals with scientific aspects of climate change in relation to natural environment, potential impacts and adaptation mechanisms.
- Conferences for young experts up to 35 years are organised annually in meteorology, climatology, hydrology, and water management. The conference is coupled with the competition for the best project.
- Civil association Young Scientists of the Slovak Republic is a non-profit and non-governmental organisation established in 2004. Its priority is to search for talented children and young people from 12 to 20 years in science and techniques and to support their development. The association organises regularly congresses for young people focused on selected topics, including climate change, water management and hydrology.

9.3 FESTIVALS, MEDIA

New information and communication technologies are used also in order to popularise and to educate in climate change. The list of most important events in the Slovak Republic is as follows:

- Envirofilm is an international festival of films on the environment. It is also educational and popularising event for public. The aim of the festival is to introduce and to award prizes to new films and TV programs, which help to disseminate the ideas of environmental protection through their contents and art level. In addition to the conferences, seminars and workshops addressed to experts, the festival offers also competitions and discussions with top national and international film directors, film makers, documentaries and environmentalists. An international competition of children art creativity, named Green World, is organised annually within the festival (www.envirofilm.sk).
- Ekotopfilm is an international film festival on sustainable development, which has been organising since 1974, so it is the oldest ecologically focused film festival in the world. This event has attained a high expert and moral credit (www.ekotopfilm.sk).
- Professional journal of the Slovak Environmental Agency – Enviromagazin (www.enviromagazin.sk) published a paper "Global warming, climate change and controversial arguments" in February 2007.
- Journal "Our Hunting" published the information on climate change, scenarios and related issues in its no. 2, 3, 4 and 7 (2006), 1 and 7 (2007), 11 (2008) and 6 (2009).
- Journal "Environment" publishes the papers with respect to potential impacts of climate change, more detailed examples are in no. 5 (2005), 5 (2007) and 4 (2009).
- Newspaper "Pravda" (www.pravda.sk) published the article "Climate change can be mitigated" in February 2005 and the article "Climate change shall hit drastically" in April 2007, the article "Climate change will change also the SR "in December 2007 and the article "Climate change will be demonstrated within Europe" in September 2008.
- Newspaper "Sme" (www.sme.sk) published the article "Climate change and our behaviour" in April 2008.
- Weekly Journal "Týždeň"(www.tyzden.sk) published the article "Briefly on the theory of the climate system" in February 2005.
- Weekly Journal "Žurnál" (www.izurnal.sk) published the article "Inconvenient truth on global warming" in November 2007.
- The internet page www.europa.eu published the contribution "Credible voice on climate change" in November 2007.
- Other papers, as well as the detailed analysis, were published in journals "Foreign Policy" no. 1 (2007), Quark no. 3 (2008) and Slovo / the Word no. 18 (2007).

9.4 OTHER ACTIVITIES

Important information role is carried out by the Public Relation Office of the Ministry of Environment. The office mediates environmental information and provides informative and educative documents on environmental protection.

As regards energy saving, the activities of the Advisory and Information Centres of the Slovak Energy (SEA – established by the Ministry of Economy by Decision 63/1999, www.sea.gov.sk) need to be evaluated positively. These centres provide information, expert advisory and promotional activities in energy management and the use of renewable sources. SEA organises short-term courses and training in formats that are compatible with those organised in the EU. SEA is accredited to organise the specialised four-semester course on Industrial Energy and Water Management in Banská Bystrica.

Non-governmental organisations are also involved in education and public awareness, such as Association of Environmental Education Špirála (www.spirala.sk). Today it groups 12 NGOs. In the Slovak Republic, several international NGOs are active. They promote environmental protection, including climate change.

In the context of voluntary environmental instruments, the instruments linked with the public administration are particularly interesting (e.g. Green Public Procurement – GPP). Eco-labelling for environmentally sound products and Environmental Management Systems are voluntary instruments with the potential of long-term favourable impact.

Eco-label scheme in the Slovak Republic has been developed in compliance with Regulation (EC) 1980/2000/EC on a revised Community eco-label award scheme, which is currently again in the process of revision. National eco-label "Environmentally Sound Product" (EVV) has been awarding since 1997, when the National Programme of the Environmental Assessment and Labelling of Products was declared by the Slovak Minister of Environment. Since 1st December 2002, the eco-label award has been regulating by Act 469/2002 Coll., changed and amended by Act 217/2007 Coll. on environmental labelling of products.

The British Council in the Slovak Republic organises several events focused on climate change, the reduction of greenhouse gas emissions, potential impacts on climate change and adaptation and mitigation measures, with Slovak and foreign speakers and lecturers. The main attention is paid to the dissemination of relevant information among young people, students and pupils. These activities are supported intensively by the British Embassy in the Slovak Republic.

List of Abbreviations

Abbreviation	Slovak	English
APVV	Agentúra pre vedu a výskum	Slovak Research and Development Agency
BOÚ SAV	Botanický ústav Slovenskej akadémie vied	Institute of Botany of the SAV
C.I.F.	Importná hodnota	Import value
CAP	Poľnohospodárska politika	Common Agricultural Policy
CCCM	Kanadské stredisko pre modelovanie klímy	Canadian Centre for Climate Modelling
CEP	Klimaticko-energetický balíček	Climate and Energy Package
CER	Certifikované emisné redukcie	Certified emission reduction
CF_4	Tetrafluórometán	Tetrafluoromethane
CFC	Chlórofluórouhľovodíky	Chlorofluorocarbons
CGCM	Kanadský model globálnej cirkulácie	Canadian Global Circulation Model
CNG	Stlačený zemný plyn	Compressed natural gas
CO	Oxid uhoľnatý	Carbon monoxide
CO2	Oxid uhličitý	Carbon dioxide
CO2 eq	Oxid uhličitý ekvivalent	Carbon dioxide equivalent
COP	Konferencia zúčastnených strán	Conference of Parties
COST	Rámcový program pre spoluprávu vo vede a technológii	Cooperation in Science and Technology
CPI	Index spotrebiteľských cien	Consumer price index
EEAP	Plán energetickej efektívnosti	Energy Efficiency Action Plan
EPPO	Európska a stredomorská organizáciu pre ochranu rastlín	European and Mediterranean Plant Protection Organization
ERU	Jednotky emisnej redukcie	Emission reduction units
ESNÚ	Európsky systém národných účtov	European System of National Accounts
EU ETS	Európska schéma obchodovania	European Union Emission Trading Scheme
EUMETSAT	Európska organizácia pre využívanie meteorologických družíc	Eropean Meteorological Satellite Organisation
F.O.B.	Exportná hodnota	Export value
FAO	Organizácia pre výživu a poľnohospodárstvo OSN	Food and Agriculture Organization of the UN
FMFI UK	Fakulta matematiky, fyziky a informatiky UK	Faculty of Mathematics, Physics and Informatics of the Comenius University
FP	Rámcový program	Framework Programme
GAAV	Grantová agentúra MŠ SR pre aplikovaný výskum	Grant Agency of the Ministry of Education for applied research
GAP	Hrubá poľnohospodárska produkcia	Gross agricultural production
GAV	Grantová agentúra MŠ SR pre aplikovaný výskum	Gross Added Value
GCM	Globálny cirkulačný model	Global Circulation Model
GCOS	Globálny systém na sledovanie klímy	Global Climate Observing System
GDP	Hrubý domáci produkt HDP	Gross Domestic Product
GEOÚ SAV	Geologický ústav Slovenskej akadémie vied	Geological Institute of the SAS
Gg	Gigagram	Gigagram
GHG	Skleníkový plyn	Greenhouse gas
GISS	Goddardov ústav pre vesmírne štúdie	Goddard Institute for Space Studies
GJ	Giga joule	Giga joule
GS	Vegetačné obdobie	Growing season
H_2	Vodík	Hydrogen
HCFC	Hydrochlórofluórované uhľovodíky	Hydrochlorofluorocarbons
HFC	Hydrofluórované uhľovodíky	Hydrogenfluorocarbohydrates
CH_4	Metán	Methane
ICAO	Medzinárodná organizácia pre civilné letectvo	International Civil Aviation Organisation
IEA	Medzinárodná energetická agentúra	International Energy Agency
IMO	Medzinárodná námorná organizácia	International Maritime Organisation
IPCC	Medzinárodný panel pre zmenu klímy	Intergovernmental Panel on Climate Change
KP	Kjótsky protokol	Kyoto Protocol
LF TU	Lesnícka fakulta technickej univerzity	Faculty of Forestry of the Technical University
LPG	Skvapalnený plyn	Liquid petroleum gas
LULUCF	Využívanie krajiny, zmeny vo využívaní krajiny a lesníctvo	Land use, land-use change and forestry
MŽP SR	Ministerstvo životného prostredia Slovenskej republiky	Ministry of Environment of the Slovak Republic
N_2O	Oxid dusný	Nitrous oxide
NA	Neaplikovateľné	not applicable
NAP	Národný alokačný plán	National Allocation Plan
NFP	Národný ohniskový bod	National Focal Point
NGO	Mimovládne organizácie	Nongovernmental nonprofit organization
NLC	Národné lesnícke centrum	Slovak National Forest Centre
NO	Oxid dusnatý	Nitrogen oxide
NO_x	Oxidy dusíka	Nitrogen oxides
NPK	Národný klimatický program	National Climate Programme of the Slovak Republic
PAM	Politiky a opatrenia	Policies and measures
PAÚ SAV	Parazitologický ústav Slovenskej akadémie vied	Parasitological Institute of the SAS
PFC	Polyfluórované uhľovodíky	Perfluorocarbons

Abbreviation	Slovak	English
PJ	Peta joule	Peta joule
PM	Pevné častice	Particulate (e.g. 2,5 or 10)
PriF UK	Prírodovedecká fakulta	Faculty of Natural Sciences of the Comenius University in Slovakia
QA	Zachovanie kvality	Quality Assurance
QC	Kontrola kvality	Quality Control
R&D	Výskum a vývoj	Research and Development
REDD	Redukcia emisií z odlesňovania	Reducing Emissions from Deforestation and Forest
SAS	Slovenská akadémia vied	Slovak Academy of Science
SBSTA	Podporný orgán pre vedeckú a technickú pomoc	Subsidiary Body for Scientific and Technological Advice
SD	Druh analógového klimatického scenára	Type of analogue climate scenarios
SE	Slovenské elektrárne	Slovak electricity plant
SEPS	Slovenská prenosová a elektrizačná sústava	Slovak electricity transmission network
SF6	Oxid fluórový	Sulphur hexafluoride
SHMÚ	Slovenský hydrometeorologický ústav	Slovak Hydrometeorological Institute
SKK	Slovenská koruna	Slovak Crown
SO_2	Oxid siričitý	Sulphur dioxide
SO_x	Oxidy síry	Sulphur oxides
SPU	Slovenská poľnohospodárska univerzita	Slovak University of Agriculture
SR	Slovenská republika	Slovak Republic
SRES	Špeciálna správa o emisných scenároch (IPCC)	Special Report on Emissions Scenarios (IPCC)
STN	Slovenská technická norma	Slovak Technical Standard
SvF STU	Stavebná fakulta Slovenskej technickej univerzity	Faculty of Civil Engineering of the Slovak Technical University
Tg	Terragram	Teragram
TJ	Terrajoule	Terra joule
TS10	Teplotné sumy	Temperature sums
TWh	Terrawatt hodina	Terra watt hour
ÚH SAV	Ústav hydrológie SAV	Institute of Hydrology of the SAS
ÚKE SAV	Ústav krajinnej ekológie SAV	Institute of Landscape Ecology of the SAS
UMB	Ústav vedy a výskumu Univerzity Mateja Bela	Science and Research Institute of Matej Bel University in Slovakia
UNFCCC	Konferencia OSN o zmene klímy	United Nations Framework Convention on Climate
USD	Americký Dolár	US Dollar
UVL	Univerzita veterinárneho lekárstva	University of Veterinary Medicine in Slovakia
ÚZ SAV	Ústav zoológie SAV	Institute of Zoology of the SAS
VEGA	Vedecká grantová agentúra MŠ SR a SAV	Scientific Grant Agency of the Ministry of Education and the SAS
VÚPOP	Výskumný ústav pôdoznalectva a ochrany pôdy	Soil Science and Conservation Research Institute in Slovakia
WMO	Svetová meteorologická organizácia	World Meteorological Organisation
WP	Druh analógového klimatického scenára	Type of analogue scenarios

ANNEX I - SUMMARY TABLES ON EMISSION TRENDS

The national emissions and trends of GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) are presented in this Annex I from the base year 1990 until 2007, according to the submission from April, 15 2009 in CO_2 equivalents.

Summary tables for CO_2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**58 055,07**	**52 609,16**	**48 984,26**	**45 030,72**	**42 507,13**	**39 260,80**	**38 103,40**	**38 082,87**	**37 307,30**
A. Fuel Combustion (Sectoral Approach)	58 054,93	52 609,03	48 984,13	45 030,58	42 506,99	39 260,64	38 103,24	38 082,70	37 307,13
1. Energy Industries	16 091,11	14 605,53	13 500,44	12 722,44	12 210,29	11 845,10	11 867,65	12 113,28	12 256,45
2. Manufacturing Industries and Construction	24 290,73	22 405,76	20 681,32	19 109,89	17 688,64	15 285,41	14 297,76	13 448,98	12 736,24
3. Transport	4 892,45	4 120,56	3 794,32	3 772,19	4 013,72	4 313,21	4 480,30	4 762,65	4 655,68
4. Other Sectors	10 908,11	9 654,10	9 235,73	7 703,35	6 919,98	6 235,35	5 920,22	6 263,19	6 205,26
5. Other	1 872,53	1 823,08	1 772,33	1 722,72	1 674,35	1 581,57	1 537,32	1 494,61	1 453,49
B. Fugitive Emissions from Fuels	0,15	0,13	0,13	0,13	0,14	0,16	0,16	0,17	0,17
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	0,15	0,13	0,13	0,13	0,14	0,16	0,16	0,17	0,17
2. Industrial Processes	**3 840,10**	**2 974,48**	**3 006,09**	**2 721,27**	**2 989,24**	**3 168,39**	**3 264,37**	**3 920,50**	**3 979,75**
A. Mineral Products	2 942,48	2 134,13	2 206,23	2 068,93	2 187,20	2 249,56	2 331,17	3 032,41	3 052,40
B. Chemical Industry	356,04	347,73	340,41	204,62	350,01	407,17	405,39	360,29	360,00
C. Metal Production	541,58	492,62	459,44	447,72	452,03	511,66	527,82	527,80	567,36
D. Other Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. Land Use, Land-Use Change and Forestry[2]	**-2 406,59**	**-3 507,55**	**-4 151,15**	**-4 284,16**	**-3 316,51**	**-2 421,63**	**-1 401,76**	**-1 939,47**	**-1 635,93**
A. Forest Land	-4 453,98	-5 485,31	-6 056,29	-6 135,02	-5 205,45	-3 968,47	-2 717,44	-3 130,06	-2 800,33
B. Cropland	3 286,66	3 210,98	3 494,78	3 456,94	2 724,78	2 062,61	3 226,12	1 797,73	1 710,69
C. Grassland	535,88	396,11	372,79	NE,NO	163,09	93,21	-49,68	69,89	-126,46
D. Wetlands	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO
E. Settlements	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO
F. Other Land	-1 775,15	-1 629,32	-1 962,42	-1 606,08	-998,92	-608,98	-1 860,76	-677,03	-419,83
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste	**66,70**	**66,70**	**66,70**	**66,70**	**66,70**	**66,70**	**48,05**	**96,60**	**67,07**
A. Solid Waste Disposal on Land	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO
B. Waste-water Handling									
C. Waste Incineration	66,70	66,70	66,70	66,70	66,70	66,70	48,05	96,60	67,07
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
7. Other ***(as specified in Summary 1.A)***	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CO_2 emissions including net CO_2 from LULUCF	**59 555,29**	**52 142,79**	**47 905,90**	**43 534,53**	**42 246,56**	**40 074,26**	**40 014,06**	**40 160,49**	**39 718,19**
Total CO_2 emissions excluding net CO_2 from LULUCF	**61 961,87**	**55 650,34**	**52 057,05**	**47 818,68**	**45 563,06**	**42 495,89**	**41 415,83**	**42 099,97**	**41 354,12**
Memo Items:									
International Bunkers	**128,46**	**116,06**	**108,44**	**97,77**	**87,45**	**102,22**	**76,31**	**84,26**	**52,42**
Aviation	63,10	58,68	54,25	53,14	44,78	53,16	47,08	43,41	43,80
Marine	65,35	57,38	54,20	44,63	42,68	49,06	29,22	40,85	8,61
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	793,83	1 069,08	865,31	1 110,96	1 150,16	1 476,75	1 288,09	1 273,01	1 303,63

Summary tables for CO_2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**36 751,43**	**38 083,76**	**36 358,69**	**38 032,37**	**36 925,99**	**36 603,26**	**35 833,83**	**33 990,18**	**-41,45**
A. Fuel Combustion (Sectoral Approach)	36 751,25	38 083,58	36 358,51	38 032,18	36 925,80	36 603,09	35 833,66	33 990,03	-41,45
1. Energy Industries	12 243,76	13 025,38	12 669,67	13 179,33	12 859,61	11 850,70	11 191,67	10 240,50	-36,36
2. Manufacturing Industries and Construction	12 833,52	12 551,03	11 989,08	13 274,60	12 342,29	12 182,85	13 338,00	12 465,36	-48,68
3. Transport	4 182,33	4 754,91	4 891,50	4 996,42	5 274,85	6 213,98	5 743,39	6 499,40	32,85
4. Other Sectors	5 979,30	6 360,54	5 638,91	5 507,04	4 943,08	4 924,13	4 507,11	3 640,77	-66,62
5. Other	1 512,33	1 391,71	1 169,35	1 074,78	1 505,98	1 431,42	1 053,48	1 144,00	-38,91
B. Fugitive Emissions from Fuels	0,18	0,19	0,18	0,19	0,18	0,17	0,17	0,15	2,73
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
2. Oil and Natural Gas	0,18	0,19	0,18	0,19	0,18	0,17	0,17	0,15	2,73
2. Industrial Processes	**3 500,75**	**3 605,24**	**3 646,92**	**3 355,19**	**4 161,20**	**4 124,86**	**4 124,31**	**4 142,71**	**7,88**
A. Mineral Products	2 522,11	2 590,16	2 602,43	2 302,82	2 982,63	2 966,52	3 013,57	3 088,52	4,96
B. Chemical Industry	398,57	407,27	395,60	349,79	403,41	421,66	350,66	326,56	-8,28
C. Metal Production	580,08	607,81	648,90	702,58	775,16	736,69	760,09	727,64	34,36
D. Other Production	NO	NO	NO	NO	NO	NO	NO	NO	0,00
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
3. Solvent and Other Product Use	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	0,00
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. Land Use, Land-Use Change and Forestry[2]	**-2 403,37**	**-5 225,15**	**-5 242,94**	**-4 833,16**	**-4 250,90**	**-877,34**	**-3 050,80**	**-3 219,35**	**33,77**
A. Forest Land	-4 318,38	-5 550,63	-5 641,22	-5 155,57	-3 995,38	-701,25	-3 096,83	-3 266,30	-26,67
B. Cropland	4 394,23	1 002,34	1 174,05	1 416,27	-14,17	1,08	1,08	2,00	-99,94
C. Grassland	-797,35	-880,44	-873,73	-1 363,19	-373,27	-441,65	-439,45	-439,45	-182,00
D. Wetlands	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	0,00
E. Settlements	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	0,00
F. Other Land	-1 681,86	203,58	97,97	269,33	131,93	264,48	484,40	484,40	-127,29
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	0,00
6. Waste	**66,58**	**55,33**	**39,42**	**32,90**	**25,44**	**12,53**	**22,50**	**8,43**	**-87,36**
A. Solid Waste Disposal on Land	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	0,00
B. Waste-water Handling									
C. Waste Incineration	66,58	55,33	39,42	32,90	25,44	12,53	22,50	8,43	-87,36
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total CO_2 emissions including net CO_2 from LULUCF	**37 915,39**	**36 519,18**	**34 802,10**	**36 587,31**	**36 861,73**	**39 863,31**	**36 929,85**	**34 921,98**	**-41,36**
Total CO_2 emissions excluding net CO_2 from LULUCF	**40 318,76**	**41 744,33**	**40 045,04**	**41 420,47**	**41 112,63**	**40 740,65**	**39 980,64**	**38 141,33**	**-38,44**
Memo Items:									
International Bunkers	**44,51**	**68,53**	**72,24**	**79,25**	**86,16**	**90,82**	**131,59**	**150,01**	**16,78**
Aviation	44,51	41,86	43,46	57,46	77,68	90,14	101,09	117,39	86,04
Marine	NA,NO	26,67	28,78	21,79	8,48	0,68	30,51	32,62	-50,09
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass	1 425,71	1 632,20	1 622,36	1 733,71	2 182,95	3 044,58	2 901,10	2 977,13	275,03

Summary tables for CH_4

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	73,44	74,76	73,40	70,45	71,15	72,46	72,42	71,30	74,40	72,09
A. Fuel Combustion (Sectoral Approach)	21,79	20,97	19,22	16,75	14,65	13,63	12,62	10,71	11,22	10,60
1. Energy Industries	0,27	0,27	0,26	0,26	0,26	0,26	0,26	0,25	0,25	0,25
2. Manufacturing Industries and Construction	1,77	1,65	1,53	1,42	1,32	1,23	1,15	1,07	1,01	0,95
3. Transport	1,03	0,94	0,92	1,00	1,07	1,14	1,17	1,23	1,30	1,29
4. Other Sectors	18,54	17,94	16,34	13,91	11,85	10,85	9,90	8,01	8,52	7,98
5. Other	0,17	0,17	0,16	0,16	0,16	0,15	0,15	0,14	0,14	0,14
B. Fugitive Emissions from Fuels	51,65	53,79	54,18	53,70	56,50	58,83	59,80	60,59	63,18	61,49
1. Solid Fuels	27,20	28,83	29,93	28,61	29,91	29,70	30,08	30,61	31,17	29,50
2. Oil and Natural Gas	24,45	24,97	24,24	25,09	26,58	29,13	29,73	29,98	32,01	31,99
2. Industrial Processes	**0,04**	**0,04**	**0,04**	**0,02**	**0,04**	**0,04**	**0,04**	**0,04**	**0,04**	**0,04**
A. Mineral Products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Chemical Industry	0,04	0,04	0,04	0,02	0,04	0,04	0,04	0,04	0,04	0,04
C. Metal Production	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use										
4. Agriculture	**112,32**	**103,22**	**91,23**	**79,71**	**75,30**	**80,15**	**75,27**	**67,66**	**63,12**	**60,65**
A. Enteric Fermentation	94,77	86,89	76,41	66,09	62,39	66,90	62,67	56,10	52,91	50,78
B. Manure Management	17,56	16,32	14,82	13,62	12,91	13,25	12,60	11,56	10,21	9,87
C. Rice Cultivation	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
D. Agricultural Soils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	**0,70**	**0,44**	**0,46**	**0,48**	**0,41**	**0,46**	**0,51**	**0,54**	**0,53**	**0,61**
A. Forest Land	0,70	0,44	0,46	0,48	0,41	0,46	0,51	0,54	0,53	0,61
B. Cropland	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste	**42,16**	**43,15**	**43,92**	**44,50**	**47,16**	**49,66**	**52,53**	**62,76**	**76,78**	**91,01**
A. Solid Waste Disposal on Land	22,37	23,45	24,16	24,89	27,75	30,85	33,81	44,10	58,01	72,24
B. Waste-water Handling	19,71	19,62	19,68	19,52	19,33	18,67	18,59	18,50	18,62	18,62
C. Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other	0,08	0,08	0,08	0,09	0,08	0,14	0,13	0,16	0,15	0,16
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CH_4 emissions including CH_4 from LULUCF	**228,66**	**221,60**	**209,05**	**195,16**	**194,05**	**202,78**	**200,78**	**202,30**	**214,88**	**224,40**
Total CH_4 emissions excluding CH_4 from LULUCF	**227,96**	**221,16**	**208,59**	**194,68**	**193,64**	**202,32**	**200,27**	**201,76**	**214,34**	**223,79**
Memo Items:										
International Bunkers	0,01	0,01	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Aviation	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Marine	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

Summary tables for CH_4

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	74,50	72,91	69,04	67,04	64,88	61,31	59,22	59,74	-18,65
A. Fuel Combustion (Sectoral Approach)	11,62	11,72	9,61	9,99	10,79	13,18	12,42	10,78	-50,53
1. Energy Industries	0,25	0,26	0,26	0,27	0,29	0,25	0,24	0,24	-10,33
2. Manufacturing Industries and Construction	0,89	0,89	0,81	0,87	0,80	0,81	0,83	0,84	-52,60
3. Transport	1,13	1,27	1,22	1,25	1,26	1,34	1,14	1,07	4,23
4. Other Sectors	9,20	9,16	7,21	7,51	8,29	10,63	10,11	8,51	-54,11
5. Other	0,14	0,13	0,11	0,10	0,14	0,15	0,11	0,11	-35,20
B. Fugitive Emissions from Fuels	62,88	61,19	59,44	57,04	54,09	48,13	46,80	48,96	-5,20
1. Solid Fuels	28,82	26,33	25,69	21,11	19,77	16,17	14,67	13,52	-50,30
2. Oil and Natural Gas	34,06	34,86	33,74	35,93	34,32	31,96	32,13	35,45	44,96
2. Industrial Processes	**0,04**	**0,05**	**0,04**	**0,04**	**0,04**	**0,04**	**0,04**	**0,04**	**5,43**
A. Mineral Products	NA	NA	NA	NA	NA	NA	NA	NA	0,00
B. Chemical Industry	0,04	0,05	0,04	0,04	0,04	0,04	0,04	0,04	5,43
C. Metal Production	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	0,00
D. Other Production									
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
3. Solvent and Other Product Use									
4. Agriculture	**59,68**	**61,08**	**59,52**	**56,91**	**52,87**	**53,30**	**52,46**	**51,92**	**-53,78**
A. Enteric Fermentation	50,16	51,44	49,78	47,65	45,02	45,64	44,97	45,07	-52,44
B. Manure Management	9,52	9,63	9,74	9,26	7,84	7,66	7,49	6,84	-61,01
C. Rice Cultivation	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
D. Agricultural Soils	NO	NO	NO	NO	NO	NO	NO	NO	0,00
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	0,00
F. Field Burning of Agricultural Residues	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	0,00
5. Land Use, Land-Use Change and Forestry	**0,67**	**0,68**	**0,66**	**0,73**	**0,82**	**1,07**	**0,90**	**0,91**	**29,61**
A. Forest Land	0,67	0,68	0,66	0,73	0,82	1,07	0,90	0,91	29,61
B. Cropland	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	0,00
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	0,00
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO	0,00
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	0,00
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	0,00
6. Waste	**76,38**	**78,67**	**113,47**	**106,66**	**111,76**	**103,35**	**108,91**	**104,09**	**146,92**
A. Solid Waste Disposal on Land	57,47	59,93	94,74	87,97	93,26	85,19	90,66	85,83	283,68
B. Waste-water Handling	18,77	18,56	18,57	18,52	18,33	18,08	18,04	17,96	-8,87
C. Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	0,00
D. Other	0,15	0,17	0,16	0,16	0,16	0,08	0,21	0,30	280,00
7. Other ***(as specified in Summary 1.A)***	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total CH_4 emissions including CH_4 from LULUCF	**211,28**	**213,38**	**242,74**	**231,37**	**230,37**	**219,07**	**221,53**	**216,70**	**-5,23**
Total CH_4 emissions excluding CH_4 from LULUCF	**210,61**	**212,70**	**242,08**	**230,64**	**229,55**	**218,01**	**220,63**	**215,79**	**-5,34**
Memo Items:									
International Bunkers	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-37,85
Aviation	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	80,41
Marine	NA,NO	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-62,07
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass									

Summary tables for N_2O

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**0,92**	**0,81**	**0,72**	**0,66**	**0,64**	**0,66**	**0,68**	**0,69**	**0,73**	**0,73**
A. Fuel Combustion (Sectoral Approach)	0,92	0,81	0,72	0,66	0,64	0,66	0,68	0,69	0,73	0,73
1. Energy Industries	0,20	0,18	0,15	0,14	0,12	0,12	0,11	0,11	0,11	0,12
2. Manufacturing Industries and Construction	0,19	0,17	0,16	0,14	0,13	0,12	0,11	0,10	0,09	0,09
3. Transport	0,39	0,32	0,28	0,27	0,29	0,33	0,35	0,39	0,43	0,44
4. Other Sectors	0,13	0,13	0,12	0,11	0,10	0,09	0,10	0,08	0,08	0,08
5. Other	0,01	0,01	0,01	0,01	0,01	0,00	0,00	0,00	0,00	0,00
B. Fugitive Emissions from Fuels	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
2. Industrial Processes	**3,71**	**2,57**	**2,29**	**1,77**	**3,16**	**3,63**	**4,24**	**4,01**	**3,41**	**2,56**
A. Mineral Products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Chemical Industry	3,71	2,57	2,29	1,77	3,16	3,63	4,24	4,01	3,41	2,56
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	**0,06**	**0,06**	**0,06**	**0,06**	**0,05**	**0,10**	**0,11**	**0,09**	**0,07**	**0,07**
4. Agriculture	**15,09**	**12,48**	**10,24**	**8,76**	**8,50**	**8,73**	**8,50**	**8,40**	**7,68**	**7,08**
A. Enteric Fermentation										
B. Manure Management	3,53	3,20	2,76	2,40	2,24	2,36	2,18	2,00	1,76	1,68
C. Rice Cultivation										
D. Agricultural Soils	11,56	9,28	7,48	6,37	6,26	6,37	6,32	6,40	5,92	5,40
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**
A. Forest Land	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
B. Cropland	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste	**0,34**	**0,33**	**0,30**	**0,29**	**0,29**	**0,30**	**0,30**	**0,30**	**0,29**	**0,28**
A. Solid Waste Disposal on Land										
B. Waste-water Handling	0,32	0,30	0,28	0,26	0,26	0,27	0,27	0,27	0,26	0,25
C. Waste Incineration	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02
D. Other	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total N_2O emissions including N_2O from LULUCF	**20,12**	**16,25**	**13,62**	**11,55**	**12,66**	**13,42**	**13,84**	**13,49**	**12,19**	**10,74**
Total N_2O emissions excluding N_2O from LULUCF	**20,11**	**16,24**	**13,61**	**11,54**	**12,65**	**13,42**	**13,83**	**13,48**	**12,18**	**10,73**
Memo Items:										
International Bunkers	**0,00**	**0,00**	**0,00**	**0,00**	**0,02**	**0,03**	**0,02**	**0,01**	**0,02**	**0,01**
Aviation	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Marine	0,00	0,00	0,00	0,00	0,02	0,02	0,02	0,01	0,02	0,00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

Summary tables for N_2O

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**0,70**	**0,79**	**0,76**	**0,80**	**0,82**	**0,94**	**0,88**	**0,93**	**0,22**
A. Fuel Combustion (Sectoral Approach)	0,70	0,79	0,76	0,80	0,82	0,94	0,88	0,93	0,22
1. Energy Industries	0,11	0,12	0,12	0,12	0,12	0,11	0,11	0,10	-50,25
2. Manufacturing Industries and Construction	0,08	0,08	0,07	0,08	0,08	0,08	0,08	0,07	-60,77
3. Transport	0,41	0,49	0,49	0,51	0,52	0,61	0,57	0,64	61,43
4. Other Sectors	0,09	0,09	0,08	0,09	0,10	0,13	0,12	0,11	-15,47
5. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-41,78
B. Fugitive Emissions from Fuels	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0,00
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
2. Oil and Natural Gas	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	0,00
2. Industrial Processes	**3,33**	**3,77**	**3,37**	**3,73**	**4,26**	**4,13**	**5,05**	**4,56**	**22,93**
A. Mineral Products	NA	NA	NA	NA	NA	NA	NA	NA	0,00
B. Chemical Industry	3,33	3,77	3,37	3,73	4,26	4,13	5,05	4,56	22,93
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	0,00
D. Other Production									
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
3. Solvent and Other Product Use	0,06	0,10	0,18	0,19	0,26	0,28	0,27	0,26	368,91
4. Agriculture	**7,21**	**7,25**	**7,41**	**7,15**	**6,88**	**6,82**	**6,70**	**6,95**	**-53,94**
A. Enteric Fermentation									
B. Manure Management	1,64	1,59	1,58	1,53	1,43	1,38	1,34	1,31	-62,98
C. Rice Cultivation									
D. Agricultural Soils	5,56	5,66	5,84	5,62	5,46	5,45	5,36	5,64	-51,17
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	0,00
F. Field Burning of Agricultural Residues	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	0,00
5. Land Use, Land-Use Change and Forestry	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,02**	**0,01**	**0,01**	**13,89**
A. Forest Land	0,01	0,01	0,01	0,01	0,01	0,02	0,01	0,01	13,89
B. Cropland	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0,00
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	0,00
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	0,00
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO	0,00
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	0,00
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	0,00
6. Waste	**0,26**	**0,25**	**0,29**	**0,25**	**0,24**	**0,24**	**0,24**	**0,24**	**-29,41**
A. Solid Waste Disposal on Land									
B. Waste-water Handling	0,23	0,22	0,26	0,21	0,21	0,21	0,20	0,20	-36,56
C. Waste Incineration	0,02	0,02	0,02	0,03	0,02	0,02	0,02	0,02	-8,33
D. Other	0,01	0,01	0,01	0,01	0,01	0,01	0,02	0,02	280,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total N_2O emissions including N_2O from LULUCF	**11,57**	**12,16**	**12,03**	**12,13**	**12,47**	**12,43**	**13,15**	**12,94**	**-35,68**
Total N_2O emissions excluding N_2O from LULUCF	**11,56**	**12,15**	**12,02**	**12,12**	**12,46**	**12,41**	**13,13**	**12,93**	**-35,71**
Memo Items:									
International Bunkers	**0,00**	**0,01**	**0,01**	**0,01**	**0,01**	**0,00**	**0,02**	**0,02**	**332,90**
Aviation	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	86,06
Marine	NA,NO	0,01	0,01	0,01	0,00	0,00	0,01	0,01	583,75
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass									

Summary tables for F-gases

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990) (Gg)	1991 (Gg)	1992 (Gg)	1993 (Gg)	1993 (Gg)	1994 (Gg)	1995 (Gg)	1996 (Gg)	1997 (Gg)	1998 (Gg)	1999 (Gg)
Emissions of HFCs[3] - (Gg CO_2 equivalent)	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**2,91**	**22,15**	**37,58**	**61,13**	**40,96**	**65,12**
HFC-23	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,00	0,00
HFC-32	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,00
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-125	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,00	0,00
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,01	0,02	0,04	0,03	0,04
HFC-152a	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,00
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143a	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,00
HFC-227ea	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,00	0,00	0,00
HFC-236fa	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed HFCs[4] - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of PFCs[3] - (Gg CO_2 equivalent)	**271,37**	**266,94**	**248,42**	**155,42**	**155,42**	**132,06**	**114,32**	**34,51**	**34,62**	**25,40**	**13,60**
CF_4	0,04	0,04	0,03	0,02	0,02	0,02	0,02	0,00	0,00	0,00	0,00
C_2F_6	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
C_3F_8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
c-C_4F_8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_5F_{12}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_6F_{14}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed PFCs[4] - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of SF6[3] - (Gg CO_2 equivalent)	**0,03**	**0,03**	**0,04**	**0,06**	**0,06**	**9,27**	**9,91**	**10,76**	**11,34**	**12,24**	**12,69**
SF_6	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Summary tables for F-gases

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
Emissions of HFCs[3] - (Gg CO_2 equivalent)	**75,59**	**82,43**	**102,35**	**131,96**	**152,88**	**172,34**	**198,90**	**226,99**	**100,00**
HFC-23	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
HFC-32	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,01	100,00
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-125	0,00	0,00	0,01	0,01	0,01	0,01	0,02	0,02	100,00
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-134a	0,05	0,04	0,05	0,06	0,07	0,07	0,08	0,08	100,00
HFC-152a	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-143a	0,00	0,00	0,01	0,01	0,01	0,01	0,01	0,01	100,00
HFC-227ea	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
HFC-236fa	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Unspecified mix of listed HFCs[4] - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Emissions of PFCs[3] - (Gg CO_2 equivalent)	**11,65**	**15,59**	**13,75**	**21,65**	**19,91**	**20,25**	**35,82**	**24,88**	**-90,83**
CF_4	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-90,84
C_2F_6	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-90,79
C_3F_8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
c-C_4F_8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C_5F_{12}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C_6F_{14}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Unspecified mix of listed PFCs[4] - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Emissions of SF6[3] - (Gg CO_2 equivalent)	**13,25**	**13,84**	**14,78**	**15,39**	**15,89**	**16,61**	**17,15**	**17,44**	**56 900,00**
SF_6	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	56 900,00

Summary tables for aggregated GHG emissions

GREENHOUSE GAS EMISSIONS	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
CO_2 emissions including net CO_2 from LULUCF	59 555,29	52 142,79	47 905,90	43 534,53	42 246,56	41 344,87	40 074,26	40 014,06	40 160,49	39 718,19
CO_2 emissions excluding net CO_2 from LULUCF	61 961,87	55 650,34	52 057,05	47 818,68	45 563,06	44 040,87	42 495,89	41 415,83	42 099,97	41 354,12
CH_4 emissions including CH_4 from LULUCF	4 801,80	4 653,52	4 390,11	4 098,39	4 075,12	4 258,28	4 216,34	4 248,22	4 512,44	4 712,32
CH_4 emissions excluding CH_4 from LULUCF	4 787,12	4 644,30	4 380,45	4 088,31	4 066,51	4 248,64	4 205,63	4 236,88	4 501,24	4 699,51
N_2O emissions including N_2O from LULUCF	6 238,29	5 037,67	4 221,22	3 579,46	3 924,15	4 161,10	4 289,34	4 181,93	3 779,30	3 328,02
N_2O emissions excluding N_2O from LULUCF	6 234,88	5 035,38	4 219,24	3 577,47	3 922,20	4 158,84	4 287,08	4 179,67	3 777,04	3 324,92
HFCs	NA,NO	NA,NO	NA,NO	NA,NO	2,91	22,15	37,58	61,13	40,96	65,12
PFCs	271,37	266,94	248,42	155,42	132,06	114,32	34,51	34,62	25,40	13,60
SF_6	0,03	0,03	0,04	0,06	9,27	9,91	10,76	11,34	12,24	12,69
Total (including LULUCF)	**70 866,79**	**62 100,96**	**56 765,69**	**51 367,85**	**50 390,07**	**49 910,64**	**48 662,79**	**48 551,30**	**48 530,83**	**47 849,94**
Total (excluding LULUCF)	**73 255,28**	**65 596,99**	**60 905,20**	**55 639,94**	**53 696,01**	**52 594,73**	**51 071,44**	**49 939,46**	**50 456,85**	**49 469,97**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
1. Energy	59 883,66	54 428,93	50 747,36	46 714,89	44 201,20	42 542,01	40 991,62	39 813,99	39 870,26	39 048,17
2. Industrial Processes	5 261,27	4 039,01	3 966,70	3 427,04	4 115,16	4 431,47	4 567,16	4 616,65	5 057,82	4 866,89
3. Solvent and Other Product Use	17,05	17,05	17,05	17,05	16,81	30,99	33,22	26,91	21,18	21,89
4. Agriculture	7 035,53	6 037,25	5 091,21	4 390,24	4 217,01	4 388,57	4 217,17	4 024,37	3 707,41	3 468,11
5. Land Use, Land-Use Change and Forestry[5]	-2 388,50	-3 496,03	-4 139,50	-4 272,09	-3 305,94	-2 684,09	-2 408,65	-1 388,16	-1 926,02	-1 620,02
6. Waste	1 057,78	1 074,75	1 082,88	1 090,72	1 145,83	1 201,68	1 262,27	1 457,54	1 800,18	2 064,91
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)[6]	**70 866,79**	**62 100,96**	**56 765,69**	**51 367,85**	**50 390,07**	**49 910,64**	**48 662,79**	**48 551,30**	**48 530,83**	**47 849,94**

[1] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the COP. For these Parties, this different base year is used to calcu

[2] Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[3] Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as CO_2 equiv

[4] In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), th

[5] Includes net CO_2, CH_4 and N_2O from LULUCF.

Summary tables for aggregated GHG emissions

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(%)
CO_2 emissions including net CO_2 from LULUCF	37 915,39	36 519,18	34 802,10	36 587,31	36 861,73	39 863,31	36 929,85	34 921,98	-41,36
CO_2 emissions excluding net CO_2 from LULUCF	40 318,76	41 744,33	40 045,04	41 420,47	41 112,63	40 740,65	39 980,64	38 141,33	-38,44
CH_4 emissions including CH_4 from LULUCF	4 436,79	4 480,90	5 097,53	4 858,76	4 837,81	4 600,55	4 652,04	4 550,67	-5,23
CH_4 emissions excluding CH_4 from LULUCF	4 422,72	4 466,62	5 083,60	4 843,43	4 820,55	4 578,11	4 633,14	4 531,64	-5,34
N_2O emissions including N_2O from LULUCF	3 585,24	3 770,46	3 729,52	3 761,05	3 866,61	3 852,21	4 075,02	4 012,27	-35,68
N_2O emissions excluding N_2O from LULUCF	3 582,14	3 767,36	3 726,42	3 757,95	3 863,13	3 846,87	4 071,85	4 008,39	-35,71
HFCs	75,59	82,43	102,35	131,96	152,88	172,34	198,90	226,99	100,00
PFCs	11,65	15,59	13,75	21,65	19,91	20,25	35,82	24,88	-90,83
SF_6	13,25	13,84	14,78	15,39	15,89	16,61	17,15	17,44	56 900,00
Total (including LULUCF)	**46 037,91**	**44 882,41**	**43 760,03**	**45 376,11**	**45 754,82**	**48 525,27**	**45 908,78**	**43 754,23**	**-38,26**
Total (excluding LULUCF)	**48 424,11**	**50 090,18**	**48 985,94**	**50 190,84**	**49 984,98**	**49 374,84**	**48 937,51**	**46 950,67**	**-35,91**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(%)
1. Energy	38 532,40	39 858,78	38 045,07	39 689,67	38 541,20	38 181,05	37 351,21	35 531,78	-40,67
2. Industrial Processes	4 634,66	4 886,24	4 823,40	4 681,38	5 672,68	5 616,41	5 942,42	5 825,32	10,72
3. Solvent and Other Product Use	20,14	29,97	57,26	59,25	80,28	86,35	82,43	79,95	368,91
4. Agriculture	3 487,13	3 530,18	3 547,31	3 411,52	3 243,67	3 234,94	3 178,39	3 244,56	-53,88
5. Land Use, Land-Use Change and Forestry[5]	-2 386,20	-5 207,77	-5 225,91	-4 814,73	-4 230,16	-849,56	-3 028,72	-3 196,44	33,83
6. Waste	1 749,79	1 785,01	2 512,90	2 349,03	2 447,16	2 256,09	2 383,05	2 269,07	114,51
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
Total (including LULUCF)[5]	**46 037,91**	**44 882,41**	**43 760,03**	**45 376,11**	**45 754,82**	**48 525,27**	**45 908,78**	**43 754,23**	**-38,26**

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[2] Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[3] Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as CO_2 equiv

[4] In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), th

[5] Includes net CO_2, CH_4 and N_2O from LULUCF.

Documentation box:

• Parties should provide detailed explanations on emissions trends in Chapter 2: Trends in Greenhouse Gas Emissions and, as appropriate, in the corresponding Chapters 3 - 9 of the NIR. Use this documentation box to provide references to relevant sections

• Use the documentation box to provide explanations if potential emissions are reported.

ANNEX II - SUPPLEMENTARY INFORMATION UNDER ARTICLE 7.2 OF THE KYOTO PROTOCOL

Table A.II: Summary of reporting of the Supplementary information under Article 7, paragraph 2, of the Kyoto Protocol in the Fifth National Communication of the Slovak Republic on Climate Change:

Information reported under Article 7, paragraph 2		NC5 section
National system in accordance with Article 5, paragraph 1		3.3
National registry		3.4
Supplementarity relating to the mechanisms pursuant to Article 6, 12 and 17		7.
Policies and measures in accordance with Article 2		4.3
Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures		4.2
Information under Article 10		
	Art 10a	3.3
	Art 10b	6.
	Art 10c	7.
	Art 10d	8.
	Art 10e	9.