5th National Communication to the UNFCCC

Hungary

2009

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1. Executive Summary

Hungary has made the transition from a centrally planned to a market economy for the last two decades so that nowadays the private sector accounts for more than 80% of the GDP. Foreign ownership of and investment in Hungarian firms are widespread, with cumulative foreign direct investment totalling more than $60 billion since 1989. The per capita income is nearly two-thirds of that of the EU average.

Hungary has a clear and well-articulated intention to harmonise and coordinate climate change related activities in a framework of mitigation policies and measures, legal procedures, awareness-raising programmes, research and development projects while setting the pace for stakeholders in realising well-defined policy targets.

In 2007, the total emissions of greenhouse gases in Hungary were 75.9 million tons carbon dioxide equivalent (excluding the LULUCF sector). This is 5 % below the 10 year average of the quite stable period 1996-2005 and by far the lowest value in the whole inventory period (followed by 2002 with 78.0 million tons). Taking into account also the mostly carbon absorbing processes in the LULUCF sector, the net emissions of Hungary were 71.8 million tons CO_2 eq. in 2007. This is the second lowest value in the whole time-series (1985-2007).

With less than 8 tons, the Hungarian per capita emissions are below the European average. Now, the emissions of Hungary are 34% below the base level set under the Kyoto Protocol (average for the period of 1985-87).

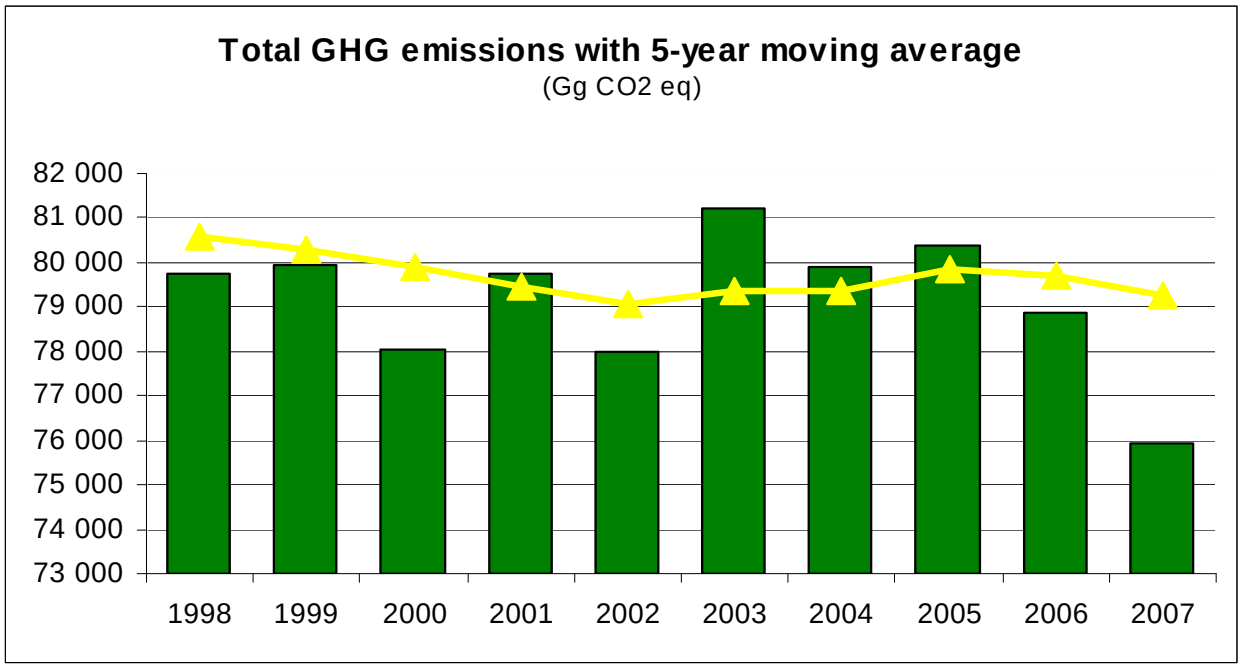

Figure 1.1. Total GHG emissions of Hungary, 1998-2007
Source: Hungarian Meteorological Service (OMSZ), 2009

Emissions decreased by almost 4% (-2.9 million tons) between 2006 and 2007 and by 6% between 2005 and 2007. The reduction between 2006 and 2007 is mainly due to processes in the energy sector (-2.3 million tons).

The carbon dioxide emissions account for 76% of the total GHG emissions. The main source of CO_2 emissions is the combustion of fossil fuels for energy purposes, including transport. CO_2 emissions have decreased by 32% since the middle of the 80s. Methane represents 11,3% in the GHG inventory. Methane is generated mainly in waste disposal sites and animal farms, but the fugitive emissions of natural gas are also an important source. CH_4 emissions are 28% lower than in base year. Nitrous oxide contributes 11,7% to the total GHG emissions. Its main sources are agricultural soils, manure management and chemical industry. The N_2O emissions were halved in the years of political and economic changes. The total emissions of fluorinated gases amount to 0,8%. However, they are showing a growing tendency especially due to their applications in the cooling industry.

By far, the biggest emitting sector was the *Energy sector* contributing 75% to the total GHG emission in 2007. Carbon dioxide from fossil fuels is the largest item among greenhouse gas emissions. *Agriculture* was the second largest source of greenhouse gas emissions in Hungary (12.5%) in 2007. In this sector CH_4 and N_2O emissions are taken into account. 77 percent of the total N_2O emissions are generated in agriculture. The *Industrial Processes* was the third largest sector contributing 6,9% to total GHG emissions in 2007. The *Waste sector* represented 5.4% of the total national GHG emissions. The *LULUCF sector* is a net sink of carbon. In 2007, the net removal was -4.1 million tons CO_2. This result is determined largely by *Forest Land*.

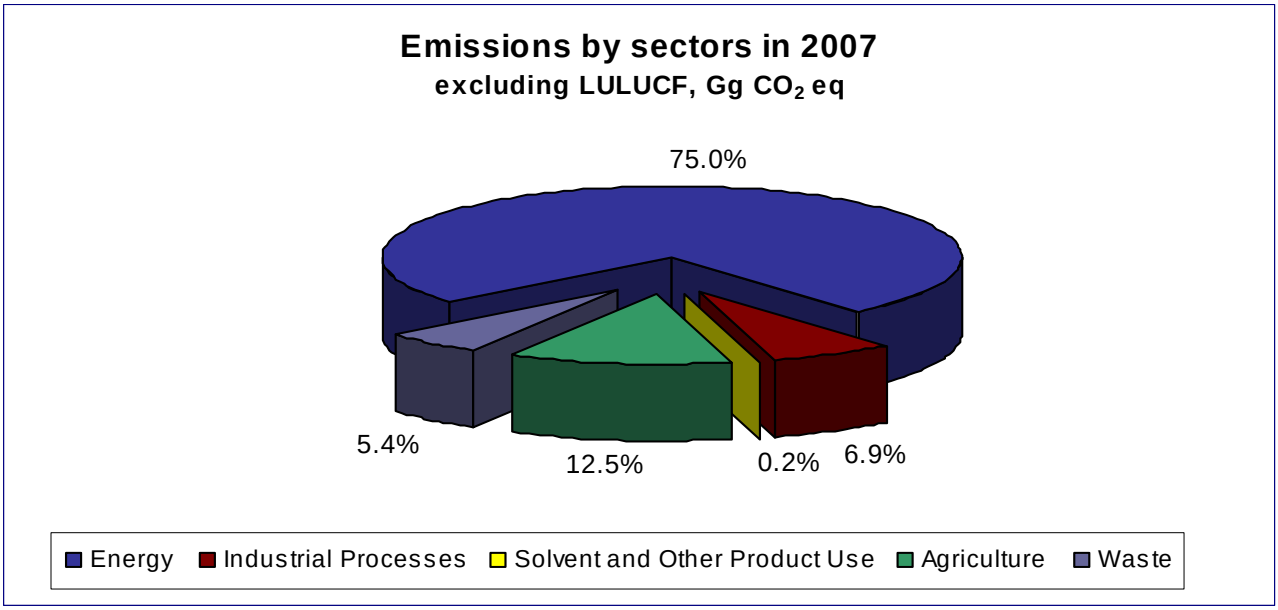

Figure 1.2. Emissions by sectors in Hungary, 2007
Source: Hungarian Meteorological Service (OMSZ), 2009

Policies and measures

A broad range of policies are adopted by the Government to promote domestic mitigation measures. Major capstones of domestic policies towards sustainable development and climate change mitigation are those outlined in the framework of the Renewable Energy Strategy and the National Energy Efficiency Action Plan. Hungary should comply with the EU's energy savings and renewable directives, the relevant ambitious goals and timely schedule. All these will have serious impact on Hungarian emission reduction compliance and energy policy.

A significant step forward, the National Climate Change Strategy was prepared pursuant to the ratification of the UN Framework Convention on Climate Change and of the Kyoto Protocol. The objectives of the National Climate Change Strategy will be implemented by National Climate Change Programmes to be prepared on a biannual basis.

In the framework of Hungary's Development Plan approximately HUF 7000 bln (approximately EUR 25 bln) is to be spent on Hungary's development in the period 2007–2013 with the utilisation of the EU Structural Funds. The specific goals of the Plan are to be achieved through 14 operational programmes. The expected implications of relevant policies and measures are summarised in Table 1.1.

Name of policy or measure	**Objective and/or activity affected**	**Implementing entity or entities**	**Estimate of mitigation impact (Mt CO_2 equivalent)**		
			2010	**2015**	**2020**
National Energy Efficiency Action Plan*	Improvement of efficiency of energy use	Ministry of Transport, Telecommunication and Energy, National Development Agency	1.258	4.857	5.464
Renewable Energy Strategy	Increase of renewable penetration	Ministry of Transport, Telecommunication and Energy, National Development Agency	6710	9223	11391
Retrofit and capacity enlargement of Paks NPP	Capacity enlargement and lifetime extension of Paks NPP	National Atomic Energy Agency, Ministry of Transport, Telecommunication and Energy	-	-	(800-1000)[1]
EU ETS	Emission Trading	National Inspectorate for Environment and Water, Ministry of Environment and Water Management	2.778	3.801	6.248
TDOP	Transportation modernisation	Ministry of Transport, Telecommunication and Energy	-	50	-
Unified Transport Development Strategy	Transportation modernisation and modality change	Ministry of Transport, Telecommunication and Energy		312	180

Table 1.1. Summary of policy-implied expected GHG emissions abatement (With Expected Measures)

Source: KHEM, KvVM, et al., 2008

Forecasted emissions trends

For the purposes of GHG emission trends development the HUNMIT model was applied, a bottom-up model developed for and adapted to the Hungarian conditions by an international research team. Considerations outlined by the review of the previous National Communication were incorporated in the model development. The model benefits from giving coverage of the economic sectors to an almost full extent. The HUNMIT-model is able to model the competition between given sectors, technologies, measures of the economy, allowing for the optimal, cost – effective solutions to be selected. This also

[1] Implementation expected after 2020

enables to get a more realistic picture about the mitigation effects and costs and the total social costs of a given range of measures.

The results of the outlined emissions trends are summarised in Figure 1.3.

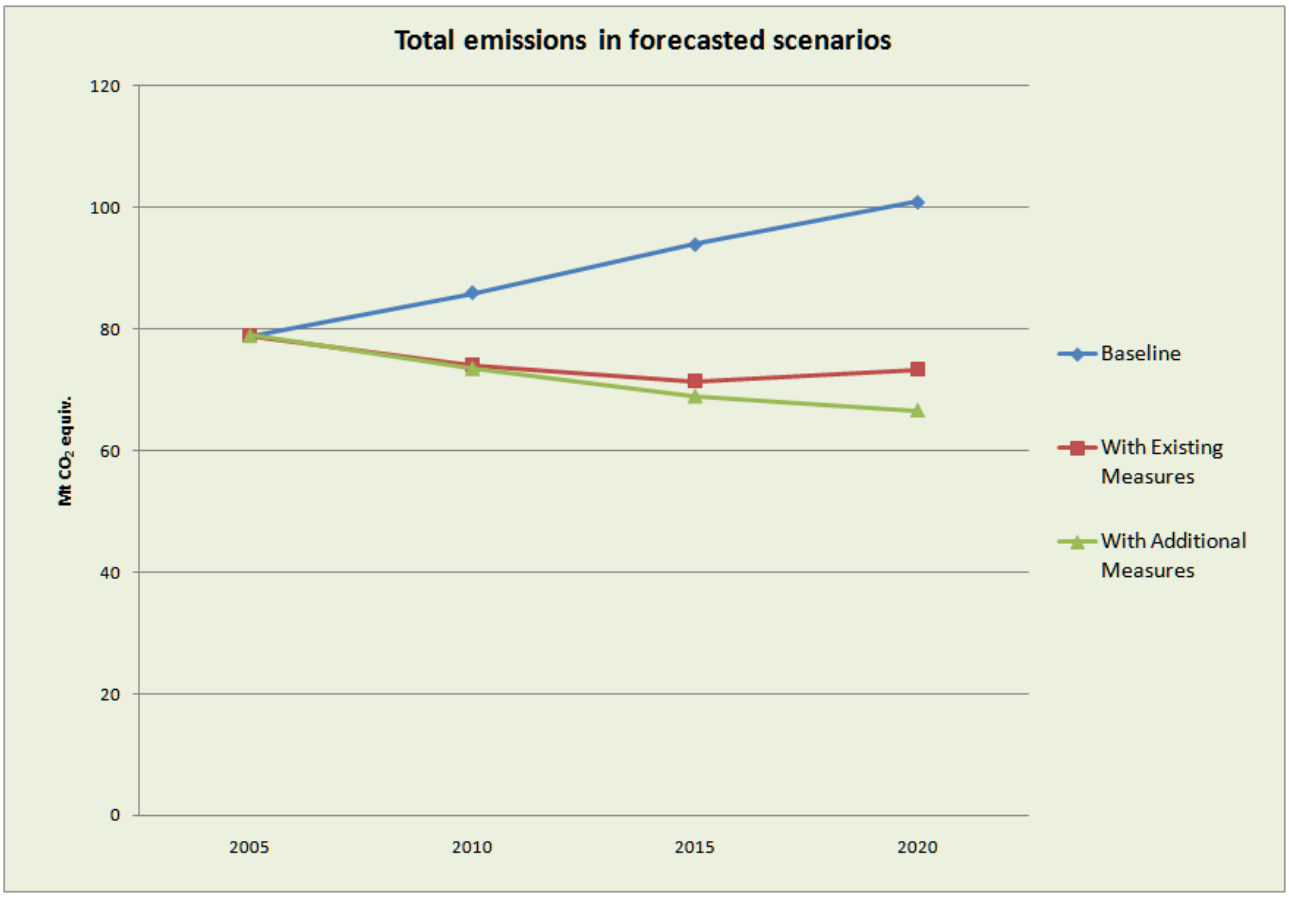

Figure 1.3. Total emissions in the Without Measures, With Measures and With Additional Measures scenarios

From the above figure it is visible that the Hungarian emissions will stay well under the country's Kyoto commitment by 2012. It is also clear that compared to earlier forecasts, a significant decrease is foreseen, this difference is due to the efforts and commitments undertaken by the government in setting goals for emission reduction and the impact of the adaptation to the respective EU directives.

In the NCCS, the Government clearly states that Hungary's goal is not just to comply with but to reduce her emissions further beyond the present and future targets.

Vulnerability and adaptation

Recent research indicates that the expected tendencies in local climate change are in line with the global tendencies and the earlier regional climate change forecasts for Central-Europe. A significant rise in temperature is expected in all seasons and in annual average, for an extent of approximately 1,0-1,4 °C,

the number of annual days with frost will reduce by 12-15 days. The number of days with heat alert might increase by 14 days in the southern regions of the country.
The estimated annual and seasonal precipitation change is not significant. However, the regional and local territorial changes might be significant and of opposite sign.
Considering our present knowledge, as regards Hungary, the impacts of climate change are not expected to arise as an immediate threat, thus leaving time for adaptation. The preparation for adaptation can not be, however, further delayed, as the impacts in the middle of the century will be probably already quite prevalent and significant, afterwards the adaptation will be highly costly and time-consuming.

Research and systematic observation

Both the political and organizational framework conditions for climate change research and observation have advanced significantly since the previous National Communication. After important groundwork done by the VAHAVA project (see 8.1) the importance of research related to climate change has been recognized and formally set by Hungary's National Climate Change Strategy adopted in 2008 and also found its way into the country's first National Climate Change Program. The coordination of climate change-related research has also become more institutionalized with the establishment of a dedicated Office of Climate Change Research Coordination at the Hungarian Academy of Sciences as well as the National Climate Change Committee (see 8.1.1) and the National IPCC Committee (see 8.2.2).
Climate change related research intensified in recent years. Both the political statements and the distribution of research activities clearly indicate a stronger focus on impacts and adaptation research than mitigation-related research.

Education

It is apparent that a lot has happened in Hungary in education, training and public awareness-raising at virtually every level, but the most significant progress seems to be in the sector of academic education. Not only has the number of their education programmes increased, but the subjects have become more and more diverse and sophisticated ranging from meteorological areas to energy modelling and economic analysis.
NGOs became particularly intensively involved in climate change related awareness-raising, by developing educational programmes in primary schools, organising film festivals and renewable energy competitions between cities. Synergies have also been exploited through cooperation; there are many events that bring dozens of stakeholders together.

2. NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

2.1. Geographical conditions

The Central European country of Hungary covers a landlocked area bordering Austria, Croatia, Romania, Yugoslavia, Slovakia, Slovenia and Ukraine. The country is mostly flat with hills and low mountains on the Slovakian border to the north. The river Danube divides the country east and west, flowing through Budapest, the nation's capital.
Administratively, Hungary is divided into 19 counties. In addition, the capital city, Budapest, is independent of any county government. The counties and the capital are the 20 NUTS third-level units of Hungary.

The counties are further subdivided into 173 subregions and Budapest is its own subregion. Since 1996, the counties and City of Budapest have been grouped into 7 regions for statistical and development purposes. These seven regions constitute NUTS' second-level units of Hungary.

There are also 23 towns with county rights, sometimes known as "urban counties" in English (although there is no such term in Hungarian). The local authorities of these towns have extended powers, but these towns belong to the territory of the respective county instead of being independent territorial units.

The area of the country is 93,033 km², of which 62.9% is agricultural area (48% arable land, 3.2% garden, orchard and vineyard, 11.3% grassland), 18.9% forest, 0.9% reed and fish-pond, 17.2% uncultivated land area.

Figure 2.1. Map of Hungary

Slightly more than one half of Hungary's landscape consists of flat to rolling plains of the Pannonian Basin: the most important plain regions include the Little Hungarian Plain in the west and the Great Hungarian Plain in the southeast. The highest elevation above sea level on the latter is only 183 metres.

Transdanubia is a primarily hilly region with a terrain varied by low mountains. These include the very eastern stretch of the Alps, Alpokalja, in the west of the country, the Transdanubian Medium Mountains, in the central region of Transdanubia and the Mecsek Mountains and Villány Mountains in the south. The highest point of the area is the Írott-kő in the Alps, at 882 metres.

The highest mountains of the country are located in the Carpathians: these lie in the northern parts, in a wide band along the Slovakian border (highest point: the Kékes at 1,014 m/3,327 ft).

Hungary is divided in two by its main waterway, the Danube (Duna); other large rivers include the Tisza and Dráva, while Transdanubia contains Lake Balaton, a major body of water. The largest thermal lake in the world, Lake Hévíz (Hévíz Spa), is located in Hungary. The second largest lake in the Pannonian Basin is the artificial Lake Tisza (Tisza-tó).

Phytogeographically, Hungary belongs to the Central European province of the Circumboreal Region within the Boreal Kingdom. According to the WWF, the territory of Hungary belongs to the ecoregion of Pannonian mixed forests.

2.2. Climatic conditions

The climate is characterised as temperate, with cold, humid winters and warm summers. Hungary is Greenwich Mean Time plus one hour.

Hungary has a Continental climate, with hot summers with low overall humidity levels but frequent showers and frigid to cold snowy winters. Average annual temperature is 9.7 °C (49.5 °F). Temperature extremes are about 42 °C (107.6 °F) in the summer and −29 °C (−20.2 °F) in the winter. Average temperature in the summer is 27 °C (80.6 °F) to 35 °C (95 °F) and in the winter it is 0 °C (32 °F) to −15 °C (5.0 °F). The average yearly rainfall is approximately 600 mm (23.6 in). A small, southern region of the country near Pécs enjoys a reputation for a Mediterranean climate, but in reality it is only slightly warmer than the rest of the country and still receives snow during the winter.

Due to climate characteristics, the primary foreseen impact of climate change is precipitation change.

2.3. Population

At the beginning of year 2009, the population of the country was 10.028 million, of which 6.81 million people lived in urban areas. The density of population was 107.8 inhabitants/km^2. Between 1970 and 2009 the population decreased by about 300 thousand people. The population peak was in 1980, with 10,7 million souls, since then a uniform decreasing tendency shows. The age structure of the population is shown on Figure 2.1. This shows that there is a definite aging process in the Hungarian society stemming from decreased childbirths and marriages.
Figure 2.2 shows the changes of population between 1970 and 2009.

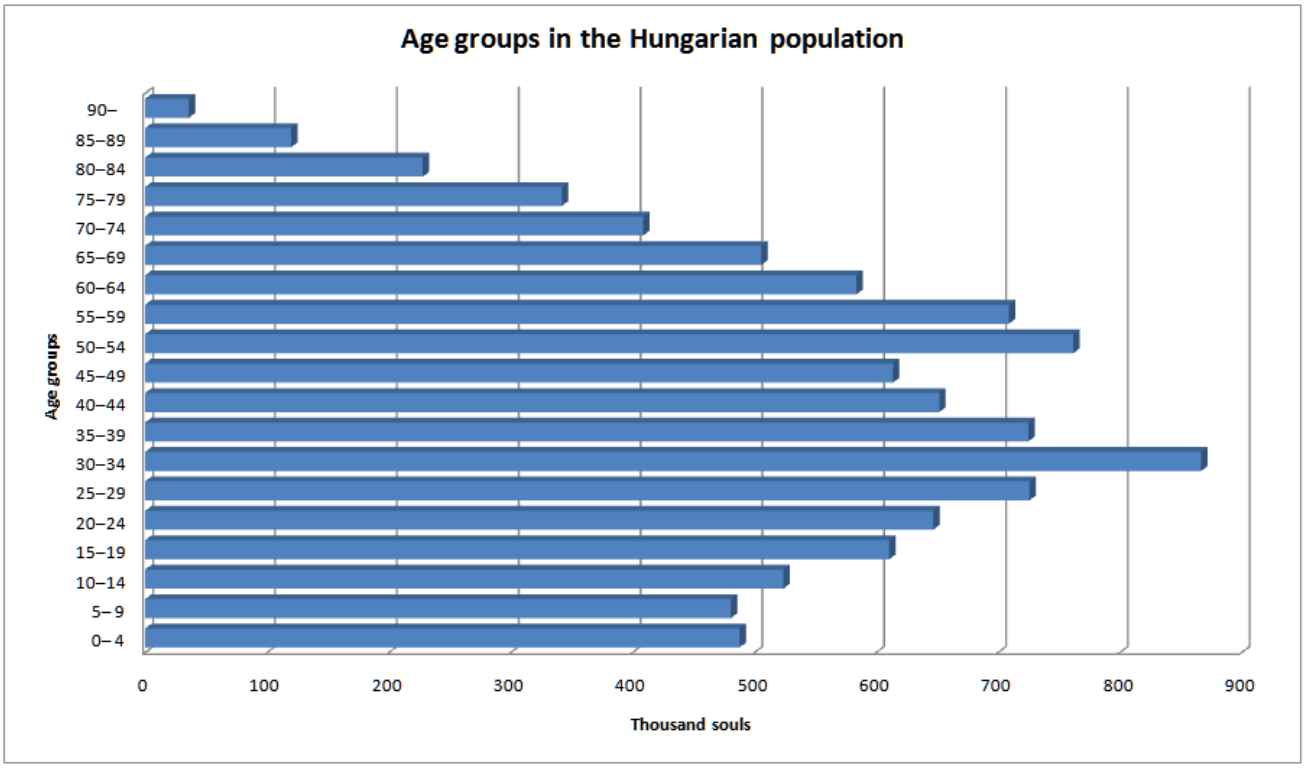

Figure 2.2. Population age tree of Hungary, 2009 (estimated)

Source: Hungarian Central Statistical Office (KSH), 2009

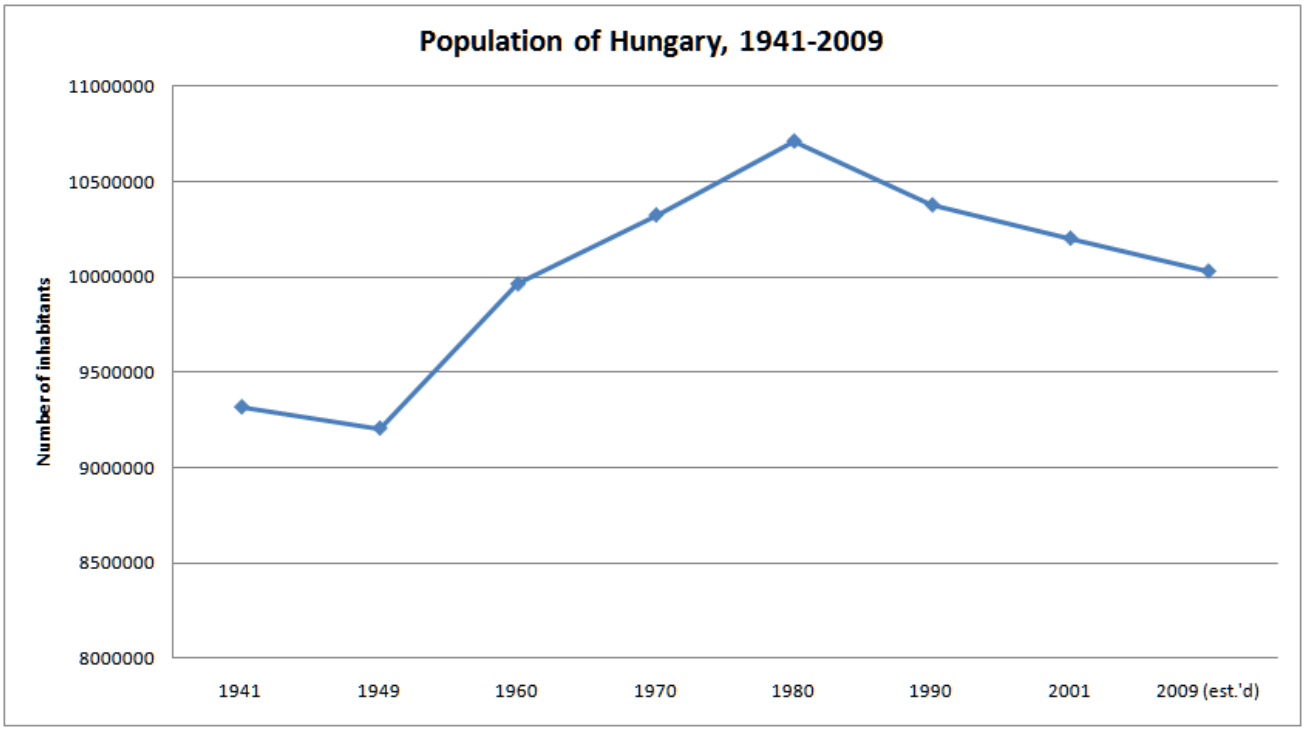

Figure 2.3. Population dynamics in Hungary, 1970-2007

Source: Hungarian Central Statistical Office (KSH), 2009

The labour force is 42% of the population, however, unemployment has a rate of 10 % presently (Fall of 2009). Hungarian is the predominant language. The use of English and German is quite high in business situations. The capital is the city of Budapest with 1.8 million inhabitants, the other cities are smaller, larger cities are Debrecen, Miskolc, Pécs, Szeged, Győr.

For historical reasons, significant Hungarian minority populations can be found in the surrounding countries, most of them in Romania (in Transylvania), Slovakia and Serbia (in Vojvodina). Sizable minorities live also in Ukraine (in Transcarpathia), Croatia (mainly Slavonia) and Austria (in Burgenland). Slovenia is also host to a number of ethnic Hungarians and Hungarian language has an official status in parts of the Prekmurje region. Today, more than two million ethnic Hungarians live in nearby countries.

2.4. Governmental structure

The President of the Republic, elected by the members of the National Assembly every five years, has a largely ceremonial role, but he is nominally the Commander-in-Chief of the armed forces and his powers include the nomination of the Prime Minister who is to be elected by a majority of the votes of the Members of Parliament, based on the recommendation made by the President of the Republic.

Due to the Hungarian Constitution, based on the post-WWII Basic Law of the Federal Republic of Germany, the Prime Minister has a leading role in the executive branch as he selects Cabinet ministers and has the exclusive right to dismiss them (similarly to the competences of the German federal chancellor). Each cabinet nominee appears before one or more parliamentary committees in consultative open hearings, survive a vote by the Parliament and must be formally approved by the president.

The Prime Minister is elected by the Parliament and can only be removed by a constructive vote of no confidence. The prime minister selects Cabinet ministers and has the exclusive right to dismiss them. Each Cabinet nominee appears before one or more parliamentary committees in open hearings and must be formally approved by the President.

The unicameral, 386-member National Assembly (Országgyűlés) is the highest organ of state authority and initiates and approves legislation sponsored by the Prime Minister. Its members are elected for a four year term. 176 members are elected in single-seat constituencies, 152 by proportional representation in multi-seat constituencies and 58 so-called compensation seats are distributed based on the number of votes "lost" (i.e., the votes that did not produce a seat) in either the single-seat or the multi-seat constituencies. The election threshold is 5%, but it only applies to the multi-seat constituencies and the compensation seats, not the single-seat constituencies.

An 11-member Constitutional Court has power to challenge legislation on grounds of unconstitutionality.

2.5. Settlement structure and building stock

Hungary is subdivided administratively into 20 regions, which are the 19 counties and the capital city Budapest (independent of any county government). There are 3,156 municipalities in Hungary *(ECEE, 2002)*, which are responsible for the provision of most local services, including schools, kindergartens, welfare and healthcare facilities, some office buildings and museums. The operation of these institutions includes supplying energy, except for some hospitals where the running costs are paid for by the central social security fund. Many of Hungary's district heating systems are also owned by municipalities.
Of the 3,156 municipalities, only 23 are considered to be major metropolitan areas and over 2900 are villages. Outside Budapest, the largest municipality in Hungary is Debrecen, with a population of only 300,000 inhabitants. Despite the limited capacity of over 90% of the country's municipalities, however, it should be noted that there are a significant number of non-residential premises that are owned by municipalities. The type and number of public buildings is shown in **Table 2.4.** Of the 51,332 non-residential buildings, over 20,000 of those are in the capital of Budapest.

Type	Total (2005)	Pre 1900 (%)	1901-1959 (%)	1960-1989 (%)	After 1989 (%)
Educational	14,134	10.5	34.1	47.0	8.4
Cultural	5,021	15.4	37.4	40.9	6.2
Social service	3,248	11.8	35.1	40.9	12.2
Health Service	5,005	6.8	32.0	51.8	9.4
Trade, Service and Administration	9,512	8.4	34.0	50.0	7.6

Table 2.1. Type and age of public buildings
Source: Hungarian Central Statistical Office (KSH), 2009

Residential flats

The latest data available on the residential housing stock is from the micro-census undertaken in 2005 of the Central Statistical Office of Hungary.
The number of inhabited flats in dwellings was 3.937M, 20-20% were to be found in the capital cities and the larger urban areas, in other smaller cities 28% and 32% in villages and smaller settlements. Proportion of flats in houses was 63%, in block houses 20% and 17% in building associations 17%, respectively. One third of the dwellings were built before 1960, 21% originates from before World War I. The major part of the present dwellings, approximately 1.5 million flats were built between 1960 and 1980. The ratio of privately owned dwellings is 92%, the number of municipality owned flats is decreasing, while around 500,000 flats are in mixed ownership (private-municipal building management. More than 2/3 of the families live in individual buildings (family houses, conventional rural houses).
The decreasing population and the number of newly built dwellings (214 thousand) result in the decrease of inhabitation intensity, which is reflected in the number of dwellers per 100 flats. This indicator decreased from 274 in 1990 to 251 in 2004. The share of flats built in new family houses decreased to 47.1% by the end of 2004 from 69.3% in 1990 and the share of dwellings in new multi-storey buildings increased to 33.7% by the end of 2004 from 13.9% in 1999. Further data is shown in Table 2.5.

(in 1000 units)	1999	2003	2005
Total dwellings	3980	4065	4173
Municipality owned dwellings	213	181	117
Privately rented	119	113	129
Dwellings inhabited by owner	3494	3450	3641
Empty private dwellings	135	313	212
Empty municipal dwellings	19	14	14
Other		91	38
Population (1000 souls)		10142	10077
Number of inhabitants/dwellings		2,494957	**2,414809**
Total flats in dwellings		3724	3937

Table 2.2. Flats and dwellings structure in Hungary from 1999 to 2005
Source: Hungarian Central Statistical Office (KSH), 2009

2.6. Economy

Hungary has made the transition from a centrally planned to a market economy, with a per capita income nearly two-thirds that of the EU-25 average. The private sector accounts for more than 80% of GDP. Foreign ownership of and investment in Hungarian firms are widespread, with cumulative foreign direct investment totalling more than $60 billion since 1989. The government's IMF-mandated austerity measures, imposed since late 2006, have reduced the budget deficit from over 9% of GDP in 2006 to 3.3% in 2008. Hungary's impending inability to service its short-term debt - brought on by the global credit crunch in late 2008 - led Budapest to seek and receive an IMF-arranged financial assistance package worth over $25 billion. The global financial crisis, declining exports and low domestic consumption, as well as fixed asset accumulation dampened by government austerity measures will result in a negative growth rate of about -1.5% to -2.5% in 2009.

Hungary has a market economy, a well developed stock-exchange and highly export-oriented industry. A structural economic crisis began in the second half of the 80s which was followed by the transformation of the whole economic and political system in 1990. Similarly to other post-soviet countries, the transition process towards market economy began accompanied by an economic depression which lasted till 1995. Since then the economy began to develop and the growth rate of the Hungarian economy exceeded the average of the EU. After having joined the EU in 2004, the present concern of macroeconomic analysts is the large share of budget deficit, which might hinder the introduction of the EU community monetary unit, the Euro.

The main economic indicators are shown in Table 2.3.

	1990	1995	2000	2005	2008
GDP growth rate	-3.3	1.5	5.2	4.1	0.5
Unemployment rate	2.1	10.4	6.4	7.2	9.7%
Inflation rate	28.9	28.2	9.9	6.2	6.8%
Central budget/GDP	0.8	-6.0	-2.8	-4.2	-4.0%

Table 2.3.: Main economic indicators of Hungary in 1990-2008 (%)
Source: Hungarian Central Statistical Office (KSH), 2009

2.7. Energy

Hungary has some indigenous resources of oil, gas and coal. However, domestic oil and gas production has peaked and is expected to gradually decline. At present Hungary imports around 80% of its oil and in terms of crude oil imports, these are sourced exclusively from Russia. The import dependence for gas is equally large, with Russia (i.e. Gazprom) providing 80% of Hungarian gas supply. With domestic oil and gas production declining in the future, the import dependence is bound to further increase. MOL, the Hungarian oil and gas company is strongly present in the oil and gas sector. In the electricity sector, the most important contribution is provided by nuclear energy with almost 40% of electricity generated in Hungary. This is generated by Hungary's sole nuclear power plant (Paks NPP), which is owned by the state company MVM. MVM is also the sole buyer and seller of electricity generated in Hungary under long-term power purchase agreements and the sole supplier to the regulated market. Besides MVM, there are several foreign private companies operating in the electricity generation and distribution sector. The Electricity Act of 2005 stipulates that MVM shall remain in state ownership. The change of the structure of total primary energy supply is shown on Figure 2.4.

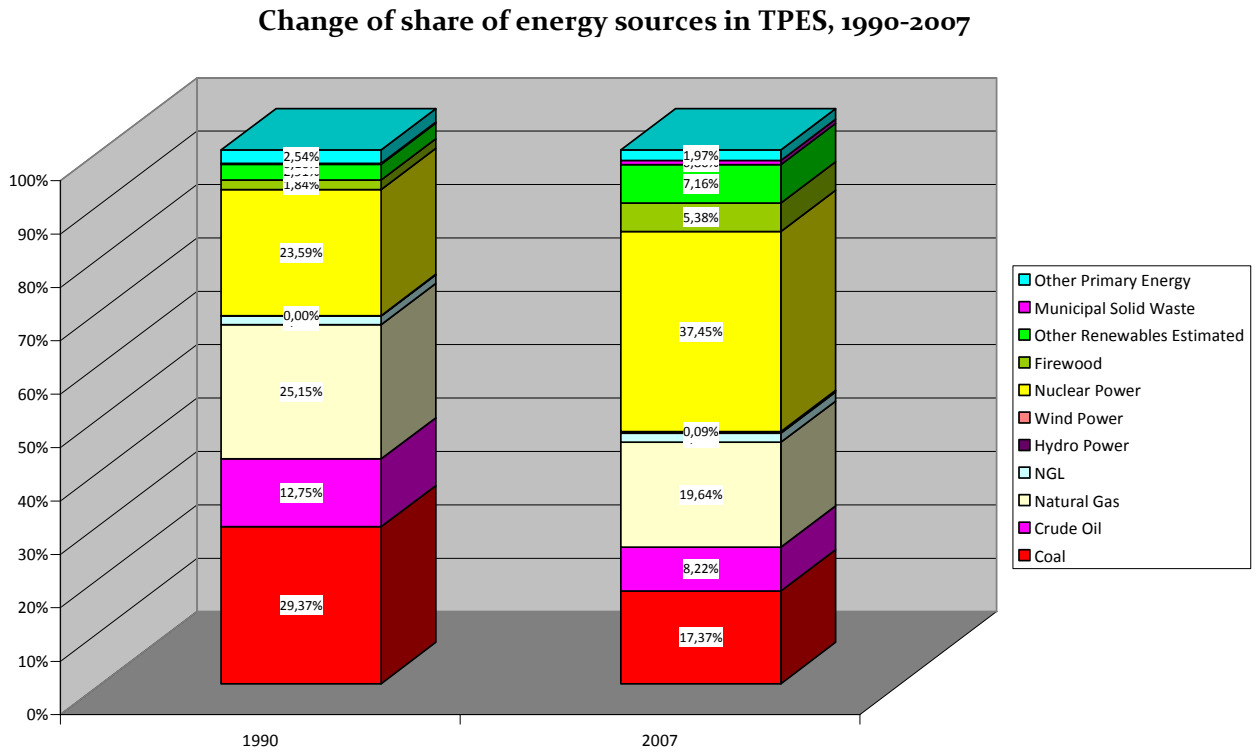

Figure 2.4. Change of structure of TPES from 1995 to 2007

The domestic utilisation was 1120 PJ in 2008, showing a slight monotone decrease since 2005 (1153.2 PJ). The decrease in energy consumption was caused mainly by comparatively less severe weather conditions, slight increase in energy efficiency and the beginning of the economic crisis.

In the overall energy consumption, electricity consumption amounted to 43,011 GWh in 2008, which indicates a 2.7% increase compared to that of 2005. The import of electricity amounted to 3903 TWh, which is a slight decrease from previous years. Peak load of the Hungarian grid was 6388 MW in January 29th, 2008. Peak load shows an increasing tendency, with summer peak metering days approaching winter peaks and winter peaks coming in later winter months as a result of generally warmer temperature.

	1990	1995	2000	2004	2005	2006	2007	2008
Total sources and distribution	39,538	36,422	38,631	41,180	41,982	43,066	43,945	43,011

Table 2.4. Electricity balance, GWh, 1990-2007,
Source: Energy Centre Ltd.

In 2007 the share of imported energy was around 66.1% and if imported nuclear fuel were considered as non-domestic energy carrier, dependency would be above 75%.

Table 2.5 presents the primary energy production by fuel types, in PJ.

	1990	1995	2000	2003	2004	2005	2006	2007
PRIMARY ENERGY	**634.8**	**574.2**	**485.2**	**434.7**	**424.9**	**427.9**	**428.8**	**427.0**
of which:Coal	186.4	130.1	121.1	113.4	91.4	73.2	73.6	74.2
of which:Lignite	37.0	48.3	55.1	63.4	62 1	55.9	56.2	57.4
Brown Coal	122.3	71.0	57.3	42.2	26.2	17.2	17.4	16.7
Hard Coal	22.4	10.9	8.7	7.8	3.0	0.0	0.0	0.0
Gas and Coke Coal	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crude Oil	80.9	68.4	47.5	46.5	45.0	39.6	37.1	35.1
Natural Gas	159.6	158.6	103.6	95.7	99.1	97.6	99.7	83.9
NGL	10.2	11.3	10.2	9.7	10.1	10.2	10.3	7.4
Hydro Power	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.8
Wind Power							0.2	0.4
Nuclear Power	149.7	152.1	154.6	120.0	129.9	150.8	146.7	160.0
Firewood	11.7	15.9	14.9	18.2	17.9	25.1	26.0	23.0
Other Renewables (Estimated)	18.5	18.9	18.1	18.3	20.4	18.3	21.5	30.6
Municipal Solid Waste	1.0	2.2	2.4	1.5	1.4	2.8	3.7	3.4
Other Primary Energy	16.1	16.1	12.2	10.8	9.1	9.7	9.4	8.4

Table 2.5. Primary energy production by fuel types, PJ,
source: Energy Centre Ltd.

Table 2.6. presents the accumulated domestic energy balances for 2006 and 2007.

Unit: 1; kt, Mm^3 at 15°C, GWh 2; PJ	2006		2007	
	1.	2.	1.	2.
I. PRODUCTION		428.8		427.0
Coal	9,952	73.6	9,818	74.2
Of which : mining and strip-mined lignite from Mátraalja	8, 467	56, 2	8, 352	57,4
Brown coal	1,485	17.4	1,466	16.7
Crude oil	886	37.1	839	35.1
Gasoline	239	9.4	200	8.4
Dry Natural Gas	3,095	99.7	2,615	83.9
NGL	220	10.3	157	7.4
Hydroelectric Power	186	0.7	210	0.8
Nuclear Power	13,461	146.7	14,677	160.0
Prod.of Wind Power Plant	43	0.2	110	0.4
Firewood Observed	26.0	26.0		23.0
Other(vegetal materials and wastes)	16.7	26.7		26.2
Geothermal	3.6	3.6		3.6
Municipal Solid Waste	3.9	3.9		3.4
Others (biogas, solar, etc.)	1.0	1.0		0.8
II. IMPORTS		884.4		850.9
Coal	2,433	63.8	2,652	71.2
Briquettes	15	0.3	13	0.3
Coke	51	1.5	27	0.8
Crude oil	6,915	289.0	6,884	287.7
Petroleum products	2,486	103.2	2,609	108.7
Natural gas	11,666	399.1	10,669	364.9
Electricity(import-export balance)	7,208	25.9	3,986	14.4
Firewood Observed and other Mun. Waste		1.5		3.0
III. TOTAL ENERGY		1313.2		1,277.9
less: exports		158.9		153.6
stock changes		2.3		-1.1
IV. DOMESTIC USE		1152.0		1,125.4
of which: electricity consumption	43 066		43 945	

Table 2.6. Accumulated domestic energy balance, source: Energy Centre Ltd.

The capacity enlargement of the power system in the 90s was undertaken with gas fired units, thus increasing gas demand significantly. The capacities are satisfactory, the necessary reserves were installed.

Total share of renewable energy utilisation was 5,8% (64.9 PJ estimated) in the energy balance in 2008.

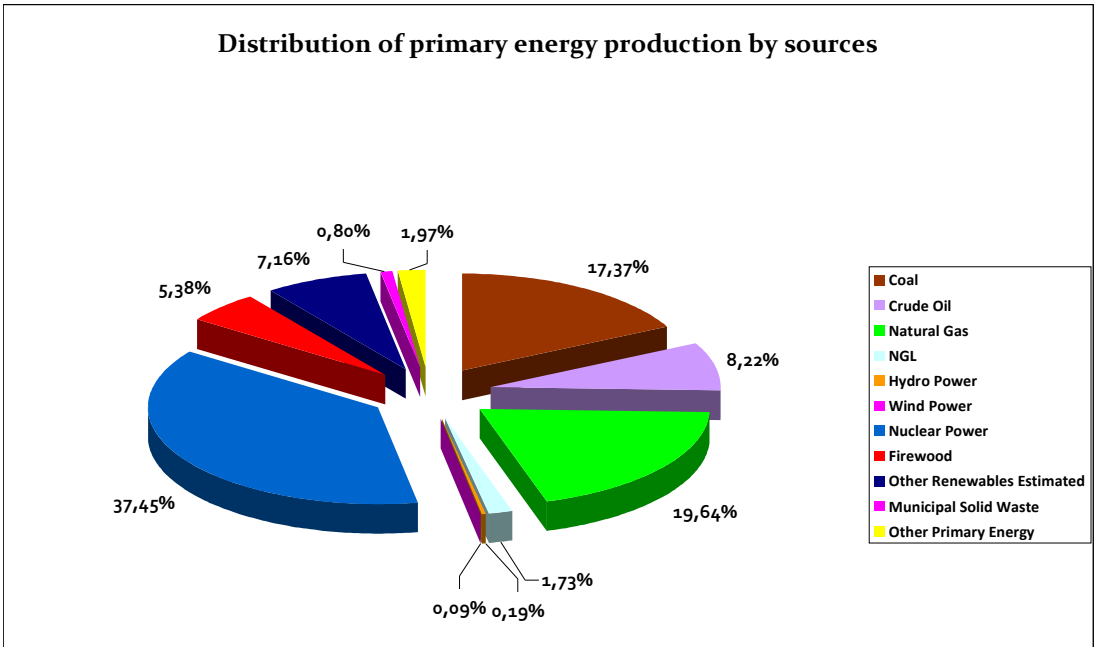

Figure 2.5. Primary energy production by sources (%), 2007
source: Energy Centre Ltd.

Figure 2.6. shows the distribution of energy consumption between actors of the economy. Industry is still a leading consumer, closely followed by the households sector.

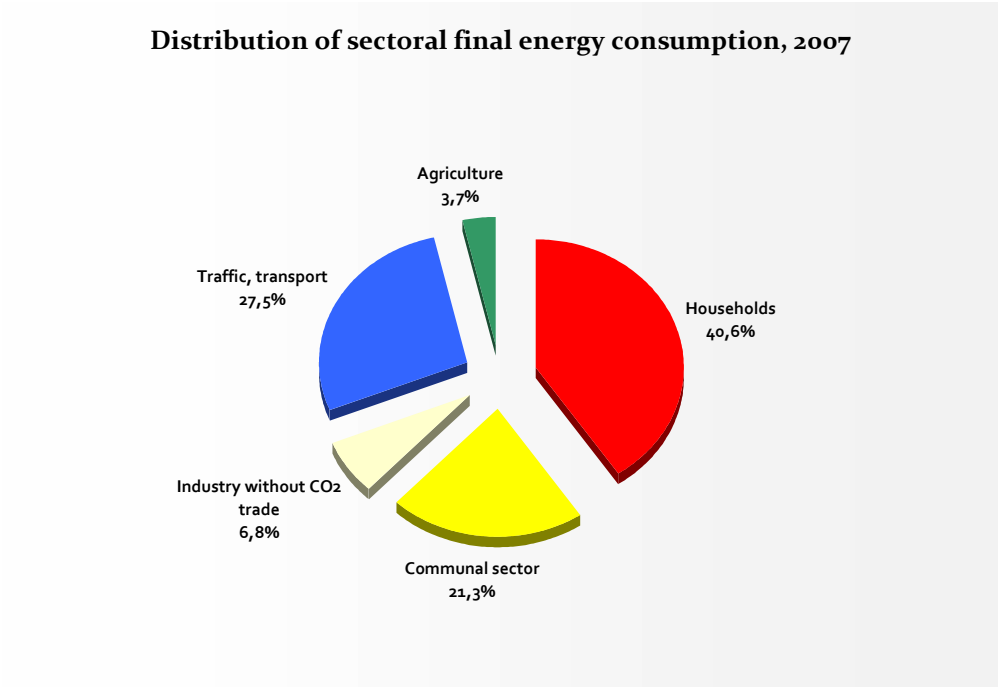

Figure 2.6. Energy use distribution by consumer groups (%)
source: Energy Centre Ltd.

2.8. Industry

In foreign investments, Hungary has seen a shift from textile and food industry to investment in vehicle production, renewable energy systems, high-end tourism, and information technology. The Hungarian automotive industry having produced 190 thousand cars and 2.3 million motorbikes in 2006 is increasing its competitiveness by further investments and launching new models. Besides automotive industry, the top 10 Hungarian companies include companies from the energy industry, telecommunication industry, consumer electronics, and pharmaceutical industry. The shift from the energy intensive heavy industry towards industries producing state-of-the-art products is one of the most important trends in the country's economy and has important impacts on the country's energy consumption trends and greenhouse-gas emissions.

In mid-2000's, the direct energy consumption by the industry sector was almost 30% of the total direct energy uses. Industrial energy uses between 1990 and 1997 decreased significantly (by 40%) and then remained unchanged for a few years until a slight increase in recent years. Structural transformation has been completed in the first half of the 1990s, which resulted in a considerable reduction of the energy use and GHG emissions. No further essential restructuring is foreseeable in the mid run and endeavours should be rather focussed on preventing the settling of energy-intensive, high-emission industries. Otherwise, the introduction of energy-intensive forms of production in the SME sector may undermine the emission mitigation efforts.

- No industry specific mitigation policies are in place: the general policies and measures described elsewhere in the current document influence emissions of industry.

It should be also noted that Hungary has implemented the EU Directive on energy-using products (EuPs) through the Governmental Decree No. 217/2007 (VIII.15) on the requirements of eco-design obligations of the energy using products and the general conditions of the placing on the market and conformity assessment of them (the "EuP Decree"). The decree was adopted in July 2007 and entered into force on 14 August 2007.

2.9. Transport

Road transport and the transport network are in a contradictory and continuously changing situation in Hungary. This can be characterised by the following factors:

- the network of good quality and rapidly expanding expressways and almost 500 dead-end settlements are present at the same time in the country
- in the south-western and south-eastern parts of the country the problem is caused by the saturation of the public roads and by delayed accessibility, respectively
- while the traffic problems of the large towns – congestions, parking difficulties, air pollution – remind us of the developed countries, the access to peripheral areas has hardly improved in 50 years

There are many, relatively new difficulties: deterioration of the main and secondary road network has grown to dangerous dimensions in the 10 years past. On the national public road network the average period of pavement renewal has been extended from an 8-15 year-interval to 47 years.
Hungary's passenger car fleet consisted of circa 2 980 000 vehicles in the year 2007. Furthermore the Hungarian vehicle stock comprises 300 000 trucks, 17 500 buses and some 120 000 motorcycles. Social, lifestyle and economic changes are behind the dynamic increase of road motorisation. In Hungary intensive increase of motorisation started at the beginning of the 1970s. Until the 1990s the increasing demands

could be met by the existing public road network with its good quality public transport; people were not very much affected by the harmful effects of motorisation and the environment-conscious attitude did not manifest en masse. At the beginning of the 90s the effects of the accelerating economic and social changes could be experienced on the public roads as well: large number of new passenger cars appeared, among them the proportion of high-performance vehicles and the road transport was also constantly growing. At the same time, the country's economic situation could not afford the road network developments required in parallel with the increasing motorisation level.

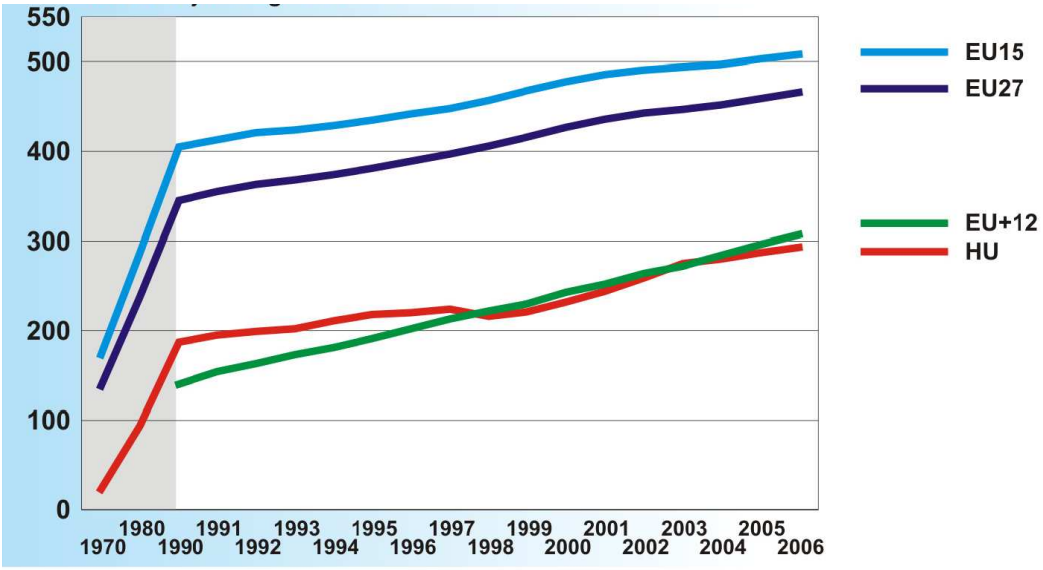

Figure 2.7. Motorisation in Hungary
(source: Eurostat 2008)

In the 1970s 25-30 passenger cars fell per 1000 residents, at the beginning of the 80s this rate exceeded 100 passenger cars/1000 population and 200 passenger cars/1000 population at the beginning of the 90s. By 2005 the national level of motorisation approximated the number of 300 passenger cars/1000 population, while in some districts of Budapest the rate exceeded even 400 passenger cars/1000 population; in the households the use of a second car has also been spreading. Forecasts expect further large scale increases. Countrywide values are estimated by the different sources to 425 passenger cars/1000 residents for 2020 and 520 passenger cars/1000 residents for 2034, respectively (Fig 2.8.).

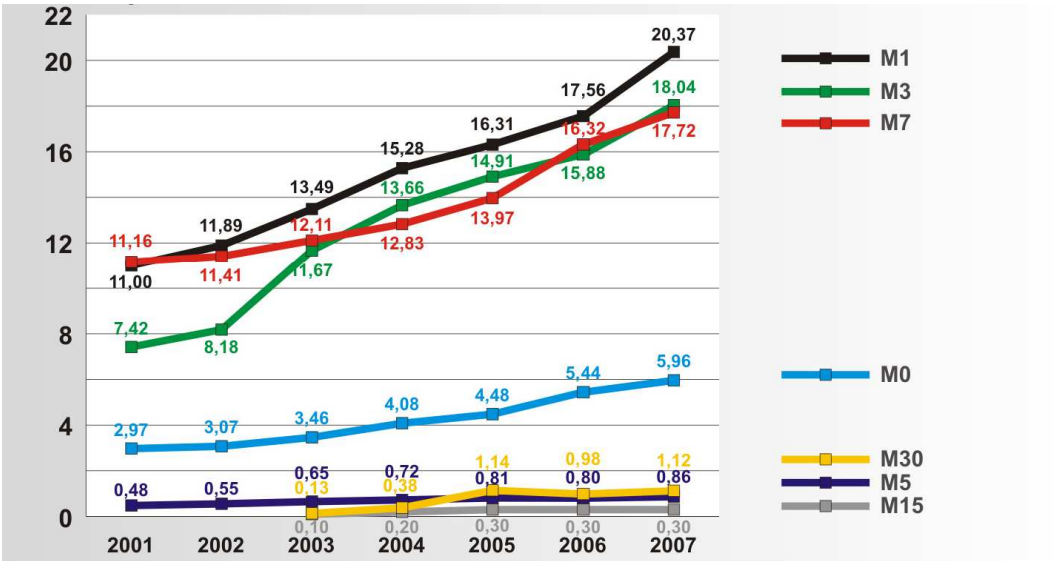

Figure 2.8. Traffic in Hungarian motorways [vehicle km]
(source: ÁAK Zrt. 2008)

It is important to note that this increasing number of vehicles is also more frequently used by the population accepting both the delays caused by congestions and the higher costs. From this point of view it should be clear that in the past 25 years the Hungarian society became unequivocally a motorists' society, people, especially in urban areas almost irreversibly got accustomed to mobility and comfort attached to motorist lifestyle.

In the field of air pollution caused by transport, due to the technical improvement of the motor vehicles that was started in the 1990s and which is still in progress, the CO, hydrocarbon and Pb emissions were eliminated or reduced to minimal levels, however there are three other challenges that should be faced with in the next 10-15 years:

- Emission of gases with greenhouse effect, primarily of the CO2 is a global problem; the share of the transport in GHG emissions is 15% in Hungary (25-30% within the EU) and it's permanently;
- Emission of nitrogen oxides is a regional and partly local problem, which also shows a slightly increasing tendency;
- Emission of NOx (transport-caused emission share is 55% of the total), the ultra fine particles (solid particles < PM2,5 - 2,5 µm) and of some components not regulated yet with limit values (PAH-s, aldehydes, N_2O, dioxins, etc.) are harmful locally, primarily endangering the health of the urban population.

The changing of the emission of pollutants is also well illustrated in Figure 2.9.

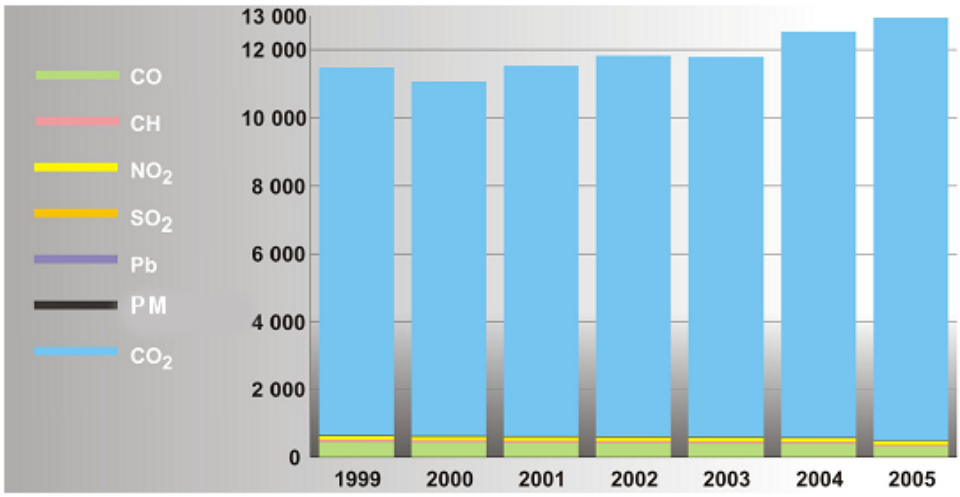

Figure 2.9. Transport emission in Hungary in ktons
source: KTI database 2008

The increasing number of vehicles and the changing utilisation patterns have significant impact on future fuel consumption and energy use.

2.10. Agriculture

Hungary has favourable national endowments to agricultural production (e.g. soil quality, climate), agriculture is traditionally export-oriented and had additional export even in terms of the EU relation.
As the result of the political and economic processes after the change of regime in 1990, between 1990 and 2000 the number of agricultural farms was reduced by more than 30%, the number of employees by more than 50%, the volume index of the gross agricultural production by more than 30% and the livestock by almost about 50%.

After Hungary joined the European Union (1 May 2004) the field of agriculture faced serious challenge in terms of the establishment of harmonisation with the legal regime of the community, the establishment of the institutional system necessary to the operation, the education of experts and the provision of information to the producers. In the framework of the PHARE projects the Hungarian agriculture sector received EUR 44.1 million to establish and reinforce the institutional system.

The Hungarian agriculture sector was disadvantageously affected by the fact that the new Member States receive only gradually the 100% of the direct Union payments after a 10-year transition period, with subsidy level starting from 25% of the original EU member states. National aid may be provided up to 30% as a complement. As regards the system of single payments Hungary chose the SAPS (Single Area Payment Scheme) offered to the new Member States.

As the result of the accession the Hungarian agriculture faced conditions that were significantly different from the former environment. Hungary had to compete with such member countries on the EU's internal market that have been the beneficiaries of the competition for years or even decades and the degree of the subsidies was also rather different. After combating the initial difficulties (in compliance with the follow-up financing requirements of the agriculture finance system had to be converted from the short-term type into

medium and long-term loans as well as the introduction of direct payments required the operation of a brand new system), the Union aid scheme has been operating relatively well since the end of 2005.

The total opening of the markets towards both directions resulted in the worsening of the agricultural trade balance in the first two years. The Hungarian agriculture sector was able to maintain its positive trade balance after the accession but – collaterally with the increasing export – the proportion of the import showed higher increase. Finally, the Hungarian agriculture has accommodated to the conditions of the Common Agriculture Policy, its competitiveness improved, the export revenues became more and more significant due to the excellent agricultural potency of the country and trade balance improved, too. The positive balance of the agriculture trade was HUF 265 billion in 2006, HUF 402 billion in 2007 and HUF 482 billion in 2008. In terms of euro the balance of 2008 increased by 14.3% compared to EUR 1,675.2 million of 2007 and exceeded EUR 1,915 million. In 2008 Hungarian export reached about EUR 5.7 billion that was more than the double of the level in 2000. The traditionally positive agricultural trade balance has been positively influencing the country's trade balance for decades. The structure of export relations has gradually shifted: the share of the new member states and of third countries is increasing against of the old member states (traditional EU).

In 2008 the share of the Hungarian agriculture sector was 4.0% in the GDP, 25.0% in the consumption, 7.9% in the export, 5.0% in the investments, 4.6% in the employment; the trade balance was HUF 482.0 billion (forecast data, KSH, 2009). If – beyond the agricultural raw material production – the performance of food industry, food trade and agricultural services as well as the field of sectoral management and administration and education, research and agriculture diplomacy are also taken into account, the share of the so-called agri-business was 12-13% in the GDP in Hungary in 2008, while raw material production itself covered only 4% of the GDP.

The share of the agriculture sector shows a decreasing tendency both in the GDP and in the consumption. The degree of reduction within the consumption is less than in the case of GDP production, since the decrease of the share of food consumption occurred within an increasing total consumption. In Hungary in 1995 the share of food represented 32.4% in the consumer basket; it has never reached 30% since 2000 and was about 25% in 2007 and 2008.

The share of agriculture in national investments was 6.1% in 2003; it decreased to 4.2% in 2006 and to 3.7% in 2007. When judging investments it is decisive that significant investments (mainly machinery) were realised in the years after the accession in the framework of the measures of the SAPARD (Special Accession Programme for Agriculture and Rural Development) and the AVOP (Agriculture and Rural Development Operational Programme) . Following the decline in 2006 the new investment programmes that are connected to the New Hungary Rural Development Programme (NHRDP) to be implemented between 2007 and 2013 brought the significant boost of investments.

According to the data of employment survey the number of employees in the agricultural sector has further decreased between 2006 and 2008 and currently its share hardly reaches 4.6% within the national economy. The role of the sector is much more significant in employment than it is indicated by the statistics, since the vast majority (almost 80%) of labour input used in agriculture is non-paid family workforce in Hungary. However, the degree of employment calculated on the basis of the hours worked is about half a million people in the agricultural sector.

As regards land use, out of the area of the country (93,033 km^2) 83.5% is area under production (48.4% arable area, 3.0% garden, orchard and vineyard, 10.9% meadow and pasture, 20.3% woodland, 1.0% reedbed and fishpond), 16.5% is uncultivated land. Out of the area of the country 40.7% is managed by economic organisations, 30.3% by individual farms, 29.0% is unidentifiable (KSH, 2009).

The start of the New Hungary Rural Development Programme (2007-2013) is promising. The investments implemented with the help of EU support significantly contribute to the modernisation of the production and processing of agricultural products, to the development of the rural infrastructure and to the improvement of living conditions. The entire amount of the funding available is EUR 5.3 billion for the seven years that equals to HUF 1,300-1,500 million depending on the exchange rate. The complementary national funding significantly contributes to the increase of profitability. Even in the course of the so-called "Health Check" serving the streamlining the Common Agriculture Policy Hungary stood and stands for such agreements that strengthen the viability of the Union's agriculture, promoting the development grounding the evolution of production potential, as well as guaranteeing the appropriate autonomy in the field of food supply in the Union. All this was done in a way to protect the interests of the development and evolution of the Hungarian agricultural sector and rural environment.

2.11. Waste management

The composition of municipal solid waste did not change significantly in the last decade, the proportion of biologically decomposable contents is roughly 50%, from which 15-17% is paper waste.

The distribution of municipal solid waste by treatment is shown on Figure 2.10.
It is visible that although the amount of waste increased only by 40 ktons, but the proportion of reused/recycled material doubled between 2000 and 2004.

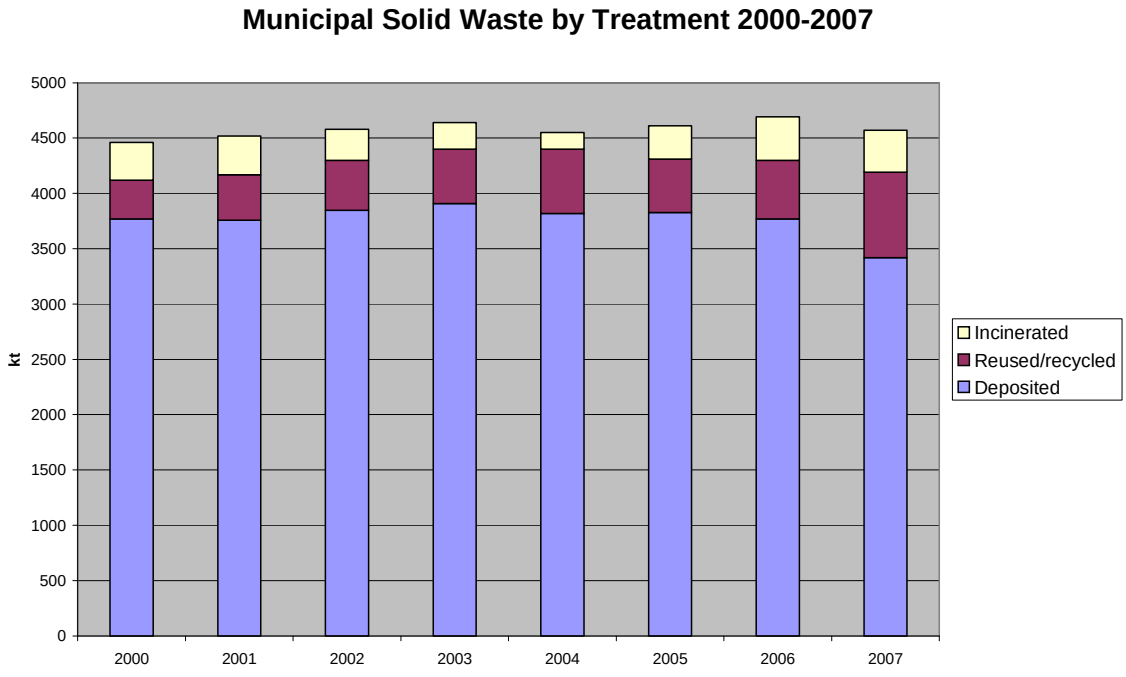

Figure 2.10. Municipal solid waste by treatment (kt)
source: KSH-Eurostat,2009

Landfill waste disposal is still a dominant method of waste removal; even developments on the mid-term are not foreseen to change the magnitude of its share. The planned developments target the construction of regional waste disposal sites, new installations on thermal utilisation are not expected due to high investment costs and long preparatory time.

From the EU's ISPA fund 12 waste management projects were supported and contracted. The realisation of the projects has already started.
The accepted regional projects strongly contribute to the goals of the Waste Management Strategy, the selective waste utilisation and the increase of bio waste treatment installations significantly increase the amount of waste re-utilised, thus reducing the amount of waste disposed in landfills.

As results of the investments, the rate of material reutilisation reached 23% by the end of 2008 (estimated). As the reconstruction of the Budapest Waste Incineration Plant has finished in 2005, the amount of incinerated waste has risen to 420 ktons/year. This resulted in the reduction of the amount of waste disposed in landfills to 67% of the basis by the end of 2008 (estimated.)

The distribution of waste treatment methods is presented on Figure 2.11.

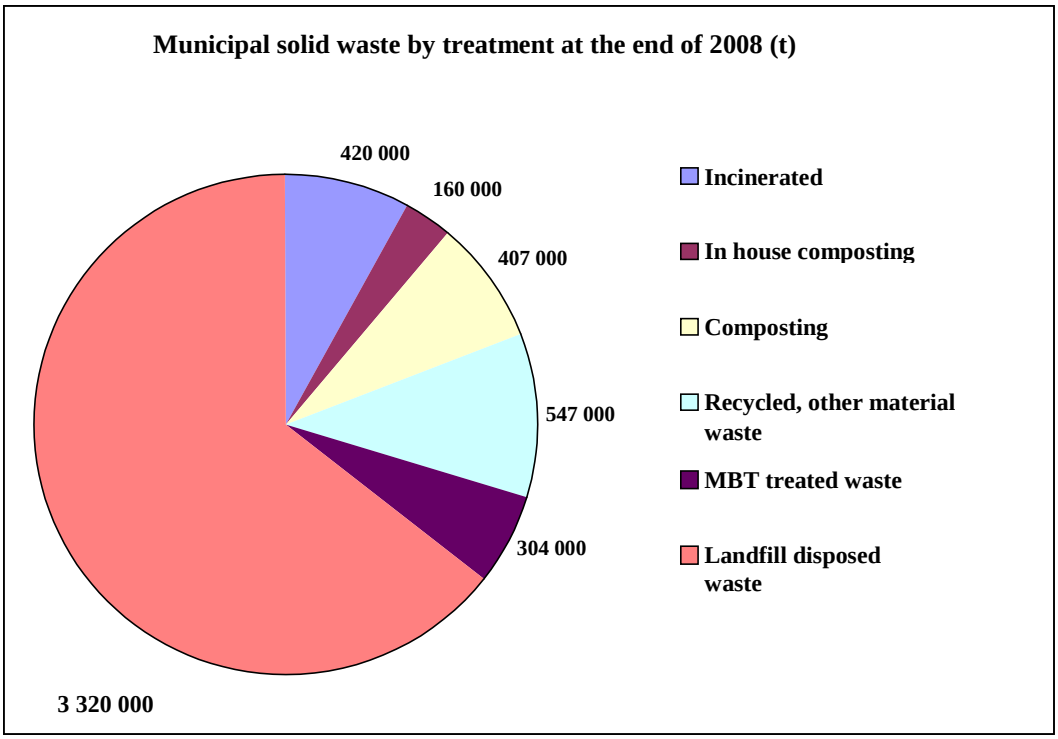

Figure 2.11. Distribution of municipal solid waste disposal methods in the end of 2008.
Source: GKM, 2008

Disposal options of waste in landfills narrowed from the 2004 figure of nearly 200 sites to only 53 in 2009. Around 2435 locations are already closed down but not recultivated.

Organic waste treatment

In 2001, the composted organic waste amounted to 74 ktons. The utilisation of capacity showed significant regional imbalance, some regions showed chronic underutilisation. The developments launched in 2001 resulted in the increase of capacities, municipalities received central budget support to develop composting and selective waste management.

The amount of composted waste was 200 ktons in 2004 (80 ktons in-house) and the mechanical biological treatment (MBT) amounted to 20 ktons, treatment in the Capital City Waste Incineration Plant was 80 ktons (organic), collected paper amounted to 430 ktons, out of which residential and tertiary source waste amounted to only 210 ktons.

Adding up the above, the organic waste treatment capacity in Hungary amounts to 510 ktons/year.

2.12. Forestry and land-use change

In general, forests in Hungary have been sustainably managed (Ministerial reports 2006-2007; MCPFE, UNECE, FAO 2007). Concerning forest area, the fact that the management was sustainable is well demonstrated by the constant increase of the area covered by forests (Figure 2.12). Of the total area of the country (~9 303 000 ha), 1 869 349 ha were covered by forests in 2007, which corresponds to a forest cover of 20,1 %. This figure includes temporarily unstocked areas; the total area of stocked forests amounted to 1 825 983 ha in 2007. The total area managed by forestry companies amounts to 1 998 472 ha. All of this area is managed based on a forest management plan

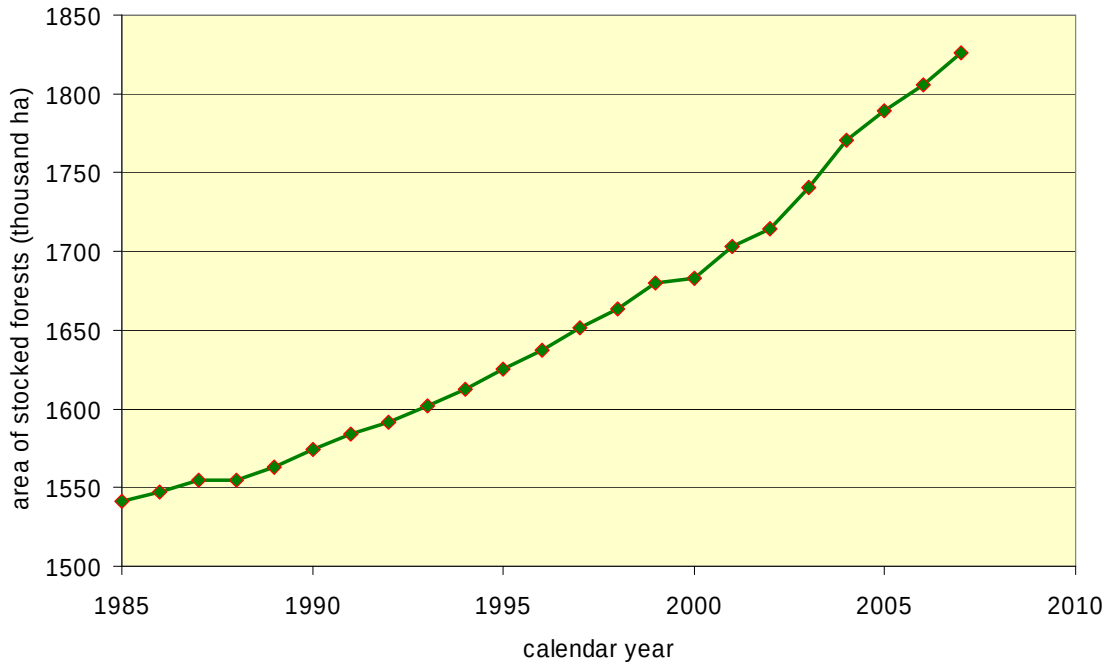

Figure 2.12. The area of stocked forests since 1985.

No major changes have taken place in the ownership structure of the forests for the last decade. Most of the changes are due to afforestation, as by far the most new forests are established in the private sector. The share of private forests amounts to 41.2%, whereas forests owned by local governments only amount to 0,9%. Most forests (57.7%) are, however, still state owned. (The ownership of some 0.2% of forests is unaccounted for).
Most forests, i.e. 63.6%, are classified as production forests. The share of protection forests is 35.1%, whereas forests serving predominantly social, touristic, educational and scientific purposes amount to 1.3%.

Sustainability is also demonstrated by the fact that the stock volume of the Hungarian forests has continuously increased in the last several decades (from 257 million m^3 in 1981 to 344 million m^3 in 2007). This increase is, however, partly due to the continuing afforestation programmes, which have substantially increased forest resources since 1930, when they started. For the last several decades, the wood increment of the forests has always topped the sum of all harvests and mortality due to disturbances and self-thinning (Figure 2.13): the amount of harvests has only been some 70% of the annual allowable cut that is set in the forest management plans. The amount of salvage cuttings (1995: 552,000 m^3; 2000: 427,000 m^3; 2005: 530,000 m^3) has not shown any increasing (or decreasing) trend.

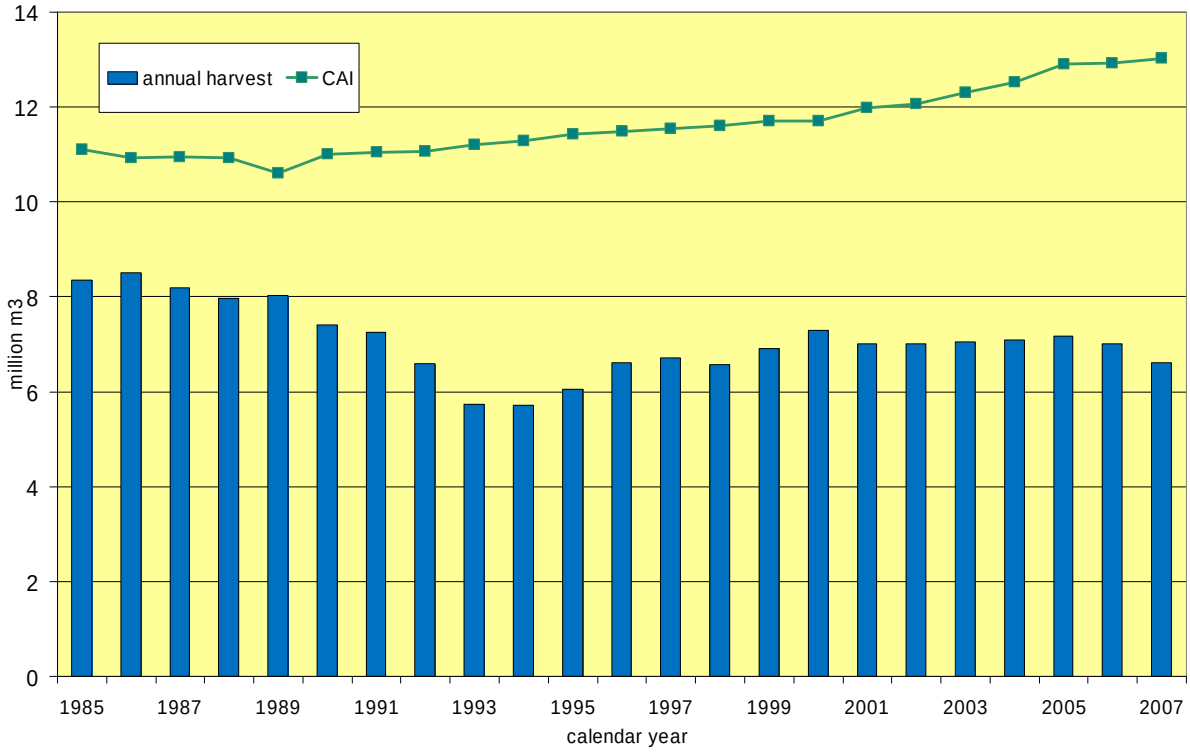

Figure 2.13. The total amount of annual harvest and the estimated current annual increment (CAI) over time in Hungary.

3. Greenhouse Gas Inventory Information

3.1. Summary tables

GREENHOUSE GAS EMISSIONS (CO_2eq, Gg)	BY fixed	1990	1995	2000	2003	2004	2005	2006	2007
Energy	84,006	70,887	61,375	58,188	61,688	59,589	60,623	59,242	56,936
Industrial Processes	10,440	8,650	4,991	5,812	5,394	6,007	6,071	5,695	5,236
Solvent and Other Product Use	384	290	250	236	275	337	148	344	158
Agriculture	17,496	16,026	9,576	9,922	9,995	9,989	9,398	9,417	9,477
LULUCF	-2,736	-4,210	-8,618	-827	-4,489	-4,201	-4,616	-4,109	-4,138
Waste	3,070	3,356	3,653	3,858	3,882	3,981	4,142	4,167	4,136
Total (including LULUCF)	**112,661**	**95,000**	**71,227**	**77,188**	**76,744**	**75,703**	**75,766**	**74,756**	**71,806**
Total (excluding LULUCF)	**115,397**	**99,210**	**79,845**	**78,016**	**81,233**	**79,904**	**80,382**	**78,865**	**75,944**

Table 3.1. Greenhouse gas emissions by sector

Source: National GHG Inventory, OMSZ, 2009

GREENHOUSE GAS EMISSIONS (CO_2eq, Gg)	BY fixed	1990	1995	2000	2003	2004	2005	2006	2007
CO_2, without LULUCF	85,795.5	72,470.8	61,501.8	58,491.8	61,640.2	59,897.9	61,098.9	59,757.5	57,751.8
CH_4, without LULUCF	10,139.2	11,153.1	9,224.5	9,368.3	9,257.6	8,921.0	8,797.7	8,710.5	8,545.3
N_2O, without LULUCF	19,223.7	15,275.3	8,880.2	9,598.6	9,485.2	10,180.0	9,557.6	9,544.3	8,857.9
HFCs	1.74	0.0	1.74	205.7	498.9	525.8	517.6	606.9	614.5
PFCs	166.8	270.8	166.8	211.3	189.6	201.1	209.4	1.5	2.4
SF_6	70.2	39.9	70.1	140.1	161.9	178.2	201.0	244.4	171.6
Total (including LULUCF)	**112,661**	**95,000**	**71,227**	**77,188**	**76,744**	**75,703**	**75,766**	**74,756**	**71,806**
Total (excluding LULUCF)	**115,397**	**99,210**	**79,845**	**78,016**	**81,233**	**79,904**	**80,382**	**78,865**	**75,944**

Table 3.2. Greenhouse gas emissions by gases

Source: National GHG Inventory, OMSZ, 2009

Besides reporting the actual GHG inventory data, the aim of this chapter is to provide a comprehensive account of Hungary's efforts to improve the quality of its reporting on GHG data. This includes information on the development of country-specific emission factors and changed and improved approaches to estimating emissions as well as on activities relating to Article 10 of the Kyoto Protocol

It is important to note that Hungary's base year is not 1990 but the averaged value for the years 1985, 1986 and 1987 and Hungary has chosen 1995 as its base year for HFCs, PFCs and SF6. Hungary's quantified emission reduction commitment is 94 per cent as included in Annex B to the Kyoto Protocol.

3.2. Descriptive summary

3.2.1. Greenhouse gas emissions in 2007

In 2007, the total emissions of greenhouse gases in Hungary were 75.9 million tons carbon dioxide equivalent (excluding the LULUCF sector). That number is 5 % below the 10 year average of the quite stable period 1996-2005 and by far the lowest value in the whole inventory period (followed by 2002 with 78.0 million tons). Taking into account also the mostly carbon absorbing processes in the LULUCF sector, the net emissions of Hungary were 71.8 million tons CO_2 eq. in 2007. This is the second lowest value in the whole time-series (1985-2007).

With less than 8 tons, the Hungarian per capita emissions are below the European average. By ratifying the Kyoto Protocol, Hungary committed to reducing its GHG emissions by 6%. Now, Hungary's emissions are 34% lower than in the base year (average of 1985-87). However, as it will be shown later, this significant reduction is mainly a consequence of the regime change in Hungary (1989-90).

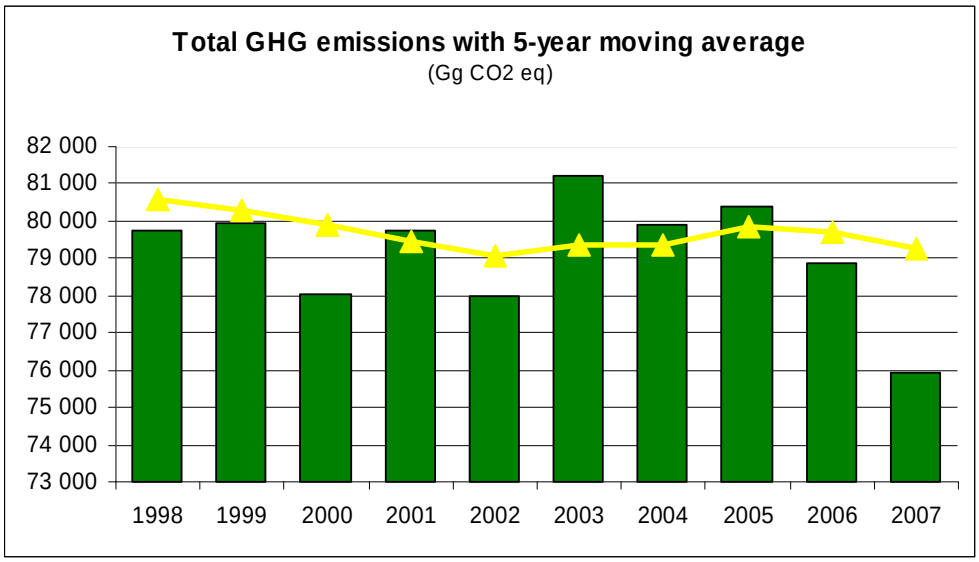

Figure 3.1. Total GHG emissions with 5 year moving average

Emissions (excluding LULUCF) decreased by almost 4% (-2.9 million tons) between 2006 and 2007 and by 6% between 2005 and 2007. The reduction between 2006 and 2007 is mainly due to processes in the energy sector (-2.3 million tons):

- Most importantly, the total fuel consumption in the residential sector decreased by 20% (including a 12% decrease in natural gas use) - mainly due to extreme mild winter in 2007 but probably the growing energy prices and the support for modernisation of buildings might have played a role as well.
- Fossil fuel needs of "other" manufacturing industries also decreased considerably which led to 4 percent lower emissions in this subcategory.
- In contrast with the above trends, the emissions from energy industries grew by 6% in line with the growing tendency of electricity generation.
- The growth in the transport sector slowed down: emissions grew only by 1% between 2006 and 2007 but by 5% between 2005 and 2007.

Emissions from industrial processes decreased by 8% (-0.5 million tons). This change is mainly due to the modernization of nitric acid production. Through putting the new acid plant into service in Nitrogénművek PLC which is the most up-to-date and high capacity plant in Europe, the company's N_2O emission volumes have considerably fallen back.

The carbon dioxide emissions account for 76% of the total GHG emissions. The main source of CO_2 emissions is the combustion of fossil fuels for energy purposes, including transport. CO_2 emissions have decreased by 32% since the middle of the 80s. Methane represents 11,3% in the GHG inventory. Methane is generated mainly in waste disposal sites and animal farms, but the fugitive emissions of natural gas are also an important source. CH_4 emissions are 28% lower than in the base year. Nitrous oxide contributes 11,7% to the total GHG emissions. Its main sources are agricultural soils, manure management and chemical industry. The N_2O emissions were halved in the years of political and economic changes. The total emissions of fluorinated gases amount to 0,8%. However, they are showing a growing tendency especially due to their applications in the cooling industry.

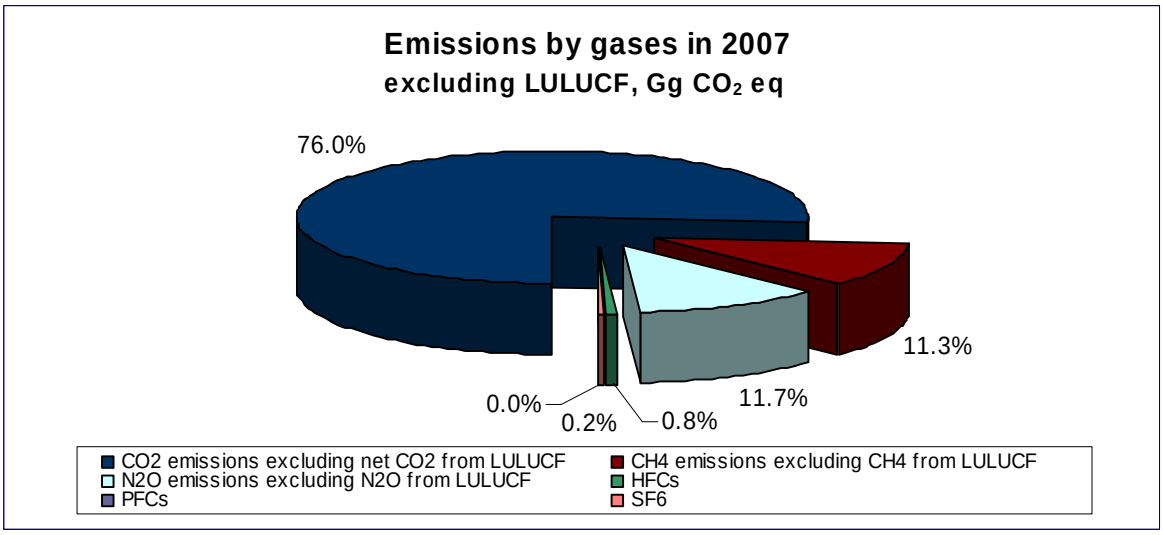

Figure 3.2. Emissions by gases in 2007

By far, the biggest emitting sector was the *Energy sector* contributing with 75% to the total GHG emission in 2007. Carbon dioxide from fossil fuels is the largest item among greenhouse gas emissions. Among fuels, gasous fuels have the highest share (44.7%), liquids have less and solids have the lowest but still representing 23.4% of the sectoral CO_2 emissions. The most important subsector is *Energy Industries* with a proportion of 36%, followed by *Other Sectors* and *Transport* representing 24 and 23% of the total emissions in this sector, respectively. Fugitive emissions from fuels play only a small role in emissions of the sector with 4%.

Agriculture was the second largest source of greenhouse gas emissions in Hungary (12.5%) in 2007. In this sector CH_4 and N_2O emissions are taken into account. 77 percent of the total N_2O emissions are generated in agriculture. *Agricultural Soils* represent the most important source of emission in this sector with 60% share followed by *Manure Management* (23%) and *Enteric Fermentation* (16%).

The *Industrial Processes* were the third largest sector contributing with 6,9% to total GHG emissions in 2007. The most important greenhouse gas was CO_2, contributing 67% to total sectoral GHG emissions, followed by N_2O with 17% and F-gases with 15%. The most important emission subcategories are mineral products and chemical industry representing 46% and 34% of the industrial processes' emissions, respectively.

The *Waste sector* represented 5,4% of total national GHG emissions. The largest category was *Solid Waste Disposal on Land*, representing 72% in 2007, followed by *Wastewater Handling* (18%) and *Waste Incineration* (10%).

The *LULUCF sector* is a net sink of carbon. In 2007, the net removal was -4.1 million tons CO_2. This result is determined largely by *Forest Land*.

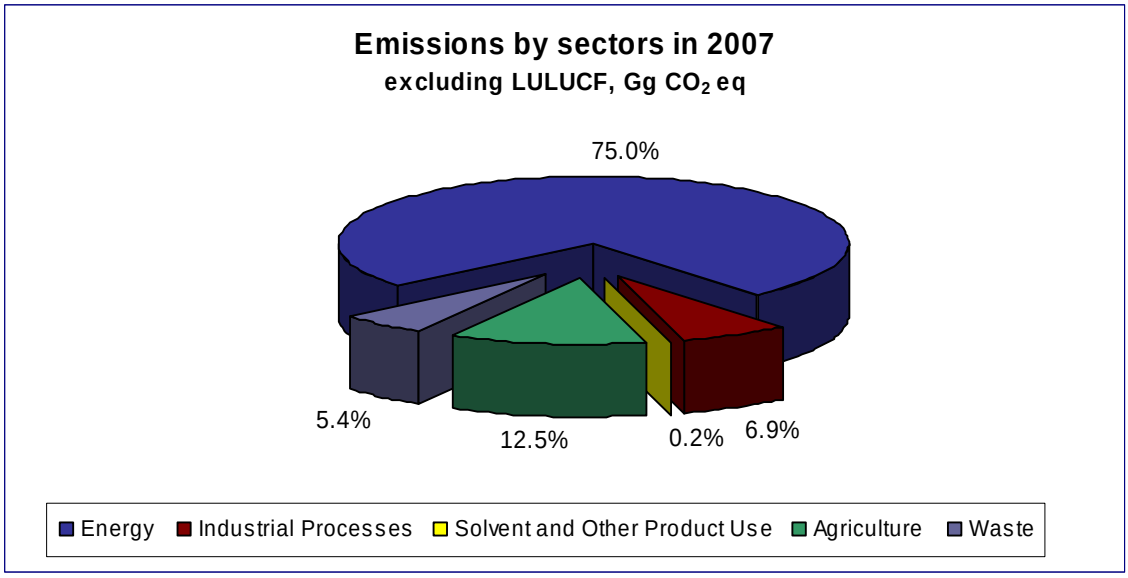

Figure 3.3. Emissions by sectors in 2007

3.2.2. Trends of emissions (1985-2007)

Compared to the base year, emissions were significantly reduced in the Energy, Agriculture, Industry and Solvent sectors. In contrast, the emissions in the Waste sector increased. In the Land Use, Land-Use Change and Forestry (LULUCF) sector removals (negative value) showed fluctuating behaviour.

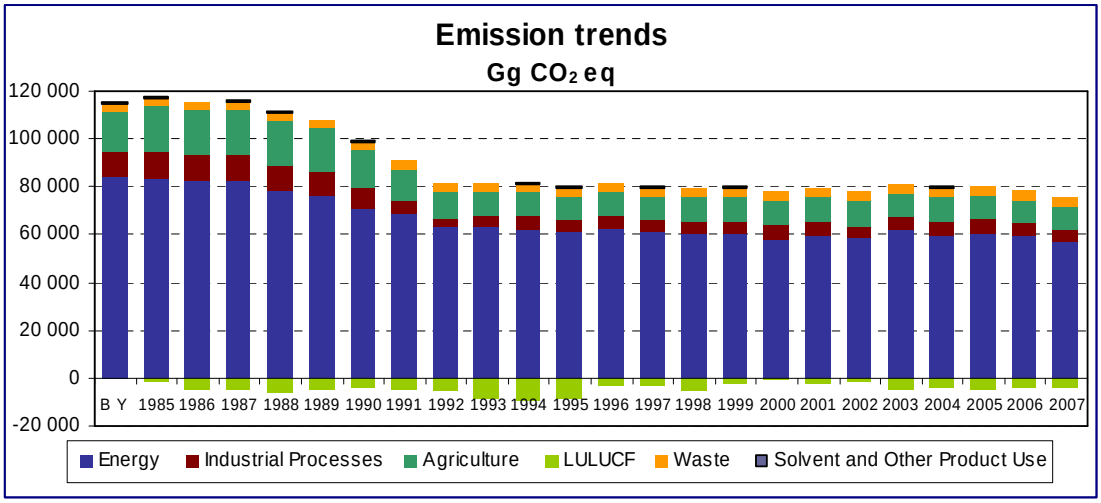

Figure 3.4. Emission trends in Hungary by sectors

To better understand the Hungarian emission trends, the time interval of the inventory should be split into two periods with different emissions corresponding to the economic processes in the background. The first one means the years following change of regime in Hungary (1985-95), whereas in the second period (1995-2007) the rules of the market economy became decisive. The second period can also be characterized by the decoupling of GDP growth from the GHG emission trend which is undoubtedly an important development.

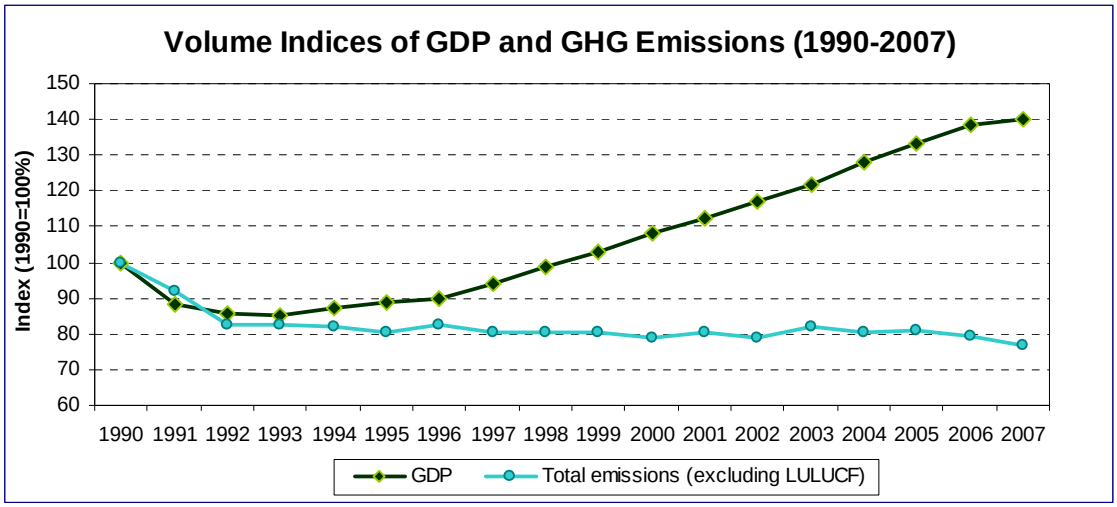

Figure 3.5. GDP and GHG trends of Hungary 1990-2007

The process of transition into market economy brought in its train radical and painful decline in the output of the national economy. The production decreased in almost every economic sector including also the GHG relevant sectors (energy, industry and agriculture). Consequently, GHG emissions decreased substantially in the first period by around 35 million tons CO_2 equivalent. Between the mid 80s and the mid 90s emissions fell back in the *Energy* sector by around 25% and even more, by around 50% in the *Industrial Processes* and *Agriculture* sectors.

The most significant drop in energy use occurred in the industry especially in energy-intensive industrial sectors (manufacture of basic metals and machinery, mining etc.). The industrial output of 1992 was two third of that of 1989. Several factories were closed down, capacity utilization was reduced, consequently the production decreased more or less drastically in each industrial sector.

- Cement production: two plants were closed;
- Iron and steel production: two out of three plants were provisionally closed down;
- Aluminium: two out of three plants were closed down in 1991 (aluminium production stopped in 2006 eventually);
- Ferroalloys: ceased to exist (1991);
- Ammonia: four out of five plants were closed down (1987, 1991, 1992 and 2002);
- Nitric acid: three out of four plants were closed down (1988, 1991 and 1995).

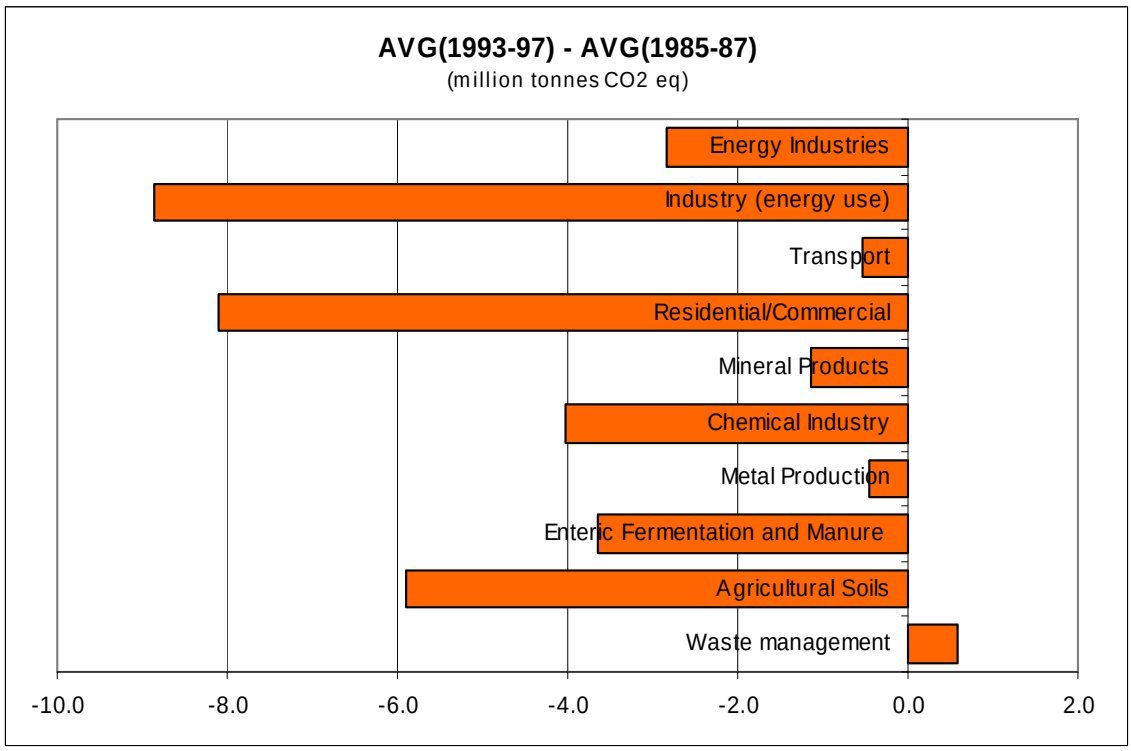

Figure 3.6. Changes of average emissions by sectors from the middle of '80s to the middle of '90s

The agricultural sector suffered a similar decline. As the result of the political and economic processes, the number of agricultural farms was reduced by more than 30%, the number of employees by more than 50%, the volume index of the gross agricultural production by more than 30% and the livestock by about 50%. As a consequence, the share of the agricultural sector in total GHG emissions decreased from 17% to 12%.

The small increase of emissions in the *Waste* sector is exceptional among all the sectors and it is attributable to the slightly increasing quantities of waste generated and collected but more importantly to the applied calculation method which assumes that the degradable organic component in waste decays slowly throughout a few decades.

After the mid 90s, emissions seem to have been stabilized around 79-80 million tons CO_2 equivalent. However, behind the quite stable emission level contradictory processes could be observed.

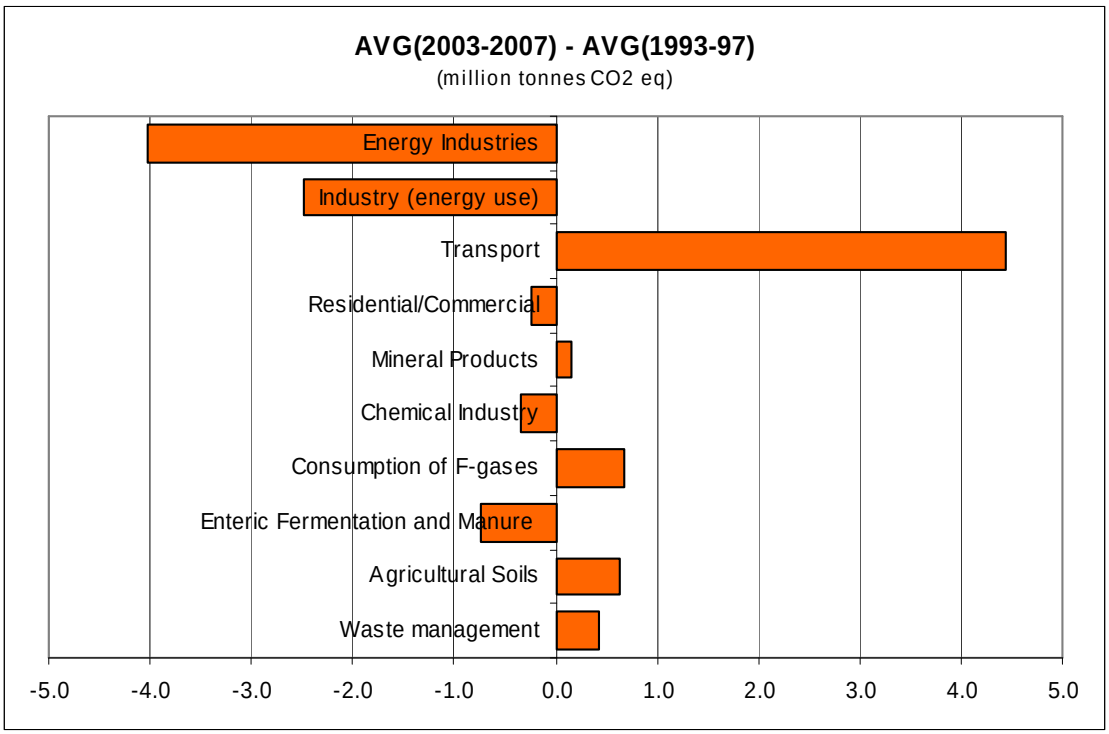

Figure 3.7. Changes of average emissions by sectors from the middle of '90s to the middle of present decade

The biggest changes occurred in the *Energy sector*. The fuel use of industry decreased further and has only a 15% share in CO_2 emissions. In contrast, emissions from transport increased significantly by more than 4 million tons CO_2 equivalent which represents a more than 60% growth.

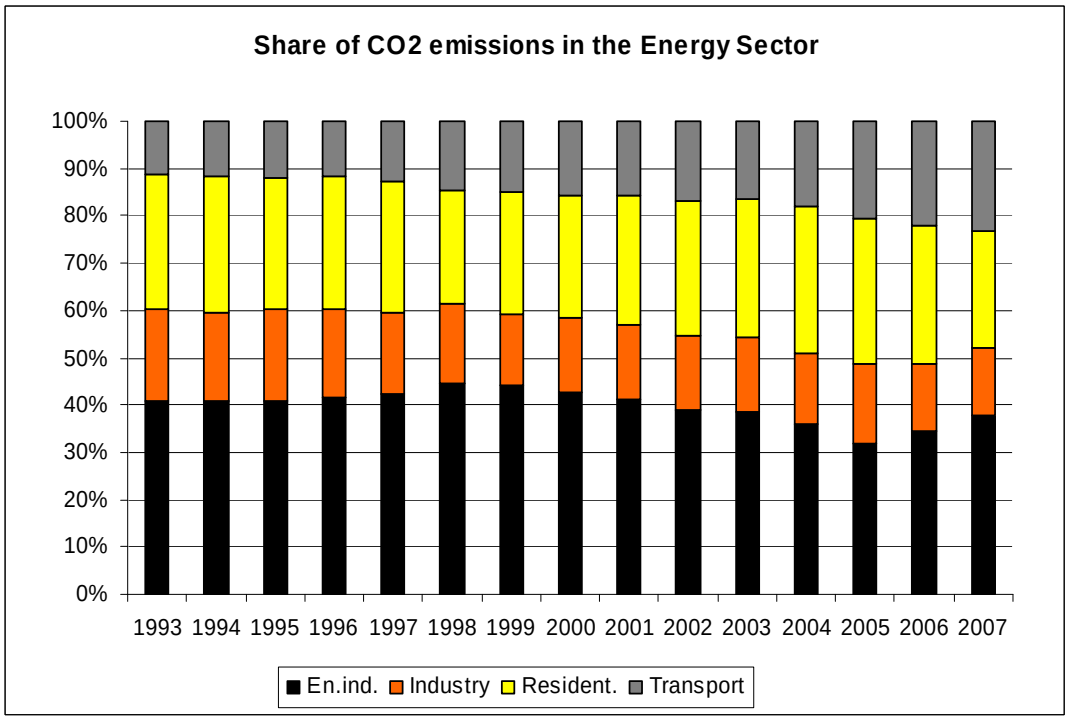

Figure 3.8. Trends of emissions by energy sectors from 1993 to 2007

The total fuel consumption in *Energy Industries* shows a slight decrease after the second peak in 1998, along with a strong fluctuation. Within this, the consumption of liquid and solid fuels has decreased significantly.

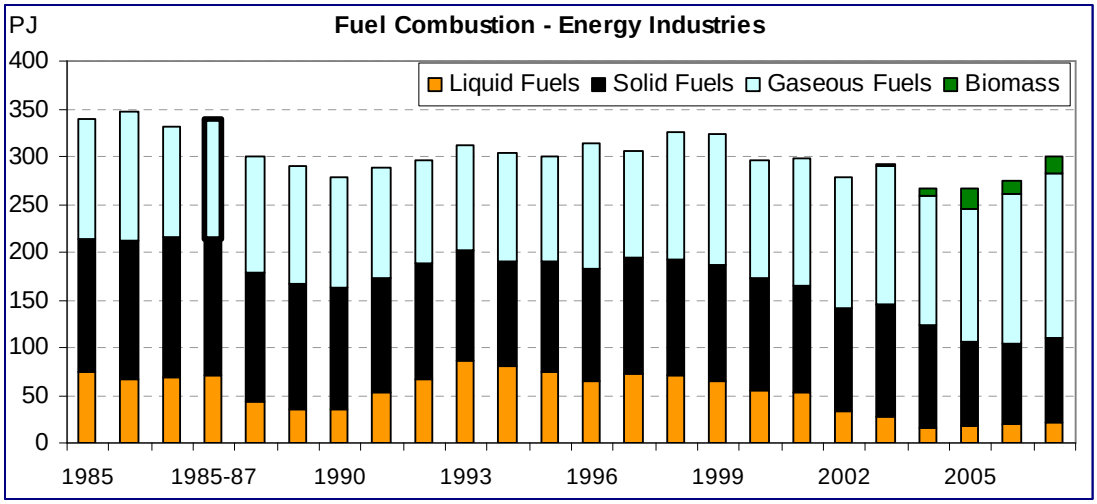

Figure 3.9. Trends of fuel consumption by fuel types from 1985 to 2007

An even more pronounced fuel switch could be observed in the residential/commercial sector. Solid fuels almost disappeared while the share of natural gas reached 85%.

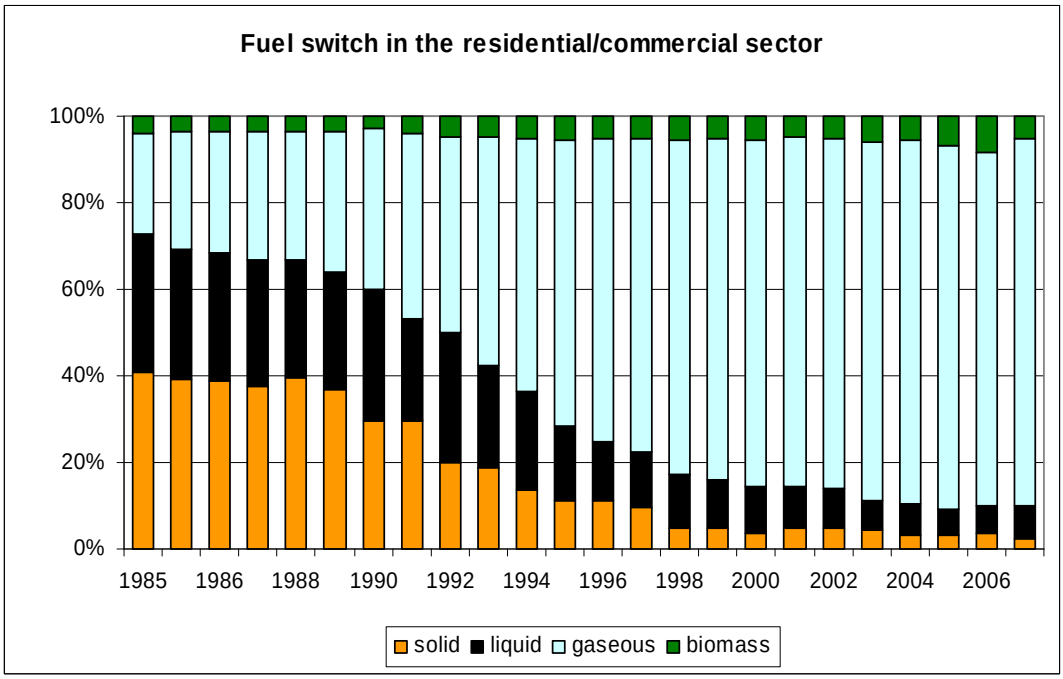

Figure 3.10. Switch in fuel types in the residential and commercial sector from 1985 to 2007

The following table illustrates the nature of the changes in the energy sector in the whole time-series of the inventory. To reduce the effect of the yearly fluctuations, 3 to 5 year averages have been compared. The table contains also the relative changes of energy use (Δ (TJ) and of emissions (Δ (Em)). The differences between the trends in energy use and CO_2 emissions cannot be emphasized enough.

	1985-87				1993-97				2003-2007	
	% (CO_2)	t CO_2 / TJ	Δ (TJ)	Δ (Em)	% (CO_2)	t CO_2 / TJ	Δ (TJ)	Δ (Em)	% (CO_2)	t CO_2 / TJ
En.industry.	34%	79	*-10%*	*-10%*	41%	79	*-6%*	*-15%*	36%	**72**
Industry	**25%**		*-38%*	*-44%*	19%		*-14%*	*-22%*	**15%**	
Residential	31%	**74**	*-17%*	*-32%*	28%	**61**	*10%*	*-1%*	29%	**54**
Transport	**10%**	71	*-9%*	*-10%*	**12%**	70	*63%*	*65%*	**20%**	71

Table 3.3. Relative change of energy use and emissions by sectors (average of years indicated)

In the *Industrial Processes* sector emissions from mineral products (cement and lime production) and chemical industry (ammonia and nitric acid production) were the most important. Two opposite effects could be observed also in this sector. Cement production increased by more than 20% which lead to more carbon-dioxide emissions. On the other hand, emissions from chemical industry decreased by 13% - partly due to changes of production but technological modernization played an important role as well.

Although emissions of F-gases represent only 1% of the total GHG emissions, their trend requires special attention. As these gases are harmless for the ozone layer, the use of HFCs in the refrigeration and air conditioning industry got widespread thus their emission increased tenfold. Most of PFCs were emitted during aluminium production that was stopped in 2006. SF_6 emissions primarily depend on their use in the power generation industry. The tendencies vary according to the manufacturing/application needs and show an increasing trend.

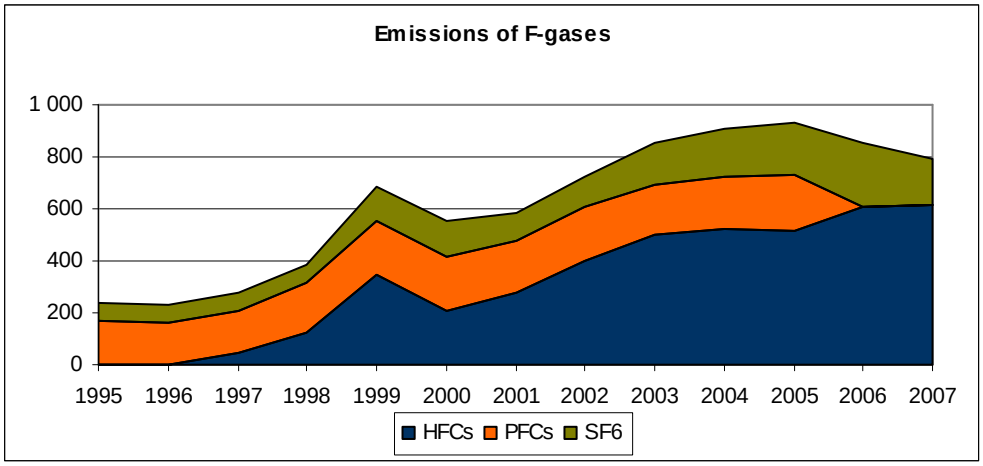

Figure 3.11. Trends of F-gas emissions

No significant trend could be shown in the total emissions of the *Agriculture sector* between 1995 and 2007. However, the relatively stable level of emissions is a result of compensatory processes. While the number of livestock decreased further, thus leading to lower emission, the use of fertilizers increased by about 60% which caused growing nitrous-oxide emissions from agricultural soils. The greenhouse gas emission of agricultural activities usually changes in accordance with the activity data. The level of production was essentially stagnating or slightly decreasing, particularly in animal production. The number of cattle and that of swine decreased by 25% and 20%, respectively, while the number of sheep increased by 30% in the last 12 years. In a few years (e.g. 2004, 2005), in some sectors of plant production (e.g. wheat and maize) the production increased due to the significantly high yield owing to the friendly weather conditions. Although

showing a growing tendency, fertiliser use of the Hungarian agriculture sector is still only slightly higher than half of the amount of that of the 80s.

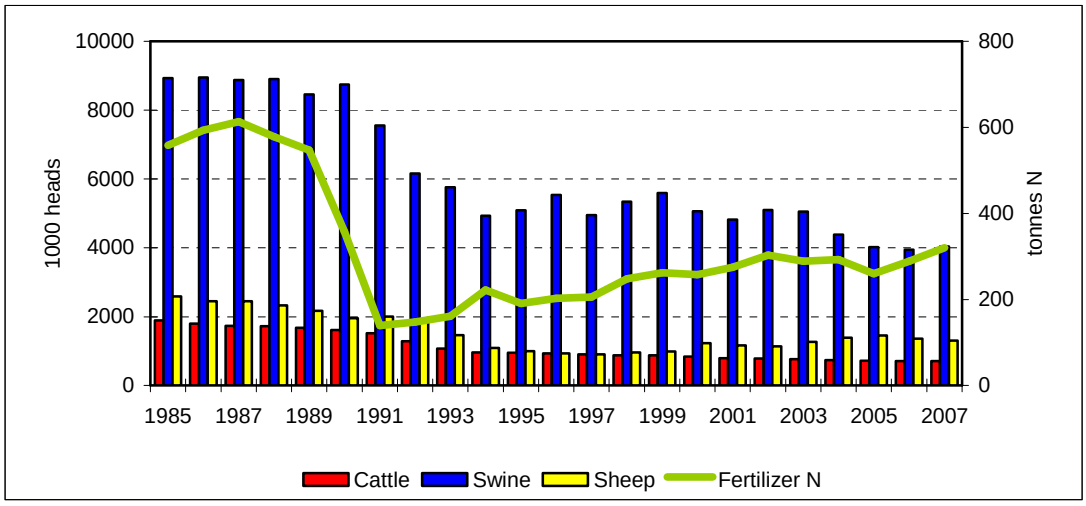

Figure 3.12. N-fertilizer usage and animal husbandry trends

The *Waste sector* represents 5.4% of total national GHG emissions. In contrast with other sectors, the emissions of waste sector showed significant increase (+35%). In the base year the total GHG emissions from the waste sector accounted for 2.6% of total national GHG emissions. However, the growth of emissions seems to be slowing or even stopping in recent years. In all the years, the largest category was Solid Waste Disposal on Land. In recent years, waste incineration gained importance while emissions from wastewater treatment decreased further.

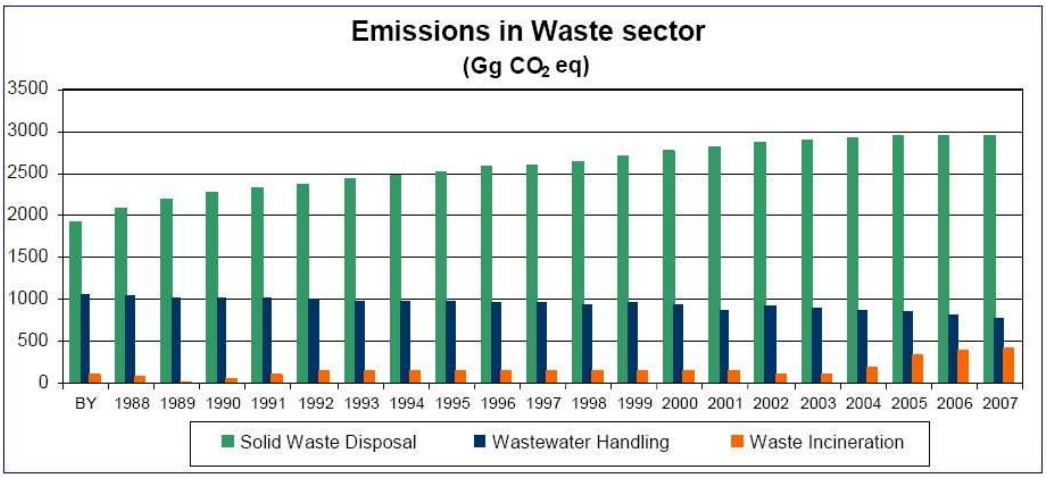

Figure 3.13. Emission trends in the waste sector

The *LULUCF sector* was a net sink of carbon in all the years. The result is determined largely by Forest Land, which is a major carbon sink. The cropland living biomass is a net sink of carbon in most years and a net source of emission in a few years due to reduction of orchard and vineyard areas. The soil disturbance generates steadily decreasing removals of CO_2, as a consequence of the reduction of agricultural land and the afforestation of croplands. The complex dynamics of the land use and land-use changes lead to a fluctuating trend in the LULUCF sector.

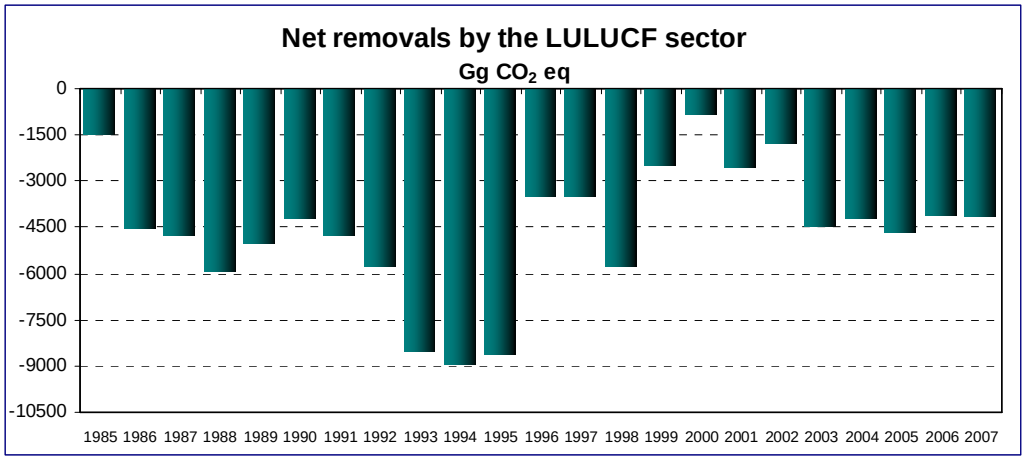

Figure 3.14. Net removals of greenhouse gases by the LULUCF sector

3.3. National systems in accordance with Article 5, paragraph 1, of the Kyoto Protocol

3.3.1 Background information to the Hungarian inventory

As the general method of preparing the inventory, the procedures described in the Revised 1996 IPCC Guidelines were used. The emissions of individual technologies were calculated using the Tier 1, Tier 2 or Tier 3 methods, attempting at the highest possible approximation except for cases where the required data were not available. Efforts have been and will be made to determine country-specific emission factors wherever possible. Key sources have been identified using both Tier 1 and Tier 2 methodology. The required uncertainty values were determined on the basis of the GPG but estimates of the data supplier institutions and experts were used as well. In order to identify the key categories, both the LEVEL and the TREND analysis were performed with and without LULUCF.

It can be generally stated that the most reliable data are those of CO_2 emissions and the least reliable ones are those of N_2O emissions. (Fluoride gases are irrelevant here because their contribution to the total emission in only 1.0%). The total uncertainty was determined which lead to the result of 8.0% of combined uncertainty as % of total national emissions (2007) and 2.3% uncertainty is introduced in the trend of emissions.

In early March 2007 the Expert Review Team of UNFCCC made a thorough in-depth in-country review. During this review a few potential problems were found. In collaboration between the ERT and the Hungarian experts, these problems could be fixed. However, some recalculations were necessary which led to changes also in the emissions of the base year and consequently in the assigned amount.

3.3.2. Institutional arrangements for GHG inventory development

Pursuant to the United Nations Framework Convention on Climate Change (UNFCCC), Hungary has been preparing annual inventories of greenhouse gas emissions using the IPCC methodology since 1994. The quality of the inventory is controlled by Hungarian and international experts regularly.

(a) Since the last National Communication, a number of institutional changes have occurred in the field of inventory preparation. In January 2006, the Ministry of Environment and Water took over the responsibility of GHG inventory compilation and also the staff from the National Directorate for Environment, Nature and Water. About a year later, the Hungarian Meteorological Service (OMSZ), a public law institution under the supervision of the Ministry of Environment and Water, started to participate in the process of the preparation of the inventory. From 2007 on, the GHG inventory has been compiled by the Hungarian Meteorological Service, based on a mandate of the Minister of Environment and Water.

The Minister for Environment and Water has overall responsibility for the Hungarian Greenhouse Gas Inventory and the Hungarian National System for Climate Reporting. The Minister is responsible for the institutional, legal and procedural arrangements for the national system and the strategic development of the national inventory. Therefore the designated *single national entity* is the Ministry of Environment and Water. Within the ministry, the Climate Policy Unit (formerly Climate Change and Energy Department) administers this responsibility by supervising the national system.

The above was confirmed also in July 2009 in an official letter of the NFP for the UNFCCC, dr. Tibor Faragó, as well. He stated that all the GHG inventory related tasks both in the context of the Convention and its Kyoto Protocol will be supervised and fulfilled by the Climate Policy Unit in close cooperation with a unit established at the OMSZ dedicated just to this very task. The GHG focal point on Mr. Faragó's behalf in the ministry is Ms. Mónika Gottfried, NFP/GHG and at the implementation level the key responsible person remains Mr. Gábor Kis-Kovács, GHG Inventory Focal Point. The contact information is the following:

- Ms. Mónika Gottfried, NFP/GHG, Hungary, Ministry of Environment and Water (Környezetvédelmi és Vízügyi Minisztérium), Fő utca 44-50 / H-1011 Budapest, Hungary, gottfried@mail.kvvm.hu
- Dr/Ms. Erika Hasznos, director, Climate Policy Unit, Ministry of Environment and Water (Környezetvédelmi és Vízügyi Minisztérium), Fő utca 44-50 / H-1011 Budapest, Hungary, hasznose@mail.kvvm.hu
- Mr. Gábor Kis-Kovács, GHG Inventory Focal Point, Hungarian Meteorological Service (OMSZ), GHG Division, Kitaibel Pál utca 1 / H-1024 Budapest, Hungary, kiskovacs.g@met.hu

(b) At the end of 2006, a Greenhouse Gas Inventory Division (GHG division) was established in the Hungarian Meteorological Service (OMSZ) for the preparation and development of the inventory. This division is responsible for all inventory related tasks, prepares the greenhouse gas inventories and other reports with the involvement of external institutions and experts on a contractual base and supervises the maintenance of the system. The GHG division can be regarded as a core expert team of four people. The division of tasks and sectoral responsibilities within the team are laid down in the QA/QC plan and other official documents of OMSZ. The Head of Division coordinates the teamwork and organizes the cooperation with other institutions involved in inventory preparations. He is responsible for the compilation of CRF tables and NIR. Within the team there are coordinators of the different sectors and also a QA/QC coordinator and an archive manager were nominated.

Some parts of the inventory (mainly energy, industrial processes and waste) are prepared by the experts of the GHG division themselves; the calculations of other sectors are made by external experts / institutions on contractual basis as follows. The agriculture sector of the inventory has been prepared by the Research Institute for Animal Breeding and Nutrition for several years. This institute collects the data, chooses the calculation method, prepares the inventory in CRF format and sends it to the inventory compiler in xml format. There is a new partner for the forestry part of the LULUCF sector, the Forestry Directorate of the Central Agricultural Office. From now on, this institute is responsible for data collection, inventory preparation. However, in this inventory cycle the former contributor, an internationally recognized expert in this field, has been heavily involved in inventory preparation by permanent consultancy and quality control of the results. For the calculation of soil C stock changes Karcag Research Institute of University of Debrecen (Department of Soil Utilization and Rural Development) was contracted. The following table summarizes the institutional arrangements:

Function	*Institution*	*Responsibilities*
Single national entity	Ministry of Environment and Water	• Supervision of national system • UNFCCC National Focal Point • Official consideration and approval of inventory
Inventory coordination and compilation	OMSZ GHG division	• Provision of work plan • Contracting consultants • Inventory preparation of Energy, Industry and Waste sector • Completion of CRF and NIR • Archiving • Coordinating QA/QC activities

		• Reporting to UNFCCC secretariat
Inventory preparation of Forestry	Central Agricultural Office (Forestry Directorate) Contracted consultant	• Data collection, choice of methods and EFs, inventory preparation
Inventory preparation of Agriculture sector	Research Institute for Animal Breeding and Nutrition	• Data collection, choice of method, emission calculation • Inventory preparation
Inventory preparation of Soil C stock changes	Karcag Research Institute of University of Debrecen	• Data collection, choice of methods and EFs, inventory preparation

Table 3.4. Functions, institutions and responsibilities in the inventory in Hungary

(c) The annual inventory cycle is carried out in accordance with the principles and procedures set out in the IPCC (1996) Guidelines and the IPCC Good Practice Guidance.
Data collection happens in several ways and throughout the whole yearly cycle of the inventory preparation. Sector specialists of the core team (or external experts on contractual basis) are making the data inquiry and collection. Data are collected from the emitter if it is possible (especially in case of power stations, heating stations and industrial technologies) but statistical databases are also heavily used as source of information. The most important statistical publications are the Statistical Yearbook of Hungary, the Environmental Statistical Yearbook of Hungary and the Environmental Report of Hungary published by the Hungarian Central Statistical Office (KSH) and the Energy Statistical Yearbook published by the Energy Efficiency, Environment and Energy Information Agency. Since the use of ETS data has several advantages, the inventory team was granted access to the verified emissions database held by the National Inspectorate for Environment, Nature and Water. In addition to statistical data, contacts were established with the representatives of a number of major emitting sectors. Moreover, information from the web sites of international associations (e.g., International Iron and Steel Institute, IISI) is used as well. For the calculation of fluoride gas emissions, import data from the Customs Office and Police were used together with data obtained directly from companies importing and using fluorinated gases and information from cooling industry associations.

The Act LX of 2007 on the implementation framework of the UN Framework Convention on Climate Change and the Kyoto Protocol thereof aims to give direct data collection authorization to the Ministry for Environment and Water in order to collect data for the national system for climate reporting and gives a permanent status to the system. Relevant paragraphs for data collection are the following: "The state authorities having disposal of the data necessary to operate the National Registration System and the organisations emitting at least 100 tons of carbon dioxide equivalent per year shall provide these data for the National Registration System in accordance with the provisions of a separate legal instrument." "The data (...) necessary to fulfil international data supply shall be provided for the National Registration System irrespective of the fact that they are qualified as individual data pursuant to the relevant provision of Act XLVI of 1993 on statistics." The draft of the above-mentioned separate legal instrument, a government decree on the implementing rules of compulsory data provision for GHG inventory and forecasting purposes, is in the final conciliation phase.

As a general method of preparing the inventory, the procedures described in the IPCC Guidelines are applied and the latest CRF Reporter programme is used. Usually, the sectoral experts are responsible for the choice of methods and emission factors. According to the recommendations of the IPCC Guidelines, the calculation methods are chosen by taking into account the technologies available in Hungary whenever possible. The calculation of emissions occurs basically by using the formula: AD x EF, where the activity data (AD) can be raw material or product or energy use etc. Part of the available data (e.g. production data) can

directly be entered into the IPCC tables; others require previous processing and conversion. The default emission factors (EF) are being gradually replaced by country-specific emission factors characteristic of domestic technologies. Efforts are made to use the highest possible Tier method, especially in case of key categories. After preliminary quality control of the basic data, the necessary calculations are carried out with the coordination of the core team. The sectoral data are compiled and - after repeated checks - unified by using the CRF Reporter programme.

(d) The key source categories are determined using both Tier 1 and Tier 2 methodology provided in the GPG. In order to identify the key categories, both the LEVEL and the TREND analysis are performed with and without LULUCF.

(e) Recalculations can be justified by several reasons. Just to name a few, QA/QC procedures, ERT recommendations, changing for higher Tier methodologies can lead to a recalculation. As a basic rule, whenever new information emerges that improves the quality or accuracy of the emission data, the emissions are recalculated. Recalculations are always documented in the relevant chapter of the national inventory report.

(f) The national system has to ensure the high quality of the inventory, i.e. to ensure that the inventory is transparent, consistent, comparable, complete and accurate. These principles guide the internal expert team that maintains the system. QA/QC activities are performed in two levels: based on the ISO 9001 standards and following the IPCC recommendations.

The Hungarian Meteorological Service introduced the quality management system ISO 9001:2000 in 2002 for the whole range of its activities which was quite unique among meteorological services. However, GHG inventory preparation was not among its activities in that time. Therefore, the scope of the ISO accreditation had to be modified and lots of efforts have been made to bring also the national system under the umbrella of the ISO QM system. Several regulatory ISO documents were created, among others: ISO procedure on the activities of the GHG Division; QA/QC plan; Register of used data, data sources and calculation methods; Record of data changes; Register of recalculations; Record of data quality check; In 2009 a new ISO document was introduced to enable the documentation of sector specific quality checks. This document includes a compulsory check list, summary of results of checks, suggestions for corrective actions similarly to the example given in Annex 6A of the 2006 Guidelines. The basic document is the Procedure on the activities of the GHG Division. It contains the basic principles of the inventory preparation and reporting processes, prescribes the obligation of making a QA/QC plan and regulates the documentation and archiving activities. The QA/QC plan, which is an audited ISO document, consists of the following elements:

- Specification of the sectoral responsibilities of the core team;
- Nomination of an officer responsible for the QA/QC system: the QA/QC coordinator;
- Documentation. All data, data sources and calculation methods need to be documented by the sectoral experts of the core team filling in an ISO form. Based on this documentation, sectoral reports are to be written about the status of the sector and possible future improvements;
- Data quality check. Besides self-checking, the entries of data providers and external experts are checked regularly which is an interactive process during the whole inventory cycle. Significant changes compared to previous data shall be explained;
- Reviews. OMSZ passed an in-depth ISO audit end of January 2009. Beside that, the planned external QA audits are part of the QA/QC plan. The recommendations of the latest centralised review by the expert review team of the UNFCCC will be taken into consideration as much as

possible.

- Development plan. Based on the outcome of all reviews and own experience, a development plan is made in order to further improve the system.
- R+D projects. The Hungarian Meteorological Service funds research and development projects for the improvement of the inventory whenever possible. (For example in 2009, the Institute of Geodesy, Cartography and Remote Sensing (FÖMI) was involved to improve the land-use area system to be able to apply the Approach2 method in the future.)
- Incorporation of ETS data in broader extent for revision of the used EFs and for better sectoral allocation of emissions
- Training plan.

Having an ISO system in place has an advantage of being subject to regular internal and external audits. During the last external audit, activities of the GHG Division were audited as well. The system was audited favourably in the end of March 2007; and the ISO certification has been renewed in January 2009. Therefore we can claim that the GHG inventory is subject to ISO 9001:2008.

Besides ISO, other QA/QC activities are carried out, as well. For every sector of the inventory, there is a responsible person within the core team of OMSZ. These sectoral responsibilities are laid down in the yearly QA/QC plan. Especially in case of external experts, this responsible member of the team conducts several quality checks on the provided calculations. Moreover, this exercise can be regarded as an interactive process throughout the whole inventory cycle, since the used methodologies, early results are discussed during the process of the emission/removal calculations. This QC procedure also led to a few recalculations. Many elements of the general Tier1 QC procedure are applied. The used parameters and factors, the consistency of data are checked regularly. Completeness checks are undertaken, new and previous estimates are compared every time. Data entry into the database is checked many times by a second person. If possible, activity data from different data sources are compared and thus verified. Several data suppliers made declarations as regards quality assurance systems in place during the collection of the data. Nevertheless, the work continues to refine the used QA/QC procedures and implement further elements.

(g) As described above, the GHG Division at the Hungarian Meteorological Service compiles the GHG inventory. In other words, the compiler institute makes a recommendation of the content of the inventory to the Minister of Environment and Water. Official submission can only be made after ministerial approval of the recommended inventory. The government decree on the implementing rules of compulsory data provision for GHG inventory, which is now in the final conciliation phase, will regulate the process of approval as well.

3.4. Information on the national registry

The registry administrator designated by Hungary to maintain the national registry is the National Inspectorate for Environment, Nature and Water (OKTVF).

Contact details of the registry administrators:

Name:	Ms. Katalin Bajsz
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Address:	Mészáros utca 58/a

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Tel.: +36 12 24 9196
Fax: +36 12 24 9298
E-mail: bajsz@mail.kvvm.hu

Name: Ms. Katalin Kőbányai
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Fax: +36 12 24 9298
E-mail: kobanyai@mail.kvvm.hu

The Hungarian National Registry is a standalone registry; it is not operated together in a consolidated manner with the registries of other Parties.

The software that serves as the basis for the national registry is the Community Registry (CR) software developed by the European Commission. The software uses a relational database system with a dedicated data model for supporting registry operations. The data model is designed to be in compliance with all relevant UNFCCC and EU regulations. The servers running the registry application and the database are maintained by the IT department of the Ministry for Environment and Water. According to the calculated estimation of the annual growth of the database, the server capacity is well over the requirement. Operational experience shows that the supporting environment of the registry meets the performance and capacity requirements.

The registry software has been developed for the Kyoto Protocol and EU Emission Trading Scheme. These require Member States' registries to be compliant with the United Nations Data Exchange Standards (UN DES) specified for the Kyoto Protocol and EU Commission Regulation 2216/2004/EC specified for the EU ETS. The Hungarian registry was tested successfully by the UNFCCC and the European Commission prior to going live with the ITL and the CITL.. As part of the development, the registry has developed functionalities for issuance, conversion, external transfer, internal transfer, (voluntary) cancellation, retirement and reconciliation processes suing XML messages and web services as specified in UN DES document.

The Hungarian National Registry fulfils all required processes to minimise discrepancies in issuance, transactions, cancellation and retirement of ERUs, CERs, AAUs or RMUs. Each transaction is carried out according to the UN DES to minimise the risk of inconsistent data in the Hungarian National Registry and the independent transaction log (ITL) and EU supplementary transaction log (CITL). The transaction is not finalised until the transaction is registered on both registry servers. The transaction is cancelled if the ITL or CITL sends an error code. The Registry Administrator has to contact the Central Administrator at the ITL or the CITL for instructions if the registry fails to terminate the transaction. Manual corrections in the registry may be performed by the Registry Administrator.

The security measures are detailed in the Hungarian National Emission Trading Registry System Procedures documentation in Section 5 (Security plan). Security measures are divided into physical and logical security.
Physical security covers access to premises, alarm systems, fire / intruder detection and personnel screening. Logical security covers definition of personnel responsibility, user authentication and network security.
According to European Commission regulation 2216/2004/EC (registry regulation) username and passwords are the only required level for secure log-in. Currently the built-in security module of the registry software is used, which conforms to the above rules. Database manipulations are only carried out by the designated

module of the registry software which processes user requests initiated on the user interface. Probability of operator (user) errors are reduced by the implementation of data validation on the user interface

The list of information made publicly available at the user interface of the national registry is in-line with the requirements laid down in part E of the annex to13/CMP.1, paragraphs 44 to 48. The publication of holding and transaction information is regulated by EU legislation (information is made publicly available on the 5th year following the year of the transaction). Until the publication date holding and transaction information is deemed confidential.

Publicly available information is to be found at http://www.hunetr.hu :

- up-to-date information for each account in the registry (https://www.hunetr.hu/crweb/reportAccountsList.do)
- JI project information, for each project identifier against which ERUs have been issued (https://www.hunetr.hu//crweb/reportProjectList.do)
- legal entities authorized to hold ERUs, CERs, AAUs and/or RMUs on their accounts (http://www.hunetr.hu/Modules/Main/unit_holding_permissions.pdf)

As part of the Hungarian National Emission Trading Registry System Procedures documentation, a Disaster Recovery Plan (DRP) has been developed in accordance with the provisions DES 9.2.2.

The DRP sets the responsibilities and the response times of personnel in the event of a disaster. Depending on the severity of the disaster, the recovery can take place at the primary or the secondary hosting site.
After the restoration of hardware, network and software elements, the restoration of data is initiated from the hourly transaction backups and the daily database backups, or in their absence, from the monthly database backups.
Monthly database backups are minimally maintained until the end of the third Commitment Period after the applicable Commitment Period of the associated units.

Before going online with the ITL, the registry software is tested in a number of ways. The most important are the internal functionality test, the UNFCCC DES Annex H test and the CITL test. The DES Annex H test mainly aims to ensure the conformity to the DES.
Any change to the national registry is carried out according to Section 8 (Procedures for change management) of the Hungarian National Emission Trading Registry System Procedures documentation. The change management procedures define the cases when the above tests have to be re-performed.

4. Policies And Measures, Including Those In Accordance With Article 2 Of The Kyoto Protocol And Domestic And Regional Programmes And/Or Legislative Arrangements As Well As Enforcement And Administrative Procedures

4.1. Policy-Making Process

There is an emerging consensus in Hungary that the climate change mitigation and the associated shift towards a more climate-friendly and sustainable development will also contribute to the improvement of economic competitiveness. CO_2 emission reductions may generate other positive additional benefits, e.g., airborne emissions may be reduced, which make the economy "cleaner". The mitigation of emissions and the adaptation may create new jobs in the environmental industry, energy industry, agriculture, transport sector, construction industry etc.
The effective emission mitigation could be achieved by increasing the efficiency of the existing technologies because the various sectors still have significant emission mitigation potentials (e.g., increasing the energy-efficiency of buildings; reducing the carbon-intensity of transport). According to the National Climate Change Strategy, the following factors may interfere with the PaM's cost-efficiency and thus should be taken into consideration:

- factors (e.g., energy safety) that cannot be quantified on the level of direct costs and benefits, but can be rather regarded as factors of strategic importance that determine the direct costs and benefits;
- current solutions require long-term thinking because the technological and infrastructural solutions providing the basis for the individual solutions can only be implemented in a longer run and, in case of appropriate planning, they may be coupled with the otherwise due renovations of the existing technologies and infrastructure;
- attention should be paid to sustainability in a wider sense; therefore, measures that have harmful long-term effects on the sustainability of the environmental and socio-economic processes should be avoided.

There are many opportunities for greenhouse gas emission mitigation in the complex multi-sectoral programmes by integrating climate change mitigation requirements.
In the following sub chapter the most important cross sectoral programmes and cross-cutting policies are summarized.

4.1.1. National Climate Change Strategy

The National Climate Change Strategy (NCCS) was prepared pursuant to §3 of Act No. LX/2007 (V. 28.) on the framework for the implementation of the UN Framework Convention on Climate Change and of the Kyoto Protocol thereof. In accordance with the national commitments, the Climate Change Strategy had to be elaborated for the first time for the period 2008-2025. The objectives of the National Climate Change Strategy shall be implemented by National Climate Change Programmes to be prepared on a biannual basis. The NCCS is also adjusted to the National Sustainable Development Strategy adopted by the Government by Govt. Decree No. 1054/2007 (VII. 9.). The NCCS identifies three major directions of action for the long term climate change policy:

- it foresees measures in compliance with the EU and international requirements in order to reduce the emissions of climate change gases and to prevent the increase thereof. The reduction of greenhouse

gas emissions should be achieved by reducing the overall energy use in a manner that enables a shift in production and consumption structures towards lower material and energy needs,

- it includes the key elements of the fight against the unfavourable ecological and socio-economic effects of the inevitable climate change and of the improvement of the adaptability to the consequences of the climate change; and
- the raising of social awareness of the climate change and the strengthening of climate awareness.

The NCCS is an explicitly inter-sectoral and all-social framework system and affects all economic sectors and all social groups. Therefore, the relevant strategic objectives and tasks should be integrated into the activities of all sectors (and ministries). The main structure of the NCCS is as follows:

1. Frameworks for the elaboration of the strategy
   - How did the climate change in the past?
   - Is it certain that these changes are caused by humans?
   - How may the climate change in the future?
2. Mitigation of the climate change
   - Should emissions be mitigated?
   - Are we taking action in time?
3. Adaptation to the changing climate
   - Should we adapt to the climate change?
   - Government tasks and social tasks

The NCCS applies to the period 2008-2025 and identifies the tasks in accordance with the international obligations. Government reviews will take place two years after adopting the NCCS and every five years thereafter. In order to implement the NCCS, the Government will adopt a National Climate Change Programme (NCCP) for a two-year period.

Presently the NCCS does not set quantified emission reduction goals, but defines conditional objectives. Based on unilateral commitment of the EU for 20% emission reductions Hungary would commit to reduce her emissions with 16-25% compared to the 1990 levels. If a global common commitment would be agreed upon by the Parties, then the EU would expectedly commit to reduce its emissions with 30%, in this case Hungary would oblige to a 27-34% reduction target.

4.1.2. Green Investment Scheme in Hungary

One of the most important financing tools of the implementation of NCCP is the Green Investment Scheme. The Green Investment Scheme's (GIS) financial background is provided from the sales of AAUs. These resources will be primarily used by the households in the framework of programmes and investments aiming at increasing the energy efficiency of existing buildings. During its operation between 2008 and 2012, the GIS framework will dispose of an estimated annual income of up to HUF 7.5 billion. The allowances allocated against payment under the international Emission Trading system may generate additional income in an estimated amount of HUF 3.3 to 3.7 billion. An estimated impact of the GIS could be quantified in energy savings of up to HUF 30 billion value per year due to the reduction in energy consumption.

Presently the 10/2009. (VII. 17.) KvVM decree regulates the operation of the Scheme. From the revenue streams generated under EU ETS or IET presently the energetic modernisation of industrialised houses is supported, further incentives are planned and under negotiation between the Government and the

stakeholders. The present investment subsidy encompasses a broad range of investments from thermal insulation and aperture modernisation to passive solar energy utilisation and switch to renewable energy sources in the industrialised housing sector.

4.1.3. National Energy Strategy

4.1.3.1 First pillar of National Energy Strategy: National Energy Efficiency Action Plan

The government of Hungary submitted its first National Energy Efficiency Action Plan (NEEAP) of Hungary to the European Commission in July 2007. The NEEAP was developed within the framework of Hungary's energy policy for the period 2007-2020. The NEEAP spans from 2007 to 2013, in consistency with the New Hungary Development Plan (NHDP).

The NEEAP describes a number of national energy-saving programmes and measures. In addition, it provides an estimation of the savings that can be achieved by 2013 by maintaining these programmes in operation during the period 2007-2013:

- Energy saving credit fund (EHA): 6-6.5 PJ/year
- Energy efficiency Credit Construction co-financed by PHARE: 5-5.5 PJ/year
- The energy saving support and credit programme "For a successful Hungary" for the residential sector: 3-3.3 PJ/year
- Development of an environmentally friendly power management under the Environment and Infrastructure Operational Programme (EIOP): 11 PJ/year
- Supporting the energy-saving modernisation and renewal of the residential buildings (panel programme): 1-2 PJ/year
- UNDP/GEF energy efficiency programme: No figures are given
- Energy certificate (currently being implemented): 2-3 PJ/year

The NEEAP estimates that the energy savings induced by those programmes listed above that were running between 2002 and 2006 amounted to 17.67 PJ/year by the year 2006. In addition, the NEEAP estimates that in the period 2002-2006 about HUF 40.2 billion were awarded in the form of state aid grants and approximately HUF 22 billion were granted as soft loans.
The NEEAP does not contain an estimation of the indicative energy savings target for Hungary requested by the EU directive 2006/32/EC.

4.1.3.2 Second pillar of National Energy Strategy: RES policy

The share of RES in total primary energy consumption was 4.87% in 2007. Biomass is the main RES source representing more than 89% of RES primary consumption, followed by geothermal (8.2%) and Hydropower (1.7%)
The Hungarian Renewable Energy Strategy (2007-2020) approved by the Parliament in April 2008 set the target for RES at 13-15% in the POLICY and at 11-13% in the BAU scenario. There is no national target/commitment for RES heating and cooling (RES-H&C). The 3.6% RES-electricity target has already been met. Hungary's RES-electricity share amounted 2.24% in 2004, 4.6 % in 2005, 3.7% in 2006, 4.3% in 2007. A new legal framework was approved in 2007 on the Feed-in-Tariff. Some of the issues that the new legal framework contains are:

- Feed-in-tariffs for Renewables and Waste (only for the licensed period and amount).

- Certificates of origin for RES-electricity.

Hungarian Energy Office sets the amount of RES-electricity that can be sold with a feed-in tariff. Period and amount depend on the return period of the investment. The Electricity Act gives the Government the right to define a start date for a green certificate system, coupled with the closing down of the domestic feed-in tariff system. The Environment and Energy Operational Programme (EEOP) also promotes incentives to RES technologies. Supported projects are biomass, biogas, geothermal and small scale wind turbines.

4.1.4. Policymaking in afforestation

In Hungary, the two ministries responsible for developing and implementing forest policies related to climate change are the Ministry of Environment and Water and the Ministry of Agriculture and Rural Development. Development of afforestation policy and regulations is subject to negotiations between land owners, forestry companies and civil organizations. In the future, attention has to be paid to couple carbon sequestration capacity of forests as a direct value to the level of forest stands where management decisions are usually made. An important obstacle of development has been the lack of clearly set priorities for forest management both at national and regional level, thus, it seems to remain a key issue. In order to optimize forest management for carbon sequestration information flow to and among forestry staff, including forestry authorities, as well as guidance from policy makers have to be improved.

Aimed at the promotion of discussion on the relevant climate change related issues, a stakeholder consultation process was initiated in 2008 by the Forest Research Institute. This consultation attracted many interested parties and yielded a fruitful cooperation.

4.2. Domestic And Regional Programmes And/Or Legislative Arrangements As Well As Enforcement And Administrative Procedures, Intersectoral Policies and Measures

4.2.1. New Hungary Development Plan

Target and main objectives

In the framework of the New Hungary Development Plan (NHDP) approximately HUF 7000 billion may be spent on Hungary's development between 2007 and 2013 with the utilisation of the EU Structural Funds. The specific goals of the Plan are to be achieved through 14 operational programmes. Many of the Operational Programmes include elements that affect and assist GHG emission mitigation activities:

The intervention of priority axis 2 of the Economy and Development Operational programme (EDOP) on the „Technological modernisation of the enterprises" - in order to support sustainable development as horizontal principle – encourages the spread of such environment-friendly, low-waste, energy and material saving production technologies, that apart from the primary objective of competitiveness improvement can also contribute to lowering pressure on the environment. Among EDOP's horizontal objectives the development of the harmonic, sustainable development of the environment, society and economy is of primary importance.

- Improving urban and agglomeration public transport is among the Traffic Development Operational Programme's (TDOP) priority axes. The objective is to establish a public transport which offers a real alternative to individual transport and is economically and environmentally sustainable.
- As declared in the basic document of the programme itself, the Social Renewal Operational Programme (SROP) can promote sustainability by creating the chances for a change in the approach. The training

and projects implemented in the framework of SROP must contribute to learning that is conducive to sustainable development.

- The objectives of the Environment and Energy Operational Programme's (EEOP) developments are to reduce the environmental problems of the country, improving the quality of life of society and to assist the Hungarian economy to adapt to environmental practices. The following priority axes of EEOP are directly or indirectly related to GHG emission mitigation:
    - Expanding the use of renewable energy sources .
    - Efficient use of energy.
    - Promotion of sustainable production and consumption patterns.

For the EEOP priorities in the 2007-2008 action plans, the targeted support was 23,5 billion HUF, while in 2008 for the actually opened calls for applications 16 billion HUF was allocated. (The "Large and medium size bioethanol plants support" and "Sustainable Energy Financing Programme" were not opened for application.)

EEOP applications financed in 2008	Applications submitted			Applications approved	
	Number	Subsidy demanded (HUF)	Total investment costs	Number	Subsidy allocated (HUF)
4.1 Heat and/or electricity production from renewable energy sources	82	6 639 592 898	16 482 860 289	14	1 282 183 886
5.1 Efficient energy utilisation	76	3 180 121 548	7 788 799 386	13	502 912 946
5.2 Third party financing	50	377 003 737	3 098 415 916	45	309 055 285
Total	208	10 196 718 183	27 370 075 591	72	2 094 152 117

Table 4.1. EEOP applications financed and approved

Source: Ministry of Transport, Telecommunication and Energy, 2009

According to the expectations of the government, the above-mentioned subsidies of the New Hungary Development Plan (NHDP) will result in a 3% improvement. Hungary's government has so far disbursed HUF 219 billion (EUR 743.25million) in European Union funding as part of its 2007-2013 New Hungary Development Plan, until March 2009.

4.2.2. New Hungary Rural Development Plan

Target and main objectives

The National Rural Development Plan[2] (NRDP) was developed in order to identify priorities for the utilisation of support provided by the European Agricultural Orientation and Guarantee Fund. It has set the strategy for 2004-2006, including specific objectives of the improvement of the quality of the environment and increase of forest cover thus improving the ecological conditions.

In conformity with 1698/2005/EC and 2006/144/EC a new development plan was worked out for 2007-2013. The so called New Hungary Rural Development Strategic Plan (NHRSP) for the first time in strategic documents establishes the fact of climate change and sets targets to mitigate this process. The NHRSP is in many aspects related to GHG mitigation, but two objectives are especially important to mention:

- As a general objective mitigation of climate change explicitly appears in the programme. The tools for addressing the problem are the increase of energy plantations and energy forests.
- Besides the sustainable management of forests, the increase of forestation is among the important specific objectives.

4.2.3. The Renewable Energy Strategy 2008-2020

The fundamental guideline of the renewable area was approved by the Government in autumn 2008.

The primary goal of the strategy is to provide a conceptual framework for the increased use of the renewable energy sources in Hungary, to contribute to the dissemination of the renewable technologies and their application, to improve the efficiency of these technologies, as well as to promote their social level acknowledgement and popularization, primarily based on market tools and competition. The aim of this Strategy is to set ambitious but realistic targets for renewable energy use in Hungary for the 2007-2020 period, in line with the European Union's Climate Change and Energy "Package".

The Government Programme 2006-2010 "New Hungary: Liberty and Solidarity" regards the issues related to energy policy as a priority area. Within the scope of energy policy special emphasize is put on the renewable energy, besides the issues of safe energy supply and market liberalization. Approval of the Renewable Energy Strategy may contribute to the achievement of the goals established in the Government Programme.

The Strategy on Renewable Energy identifies general national goals for Hungary. The Strategy also determines the detailed national objectives with regard to electricity, cooling and heating, as well as biofuels.

[2] The NRDP also contains the objectives and measures of National Agro-Environmental Programme (Govt. Decree 2253/1999 (X.7.))

General target and objectives are presented in 4.1.3.2.

Targeted effects for the two scenarios (With Existing Measures, With Additional Measures) based on the objectives of the Renewable Energy strategy are expressed in aggregate emission savings in CO_2 equivalents. Quantified effects are presented in Table 4.2.

Targets WEM (Base)		2005*	2010	2015	2020
Power	ktCO2	1676	3694	5518	7028
Heat	ktCO2	1631	2263	2533	2955
Biofuel	ktCO2	15	753	1172	1408
Total	ktCO2	3322	6710	9223	11391
Targets WAM (Policy)		2005*	2010	2015	2020
Power	ktCO2	1676	3741	6428	8807
Heat	ktCO2	1631	2884	4079	5008
Biofuel	ktCO2	15	753	1172	1408
Total	ktCO2	3322	7378	11679	15223

Table. 4.2. Estimated effects of RES policy in emissions mitigation in WEM and WAM scenarios

* achieved targets, emission abatement impacts are only quantified in CO_2 equivalents.

4.2.4. 2nd National Environmental Protection Programme - Action Programme of Climate Change

Target and objectives

The 2nd National Environmental Programme (NEP-II) approved by the Hungarian Parliament in its Resolution 132/2003. (XII.11. OGY), is still in force. The programme also defines the environmental policy objectives for 2003-2008. Important elements of implementation include Action Programmes in areas requiring special treatment, identifying the specific and operational objectives, funds and responsible parties in the fields of environmental protection and nature conservation, as well as complex fields of water management. The main objectives of the Action Programme of Climate Change in the framework of NEP-II are as follows:

- Promoting the reduction of atmospheric emissions from energy management activities
  - Modernization of energy production, conversion and transportation
  - Improvement of the energy conservation and energy efficiency of the consumers
- Development and dissemination of technologies related to the utilization of renewable energy sources (to subsidize investments)
  - Application of alternative fuels
  - Utilization of landfill gas
  - Other biomass utilization, replacement of gas fuel used currently for local goals with local biomass and development of simultaneous heating systems

  - Application of solar, wind and geothermal energy
  - Price preference for electricity generated from renewable energy sources
- Reduction of pollution emission from transport
  - Accelerating the modernization rate of the vehicle stock
  - Moderation of the environmental impact of freight transportation: supporting the propagation of environmentally friendly transportation methods, shifting freight transportation from trucks to railway
  - Support for environmentally sustainable means of transport
- Reduction of greenhouse gases from agriculture and waste by strengthening carbon dioxide sink capacities
  - Reduction of methane emission from livestock and cultivation
  - Support for cultivation aimed at power generation and binding potential increase
- Stratospheric ozone depletion and prevention of atmospheric acidification
  - Reduction of gas emissions depleting the stratospheric ozone layer, compliance with relevant international conventions
  - Prevention of atmospheric acid deposition
  - Launching a halon treatment programme
- Research-development, horizontal measures
  - Research and development on climate change (research on direct and indirect impacts of air pollution, climate change, on their abatement, impacts and harm reduction)
  - Attitude forming, information dissemination (tasks in relation to technological switchover, consumption habits) training courses
  - Awareness-raising aimed at the development of information systems

4.2.5. Act on general rules of the protection of the Environment

The Act on the Environment Protection (LIII/ 1995) provides a legal framework for the policies and measures of climate change.

4.2.6. Act on Electricity

The Act of Electric Energy (the Act CX of 2001, "VET") was reworked and reissued in 2007, in the Act LXXXVI of 2007. The Act regulates and supports a broad range of relevant, GHG mitigation measures, among others the support of renewable energy, CHP is supported with the aid of feed-in tariff and takeover obligation. The Act, which entered into force in 1st of January 2008, consists of the following sub-acts:

- The implementing decree, the 273/2007. (X.19.) Government Decree
- The system fees regulation in the Ministerial decree 119/2007. (XII. 29.) of GKM
- The financial and technical regulation of grid connection in the Ministerial decree 117/2007. (XII. 29.) of GKM
- The price regulation on the uniform service provided on the electricity market, in the Ministerial decree 115/2007. (XII.29.) of GKM

Besides regulating many aspects of the liberalised market the Act further enhances and refines conditions of obligatory takeover and pricing for electricity from renewable energy sources and CHP sources, while maintaining the important capstones of the previous Act.

The most important new elements of the Act are the guarantee of grid access to any consumer, the free choice of power suppliers for consumers, the declination of price regulation, the introduction of universal service, which is regulated by the Hungarian Energy Office, the contracting obligation for the consumers on grid connection, grid use and power purchase.

Changes in the VET compared to the earlier state include the followings: free selection of service providers, detailed breakdown of costs on consumer invoices, other consumer protection measures, (socially handicapped) consumers to be protected, security of supply, complaint management and debt management.

4.2.7. Act on Gas Supply

The Act on Gas Supply (Act XL of 2008) inter alia regulates the access to the gas network and sets the framework for a liberalised market according to the EU requirements. The Act enables free selection of gas providers and partially liberalises market prices for the consumers. The Act also defines the framework for the so called universal service to protect individual consumers.

Support of biogas production

As a result of the amendment of the Act on Natural Gas of 2005[3] the legal obstacle hampering the feed of purified biogas and biomass gases into the natural gas network was abolished, although the actual use requires further, detailed, legislative regulations.
Wider penetration of biomethane is set back by the fact that the current retail price of the natural gas is still much lower than that in Western-Europe, therefore biomass based biomethane production in agricultural plants is currently not economical. In line with the reducing scale of operation, production costs are increasing so it is mainly biomethane coming from bulk production that can be the alternative of the natural gas. Primary materials from agricultural and food industry are available for the production of biomethane, in an appropriate regulatory environment at least 1% of the Hungarian natural gas consumption could be dischargeable[4].
Biogas can be applied in modern block-heating power plants with the purpose of heat and electricity production (cogeneration). 20-30% of the heat generated is required for heating the fermentors, while the remaining heat energy can be used for heating stables, buildings, greenhouses, dryers and for cooling livestock husbandry plants in summer. Through the distance heating network heating of buildings located far from the plant can also be solved. A biogas plant can meet the hot water and stream requirements of food industry plants.

4.2.8. The Energy Centre

[3] Act No LXIII of 2005 amending act No XLII of 2003 on natural gas.

[4] Calculation made with the biomethane production of 20 biogas plants with the capacity of 8 million m^3/year.

The Energy Centre, or by its longer name "Energy Efficiency, Environment and Energy Information Agency" is supervised by the Ministry of Transport, Telecommunication and Energy and is the national energy agency responsible for the improvement of energy efficiency and renewable energy utilization.
The Centre is active in managing subsidy and loan programmes for energy efficiency and renewables, prepares energy efficiency statistics and government strategies related to energy efficiency, but is also active in the field of training, providing information, technical assistance and knowledge transfer on energy efficiency and renewables.

4.3. Policies And Measures And Their Effects

4.3.1. Policies and measures in the energy sector

4.3.1.1 General background

Taking into consideration Hungary's import dependency, energy efficiency is an important principle of the energy strategy. The importance of energy efficiency is highlighted by those external and internal challenges faced by Hungary similarly to other EU Member States:

- dependence on external energy continues to increase;
- the purchase of fossil fuels is getting more difficult , the risk of shortages will increase;
- the global trend of energy prices' increase continues in the long term as well;
- environmental protection requirements get stricter and stricter;
- enforcement of Hungary's interests needs to be ensured in the field of energy within the country, as well as internationally.

4.3.1.2. The Hungarian Energy Efficiency Strategy and Action Plan

The key principles of the new Hungarian energy policy adopted by the Parliament on 14 April 2008 for the period 2008-2020 are the *security of supply*, *competitiveness* and *sustainability*. These principles highlight the need to increase energy savings and energy efficiency. The most important development in this area is the approval of the Hungarian Energy Efficiency Strategy and Action Plan (2019/2008 (II. 23.) Govt. decree) by the Hungarian Government in February 2008.

Energy efficiency is one of the priorities in the EU Energy Policy. The European Parliament and Council Directive 2006/32/EC sets an obligation for the Member States to save 1% energy per year for 9 years between 2008 and 2016 in the non EU-ETS sectors; the "Energy Package" of January 2007 raised this obligation to 20% by 2020. (The 1% is calculated on the basis of the ultimate energy consumption of the country, which is not subject to the CO_2 trade, instead of the national energy consumption). Both the EU Energy Efficiency Action Plan and the conclusion of the European Council in March 2007 confirmed that by 2020 20% energy must be saved relative to the current energy consumption of the EU. The above Directive also sets an obligation to the EU Member States to prepare a national energy efficiency action plan by 30 June 2007.
The Strategic Energy Review process will include the directive for 20% reduction of energy use until 2020; presently this is not yet in force.

The 1% energy savings per year corresponds to 6.38 PJ/year reduction in the annual energy demand, indicating the tense EU requirement in comparison with the results of the previous period and the fact that

the activities related to energy efficiency must be made more effective and that the required state support must be provided.

Besides the security of supply and liberalisation, the energy policy also stresses the need for energy efficiency. The approval of the National Energy Efficiency Action Plan may also contribute to the achievement of the targets defined in the government programme.

The action plan outlines those energy efficiency measures which are either already in progress or are just planned. If they are applied with the required efficiency, Hungary's energy consumption may be reduced by 1% per year during the 9 years between 2008 and 2016. In order to meet this objective, Hungary needs to achieve 15,955 GWh/year (57.4 PJ/year) energy saving within the final energy consumption of 2016. This objective – after rounding – corresponds to an annual energy saving of 1,773 GWh (6.4 PJ/year). For Hungary, fulfilment of this objective requires a qualitative change in the field of energy saving activities compared to earlier periods, a substantially more effective approach backed by significantly greater financial and social support. This is emphasised by the fact that the energy saving activities conducted in Hungary since 1990 as supported by the government and promoted in other forms resulted in the reduction of the annual energy consumption by approximately 15-16 PJ in total up until 2007 (i.e., 1 PJ each year) compared to 1990.

In order to achieve the objectives, the approved action plan designates the following major fields and partial areas for intervention:

- residential buildings,
- institutional buildings,
- energy transformation,
- traffic, transport,
- architecture (new buildings),
- typical energy consuming product groups that may have a more significant influence on the volume of energy needs.

In line with Directive 2006/32/EC, the Action Plan relates to the 9-year period between 2008 and 2016. In order to continue the tasks and to achieve the 20% energy saving required by 2020, further review will be needed subject to the new financial opportunities under the EU budget after 2013.

The detailed target system of the action plan

The primary goal of the action plan is to achieve the highest savings in the final energy consumption through the effective use of the available resources. Apart from this direct objective, the indirect objective of the planned measures is to start a change in the people's attitude making them aware of the real value of energy thus indirectly also supporting the achievement of the environmental protection and climate protection goals.
The following table contains the annually aggregated energy consumption figures for Hungary.

	2002	2003	2004	2005	2006	
	Total	Total	Total	Total	Total	Average of 5 years
	GWh	GWh	GWh	GWh	GWh	GWh
Total final energy consumption	197,019	203,662	201,628	207,813	213,756	204,776
Consumption subject to emission trade	28,800	27,296	27,972	26,368	27,062	27,500

Consumption volume covered by the directive	168,219	176,366	173,656	181,446	186,695	177,276
Households	70,733	78,752	72,011	73,262	75,725	74,097
Communal sector	36,981	37,474	37,927	40,061	39,804	38,449
Industry without CO_2 trade	13,422	13,091	13,352	12,399	12,778	13,008
Transportation	39,458	39,844	43,103	48,499	51,4745	44,476
Agriculture	7,624	7,204	7,262	7,224	6,914	7,246

Table 4.3. Aggregated annual energy consumption figures
Source: Energy Centre Ltd.

Under the ESD Directive Hungary must reduce its final energy consumption by 15,955 GWh/year (57.4 PJ/year) by 2016. This objective reflects 1,773 GWh (5.38 PJ) energy savings each year. Hungary's final consumption covered by the ESD (5 years' average) is 177,276 GWh (638.2 PJ).

This objective of the national energy efficiency strategy involves on average 1,773 GWh (6.4 PJ) savings in energy carriers each year, representing in total 15,955 GWh –t (57.4 PJ) between 2008-2016.

The following table illustrates the savings objectives and the 'optimistic' and pessimistic' extreme results that may be achieved with the individual measures:

Total (annual aggregate) national energy savings target planned until 2016		15,955 GWh (57.4 PJ)
Total (annual aggregate) national energy savings interim target planned until 2010		2,600 GWh (9.4 PJ)
Energy efficiency programmes and other measures	Annual energy savings until 2010 [GWh/year]	Annual energy savings until 2015-2020 [GWh/year]
Measures in the household sector	250	1,125
Support to the energy efficient modernisation of residential buildings constructed with industrial technology	167-222	750-1,000
'For a Successful Hungary' household energy efficiency support and credit programme (NEP application system)	83	375
Use of individual measurements and mini heating centres in district heat supply	83	375
Development of the operation of the energy efficiency consultation network	28-83	125-375
Regular review of household boilers	28-56	125-250
Labelling of household boilers and air conditioning equipment	17-28	75-125
Labelling of household electrical and gas boilers for energy efficiency purposes	17-28	75-125
Support for the purchase of highly energy efficient 'A' labelled household fridges and highly energy efficient 'A' labelled household freezers and other domestic appliances, in exchange of the old appliance	28-44	125-200
Increase in the dissemination of energy efficient lighting equipment (compact light tubes)	39-78	175-350

Elaboration of energy efficiency training materials for primary and secondary education	`6-28	25-125
Measures in the tertiary sector		
Municipality training, awareness-raising, consultation based on the experiences of the UNDP/GEF municipality energy efficiency programme	56	250
Third party financing - EEOP 5.2 instrument	489	1750
Promotion of reduction of energy consumption in the Regional Operational Programmes	28-39	125-175
Promotion of ESCO type investments	28-139	125-625
Elaboration and application of energy efficiency guidelines related to public procurement	278	1250
Elaboration of minimum energy efficiency requirements for office equipment	56	250
Measures in the industrial sector		
Continuation of the Energy Efficiency Loan Fund with the integration of the PHARE loan instrument	306-361	1.375-1.625
EIOP 2006-1.7 environmentally friendly energy management	83	375
Refurbishment of the district heat supply systems, making district heat supply more competitive	56-167	250-750
'Efficient energy consumption instrument' in the Environment and Energy Operational Programme	417-500	1.875-2.250
Mandatory employment of an energy manager at large energy consumers	111-222	1.875-2.250
Mandatory energy consumption report of large consumers	56-111	250-500
Voluntary agreements (audit, energy efficiency)	66-83	250-375
Reduction of transformer losses on the electricity network	66-83	575-725
Measures in the transportation sector		
Maintenance and expansion of the toll to be paid by heavy road vehicles	194-278	875-1.250
P+R system for energy efficient personal transportation	`6-56	25-250
Horizontal and inter-sectoral measures		
Awareness-raising – training of special consumer groups	11	50

Table 4.4. Energy savings from sectoral measures (GWh/year)
Source: GKM, 2008

The detailed description will be provided in the sectoral measures presentation in the following chapters.

The following table summarises the sectoral emissions savings estimated from the governmental goals of energy savings for the purposes WEM and WAM scenario:

CO2 emissions savings (Mtons)	WEM 2010	WEM 2015	WEM 2020	WAM 2010	WAM 2015	WAM 2020
Measures in the household sector	0.297	1.194	1.343	0.383	1.577	2.274
Measures in the tertiary sector	0.375	1.337	1.504	0.424	1.533	2.21
Measures in the industrial sector	0.502	1.987	2.236	0.693	2.771	3.996
Measures in the transportation sector	0.08	0.321	0.361	0.134	0.535	0.771
Horizontal and inter-sectoral measures	0.004	0.018	0.02	0.004	0.018	0.026
Total	**1.258**	**4.857**	**5.464**	**1.638**	**6.434**	**9.277**

Table 4.5. Estimated sectoral emissions abated in CO_2 equivalent in the WEM and WAM scenarios

4.3.1.3. Support of energy production from CHP

The 389/2007 Govt. Decree regulates the relevant aspects of obligatory takeover of electricity produced from renewable energy sources and CHP sources.

Description and objectives

The updated Act on Electricity, in its implementing provisions further regulates the CHP related supporting measures. The Act states that there is an obligation of takeover for electricity produced from renewable energy sources, waste incineration and CHP generation, but the producer has to choose the obligatory takeover system (e.g. a co-firing CHP plant can either take part in the CHP or the renewable energy sources takeover, but can not participate in both frameworks).

The price and quantity of electricity taken over under the stipulations of the Act is defined by the Hungarian Energy Office based on indicators like the share of renewable energy sources in TPES and economic factors in order to improve competitiveness and mitigate GHG emissions.
The regulative implementation was brought about by the 389/2007 Govt. Decree. The implementing decree considers several factors in setting takeover price, including the efficiency of the primary resources, the burdens on consumers and the technology's effect on the balanced operation of the power system. The Decree is foreseen to change in 2011.

The obligatory takeover is guaranteed by the Decree if the heat generated is sold for district heating purposes or institutions, generally the maximum capacity can not be larger than 190 MW_e (defined ranges are of 20-50-150-190MW_e with other constraints, different prices are defined for each case). The amount of electricity is limited in percentage of the heat sold in peak, valley and deep valley periods by the installed capacities of the CHP plant.

4.3.1.4. Energy savings on the electricity transmission network

Any energy savings achievable this way is considered a security reserve in case the measures contained in the proposals cannot be fully implemented.

	Reduction of transformer losses on the electricity network
Description:	Replacement of older models with state of the art transformers enabling smaller losses on the high and middle voltage network in order to reduce transformer losses.
Implementing entities	Ministry of Economy and Transport
Type of policy	voluntary agreements, financial measures with non-repayable support (system operation) (4.2) and (3.1)
Status of implementation	Adopted, implemented
Effect	20-25 GWh/year at the level of end-users, representing 64-81 GWh savings based on the efficiency of the electricity system (0.23-0.29 PJ/year). Estimated emission savings are included in Table 4.5. and detailed in Annex 3.

	Use of the heat loss of transformers
Description:	Use of transformer heat loss for heating buildings. The waste heat generated in transformer processes is currently not used. The waste heat may be used as heating energy.
Implementing entities	Ministry of Economy and Transport
Type of policy	voluntary agreements, financial measures with non-repayable support (industrial organisations of energy intensive sectors) (4.2) and (3.1)
Status of implementation	Adopted, implemented
Monitoring indicators	Number of voluntary agreements, energy saved in total
Effect	14-19 GWh/year (0.05-0.07 PJ/year). Estimated emission savings are included in Table 4.5. and detailed in Annex 3.

4.3.1.5. Measures for District Heating

Use of individual measurements and mini heating centres in district heat supply

	Use of individual measurements and mini heating centres in district heat supply
Description:	Under Act XVIII of 2005 on district heat supply the quantity of heat may also be measured at the final heat consumption site, not only aggregately. The quantity of consumed district heat may also be measured in each home. The plan is to improve the currently general aggregate heat measurement system and introduce the control of the heating system and the consumed quantity of heat in each home. Apart from the considerable energy savings, in this system the expenses of the consumers will be proportionate to the service.
Implementing entities	Ministry of Transport, Energy and Telecommunication Ministry of Local Government and Regional Development Hungarian Development Bank
Type of policy	Financial measure (non-repayable support and/or loan with preferential interest rate)
Status of implementation	Adopted
Effect	42 GWh/year (0.15 PJ/year). Estimated emission savings impacts are included in Table 4.5. and detailed in Annex 3.

4.3.1.6. Paks NPP enlargement and power rating upgrade

Description
The Paks NPP lifetime extension was approved by the Hungarian Parliament in 2005. The National Atomic Energy Agency published its revision of the process in June, 2009, which includes minor technical issues.
The Agency issued the permit for the power upgrade of the 2nd block of the NPP, with a nominal capacity of 500MW_e. Block 1 and Block 4 has received permits of power upgrade in 2008 September and 2007 September respectively.
Block 2 received the upgrades and refurbishments necessary in 2008, as approved by the NAEA, the operational tests did not indicate any malfunction or deviation from normal operational conditions.
Block 3 is expected to receive the capacity upgrade by the end of 2009.

Type of policy: Technical development

Status: Implemented

Implementing entities: Paks NPP, National Atomic Energy Agency

Temporal effect: 2024-2034, depending on the official issuance of the lifetime extension permit

Effected emissions: CO_2

Effect: Depending on the future capacity mix, the estimated abated emission increase is 6-10 Mt of CO_2 equivalent (mean estimate of power production is approximately 14 TWh_e/a). This effect is in the range of the Hungarian forests carbon sink effect. The effect of the Paks NPP lifetime extension is included in the model calculations.

4.3.1.7. Paks Nuclear Plant New Blocks Planned

Description
In the 25/2009 IV.2. Parliamentary Decree the Hungarian Parliament decided in accordance with the 7th paragraph of Act CXVI of 1996 on Nuclear Energy on the theoretical support of installation of new blocks in the Paks NPP. That is in accordance with the National Energy Strategy which states that the NPP enlargement has to be examined and assessed.
The Decree states that the following factors have to be examined:
environmental effects, the consumption demand after 2025 considering the energy efficiency goals set by the Government and the more extensive utilisation of renewables;
the neighbouring energy markets expected capacities, the sales options, the border-crossing capacities and the inland grid capacity;
the controlling, reserve and network development needs on the system level necessary for the new power plant.

The acceptance of the Decree does not involve automatically that the capacity enlargement will be implemented.

Type of policy: Technical measure, capacity enlargement

Implementing entity: Hungarian Power Companies, National Atomic Energy Agency, Government

Effects: The effect of the Paks NPP capacity enlargement is included in the model calculations, based on the MAVIR 2007 information, with the constraint that maximum 40% nuclear electricity was assumed within the total electricity generation.

4.3.1.8. EU ETS

Description of the period 2008-2012
The EU Emission Trading scheme (EU ETS) was launched in 2005, as it was described in the previous Biannual Report of Hungary. The EU ETS covers carbon dioxide emissions from power and heating plants, oil refineries, installations that produce and process iron, steel, glass and glass fibre, lime, cement and ceramics, as well as installations that produce paper and pulp. Most of the emission allowances allocated during the period 2008-2012 are free in accordance with established criteria. The legal framework of the scheme is described in the Act XV. of 2005 and its implementing decree, the 213/2006. (X. 27.) Govt. Decree. Additional legal background is laid down in the Act LX. of 2007. The current National Allocation Plan for the period 2008-2012 and operative framework is defined in the 13/2008. (I. 30.) Govt. Decree.

The existing installations in Hungary have been allocated approximately 26.1 million tons of CO_2 emission allowances in average per year between 2008 and 2012.
In addition to that there is a reserve for new entrants that amounts to 13.1 million tons of carbon dioxide for the entire period.
The existing installations in the sector of electricity and district heating have no free allocation of emission allowances, while the industry received cost-free allocations according to fixed criteria.

New entrant reserve distribution by years:	
2008	12%
2009	16%
2010	20%
2011	24%
2012	28%
Total	100%

Table 4.6. New entrant reserve distribution

12,209,588	I/a. Electricity production (with JI project reserve to be subtracted)
216,466	From this: JI project reserve to be subtracted
1,518,933	I/b. Communal and public district heating
3,197,705	I/c. Autoproduction for self consumption and industrial heat
310,680	I/d. Sugar sector combustion installations
204,696	I/e. Gas transport and storage
5,122	I/f. Biofuel production
1,282,403	II. Oil-refining
98,707	III. Coke production
1,568,984	IV-V. Iron ore roasting and sintering, steel industry
2,125,516	VI/a. Cement industry
429,401	VI/b. Lime production
306,952	VII. Glass industry
67,996	VIII/a. Production of ceramic products
669,560	VIII/b. Brick production
170,231	IX-X. Cellulose, paper and pulp production
24,166,474	Existing installations total
2,193,902	2. new entrant annual average reserve
507,480	3. JI project reserve that can be added to total
548,476	4. Allowances not subject to free of charge allocation
26,908,852	5. Total without added JI project reserve

Table 4.7. Allowances allocated by sectors, total quantity to be allocated to existing installations free of charge (in tCO_2)

Source: Hungarian National Allocation Plan, 13/2008. (I. 30.) Governmental Decree

Expected developments after 2012

It is expected that the Community-wide quantity of allowances issued each year starting in 2013 shall decrease in a linear manner beginning from the mid-point of the period from 2008 to 2012. The quantity shall decrease by a linear factor of 1,74 % compared to the average annual total quantity of allowances

issued by Member States in accordance with the Commission Decisions on their national allocation plans for the period from 2008 to 2012.

Implementing entity: Ministry of Environment and Water Management, National Inspectorate for Environment, Nature and Water

Type of policy: Regulatory, economic

Status of policy: Implemented

Effect of policy: The maximum allocation of emission allowances has reduced for the period 2008-2012 compared to the period 2005-2007. As a result of the EU ETS, companies are expected to have taken the initiative regarding measures for reducing emissions. However it is difficult to estimate the effect on emissions due to the EU ETS, since the instrument is interacting with several other instruments, for example energy- and carbon dioxide taxes and the electricity certificate system. The companies are also influenced by for example fuel and electricity prices and economic development. The effect of the EU ETS on emissions reductions are calculated in the forecasting section of this document based on the HUNMIT modelling methodology for different AAU (EUA) prices.

4.3.1.9. Renewable energy policy

EEOP - Direct Financial Support for the Use of Renewable Energy until 2015
As a member of the European Union, Hungary is entitled to EU-funded support for development purposes in the 2007–2013 period. From the EUR 4.916 million (HUF 1.332 billion) budget of the Environmental and Energy Operational Programme (EEOP) of the New Hungary Development Plan (NHDP) there are 2 priorities promoting national energetic projects: 5.15% of the total budget is available for the purposes of priority axis titled "Increasing renewable energy source use" and 1.58% of the budget is allocated for the purposes of priority axis "Efficient energy use" promoting energy saving.

The primary objective of priority axis „Increasing renewable energy source use" is governing the source structure of domestic energy carriers into a favourable direction that is facilitating the shift from fossil energy sources use towards renewable energy sources. In order to achieve this goal, namely larger share for RES, applications may be submitted for heat and/or electric energy production support up to a total budget of HUF 58 billion and for the support of large and medium capacity bioethanol plant establishment up to a total budget of HUF 5 billion in the 2007–2009 period.

Activities supported in the scope of the heat and electric energy scheme are biomass use, biological waste-based biogas production and use, utilization of geothermal energy, commissioning of heat pump systems, utilization of solar energy and hydropower, establishment of wind power plants which produce electricity for non-grid systems, development and modernisation of community district heating systems utilizing renewable energy sources and the preparation of renewable-based solid combustibles (e.g. pellet, briquette production).

Considering the off-take prices of electricity generated from wind energy, which are favourable even in an international context, as well as the installed capacity limit set for 330 MW for the medium term, in the 2007–2013 period EEOP does not grant additional investment support for wind energy projects producing for the grid.

Implementing entities: Respective operational programmes are supervised by the managing authorities operating within the scope of the National Development Agency (NFÜ) as independent organisational units. KHEM and KvVM are responsible for planning the 2 energetic priorities of EEOP. The applications for energetic programmes are managed by Energia Központ Kht.

Effects of the policy are included in Table 4.2.

NHRDSP – RES use promotion in the agriculture

In addition to EEOP, the measures of the New Hungary Rural Development Strategic Plan (NHRDSP) promote the spread of RES use in Hungary, as well. The objective of NHRDSP is that rural areas, beyond producing necessary raw materials, can intensively participate in the development of the bioenergy segment. NHRDSP supports the use of renewable energy sources along 3 strategic directions: liquid biomass (bioethanol and biodiesel), solid biomass (wood and herbaceous energetic plantations) and biogas. The source of the support is the European Agricultural Fund for Rural Development (EAFRD), which grants aid for the competitive production of biomass and its processing into a semi-finished primary product, as well as for the individual energy supply of producers.

Effects are included in Table 4.2

ESCF- Soft loan for renewable based investments

Beyond EU support, programmes promoting energy saving and renewable energy use set up in the recent years and funded by Hungary will probably keep on operating. The Energy Saving Credit Fund (ESCF, in Hungarian: EHA), possibly supplemented by the budget of the PHARE programme in the future, provides a soft loan for investments aimed at renewable energy carrier use. Application opportunities of the National Energy Saving Programme – planned to be a continuous programme for 2009–2013 – may generate further growth.

The envisaged outcome of support granted by EEOP for boosting RES use:

		Target values achievable through EEOP support			
		2007	2010	2013	2015
Renewable energy carrier-based electricity production growth	GWh/year	0	676	967	1170
Renewable energy carrier-based heat production growth	PJ	0	7.5	10.1	11.4
National ratio of bioethanol use/engine fuel[5] use reached by supporting the establishment of bioethanol plants	%	0	8.2	10.1	9.9
Growth of renewable energy carrier use achievable by EEOP[6]	PJ/year	0.0	28.8	38.0	41.3
Ratio of renewable energy carriers in the national energy consumption achievable by EEOP [%]	%	0	2.6	3.3	3.4

Table 4.8. Energy savings values achievable through EEOP support

Source: Environmental and Energy Operational Programme and related action plan

A total of HUF 58.5 billion can be allocated for the support of thermal and electric energy production in the scope of EEOP while further HUF 5 billion are available for promoting the establishment of bioethanol plants. Electric energy production, backed by an estimated HUF 15–25 billion EEOP support, is expected to grow by 1170 GWh/year[7] and heat production, with the help of an estimated HUF 32–40 billion EEOP support, may grow by 11 PJ by 2015. Thus, thanks to the help of EEOP support schemes, renewable energy carrier use on the resource side may increase by a total of 41 PJ until 2015.

Effects are included in Table 4.2.

Promotion of Renewable-Based Electricity Production in Hungary

In order to reach the objectives of Directive 2001/77/EC, Act CX of 2001 on electric energy (VET) introduced the institution of obligatory takeover, which made it possible to support electric energy producers using renewable energy sources[8].

The framework of obligatory takeover was modified in the 386/2007 Govt. Decree. The modification separates the electricity coming from sources which can be regulated (e.g. biomass) from electricity which can not be controlled (e.g. wind), that is, the Decree integrates the grid operator's criteria in the power system. The price distinctions for peak, valley and deep valley periods remain for the controllable sources. The present problem decision makers must face as mentioned in section 3.1., is the excessive amount of subsidy spent on CHP support.

[5] Engine fuel = petrol + diesel in total (produced quantity, not consumed quantity)

[6] Together with the fuel heat equivalent of electric energy and bioethanol

[7] its TPES equivalent is 11.5 PJ

[8] The details of the regulation are stipulated in GKM Decree No. 56/2002 (29.12) on the rules governing the acceptance of electricity covered by off-take obligation.

Effects are included in Table 4.2. and considered directly in the model methodology.

4.3.1.10. Land based support of energy crops

Earlier policy results from land based support of energy crops

Hereby we refer to the respective part (3.2.1.4.) of the first report of Hungary. In line with the priorities of the National Rural Development Plan, Decree 28/2005. (IV. 1.) of the Ministry of Agriculture allocated EUR 946 000 for the production of energy crops (both wood and herbaceous plants). The detailed regulation of the support is codified by Decree 74/2005. (VIII. 22.) of the Ministry of Agriculture.
The energy crop producers can claim the land based subsidy for bioenergy support, however they have to contract a certified gross trader that is on the list of the Agricultural and Rural Development Office (MVH). The traders have the obligation to resell for energy purpose.
The latter decree defines which plant classifies as energy crop, maximises the area that can obtain financial support and the obtainable finance: for wheat, corn, rape and sunflower together it is 16000 ha and EUR 27/ha, for energy grass 10000 ha and 32 EUR/ha, for energy forest 2500 ha and 194,13 EUR/ha.
For energy crop plantations altogether 3705 applications arrived, with final payment in 2009, for an area of 165,300 hectares, for a total subsidy of 31,65 EUR/ha*165,300 ha, for approximately 5.27 M EUR, paid until the end of 2008.

Support of renewable energy equipment for agricultural purposes

The Act XVII of 2007. regulates the land based subsidies and general subsidisation of agricultural activities. Based on the Act there is a direct subsidy for renewable energy utilisation in the agriculture for sectoral energy production. The Decree 78/2007 of the Ministry of Agriculture and Rural Development (FVM) and the subsequent 101/2007. (IX. 21.) FVM and 38/2008. (III. 29.) FVM decrees regulate the European Agricultural and Rural Development Fund subsidies for renewable energy sources and energy production in the agriculture.

The support aims at extending the use of renewable energy resources in the agriculture and the reduction of fossil dependence of producers.
The decree allows for non refundable grants on equipment utilising agricultural energy, biomass boilers and the procurement of equipment for the distribution and storage. The purchase of the latter can be supported only in case it is coupled by the purchase of a biomass boiler. The subject of subsidy should also submit a declaration on the source for the biomass boiler. The maximal amount of subsidy per year and per applicant can not exceed HUF 200 M (approximately EUR 800,000). In case of non-agricultural investments, the maximal subsidy can reach EUR 200,000 per applicant and for 3 years (decreased by the de minimis supports received earlier).

The grant rate can not exceed 50% of the investment. Implementation was undertaken through the 23/2007. (IV. 17.) FVM decree.
The implementing entity is the Agricultural and Rural Development Office, Ministry of Agriculture and Rural Development

4.3.2 Measures in the household sector

Measure	End-user action triggered by the measure	Term	Planned savings by 2016 [GWh/year]
Support to the energy efficient modernisation of residential buildings constructed with industrial technology	energy efficient modernisation of homes built with industrial technologies	(2001-) 2008 - 2016	1,125
'For a Successful Hungary' household energy efficiency support and credit programme (NEP application system)	energy efficient modernisation of homes built with traditional technologies	2008 - 2016	750-1,000
Use of individual measurements and mini heating centres in district heat supply	reduction of the district heat demand	2008 - 2016	375
Development of the operation of the energy efficiency consultation network	incentives for energy efficient modernisation	2008 - 2016	375
Energy efficiency certificate of buildings	promotion of energy efficient modernisation	2008 - 2016	125-375
Regular review of household boilers	incentive for the exchange and refurbishment of boilers	2008 - 2016	125-250
Labelling of household boilers and air conditioning equipment	replacement of boilers, purchase of more efficient boilers	2008 - 2016	75-125
Labelling of household electrical and gas boilers for energy efficiency purposes	replacement of household appliances, purchase more efficient appliances	2008 - 2016	75-125
Support for the purchase of highly energy efficient 'A' labelled household fridges and highly energy efficient 'A' labelled household freezers and other domestic appliances, in exchange of the old appliance	replacement of household appliances, purchase more efficient appliances	2008 - 2016	125-200
Increase in the dissemination of energy efficient lighting equipment (compact light tubes)	replacement of lighting tubes	2008 - 2016	175-350
Elaboration of energy efficiency training materials for primary and secondary education	laying down the foundation for energy conscious behaviour	2008 - 2016	25-125
Total			3,350- 4,425

Table 4.9. Summary table of the measures planned for the household sector
Source: KHEM

4.3.2.1 Existing measures in the household sector

	Support to the energy efficient modernisation of residential buildings constructed with industrial technology
Description	Objective of the support The purpose of this support is energy efficient refurbishment of residential buildings constructed with industrial technologies and modernisation and reconstruction of the engineering systems and equipment of these residential buildings, as well as the roads, car parks, playgrounds and parks around them. For the purpose of this support scheme residential buildings constructed with industrial technologies include residential buildings built with concrete panel, concrete block, reinforced block, cast wall, ferro-concrete structure and other pre-fabricated technologies.
Implementing entities:	Ministry of Local Governments and Regional Development
Type of policy	financial measure (non-repayable support)
Status of implementation	adopted, implemented
Effects	125 GWh/year (0. 45 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3

	For a Successful Hungary' household energy efficiency support and credit programme
Description:	The purpose of the support is energy efficient modernisation of homes, reduction of residential energy consumption and reduction of the energy expenses of the residents with the following modernisation objectives: subsequent heat insulation of residential buildings constructed with traditional technologies before 1994 (facade, roof, bearing structure and cellars). subsequent heat insulation and replacement of doors and windows of residential buildings constructed with traditional technologies before 1994, replacement or modernisation of the heating and hot water supply equipment of residential buildings constructed with traditional technologies, within the framework of this scheme only energy efficient modernisation of residential houses, buildings, homes, farms (hereinafter: residential property) is eligible for support.
Nature and time schedule of the measure:	The scheme was launched in 2007

Implementing entities	Ministry of Economy and Transport/Ministry of Transport, Telecommunication and Energy Hungarian Development Bank, Energy Centre Ltd.
Type of policy	financial measure (non-repayable support and/or loan with a preferential interest rate) (3.1 and 3.3)
Status of implementation	adopted, implemented
Effects	83-111 GWh/year (0.3-0.4 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3

Development of the operation of the energy efficiency consultation network

Description:	An advisory organisation providing information about the options of energy saving and the procedure of application for funding to the population had to be set up. This advisory organisation achieves the objective stated above with printed publications, information available through the Internet, as well as co-ordination of the operation and training of local NGOs operating with similar objectives.
Implementing entities	Ministry of Transport, Telecommunication and Energy Ministry of Local Government and Regional Development Hungarian Development Bank
Type of policy	information, awareness
Status of implementation	adopted
Effects	42 GWh/year (0.15 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3.

Energy efficiency certificate of buildings

Description:	Implementation of the provisions of the Directive 2002/91/EC of 16 December 2002 of the European Parliament and Council. The first implementing regulation was the Decree 7/2006 of the Minister without Portfolio on the definition of the energy management features of buildings. Further legislation was developed in order to implement the directive fully, the 176/2008(IV.30.) Govt. Decree regulates the implementation of the tasks relating to building energetics. The implementation will be undertaken in multiple steps by 2012 set as a

	final date. By 2009 it was applied to new buildings and public buildings over 1000 m^2, by 2012 it shall be applied for sold and rented buildings and dwellings. As a result of the measure an energy management form has been designed for the buildings and homes, summarising the energy management and energy efficiency features of the building.
Implementing entities	Ministry of Economy and Transport Ministry of Local Government and Regional Development
Type of policy	legislation (energy efficiency certificate of buildings) (1.1)
Status of implementation	adopted
Effects	14-42 GWh/year (0.05-0.15 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3.

Regular review of household boilers

Description:	Implementation of the provisions of the European Parliament and Council Directive 2002/91/EC of 16 December 2002, in relation to which the first step was the Decree 7/2006 of the Minister without Portfolio on the definition of the energy management features of buildings. Further legislation also needs to be developed in order to implement the directive fully. The boilers not satisfying the minimum energy efficiency requirements may be identified by regular review of household boilers. Preferential loans should be provided from a related fund for the replacement of boilers that no longer satisfy the minimum requirements. The 264/2008(XI.06.) Govt. Decree was issued on the energetic review of heating and air conditioning equipments.
Implementing entities	Hungarian Trade Licensing Office Ministry of Energy, Telecommunication and Transport
Type of policy	legislation (definition of minimum energy management requirements) (1.2)
Status of implementation	adopted
Effects	14-28 GWh/year (0.05-0.1 PJ/year). Estimated emission savings are included in Table 4.5 and Appendix 3.

Labelling of household boilers and air conditioning equipment (4.1.2.5)

Description:	Describing the efficiency indicators of new boilers. As boilers are used widely, the energy management characteristics, which have a major

	influence on the purchasing preferences of household consumers, need to be presented in a clear and generally understandable language. It is therefore necessary to elaborate legal regulations supporting the achievement of the objectives of the measure.
Implementing entities	Hungarian Trade Licensing Office Ministry of Energy, Telecommunication and Transport
Type of policy	Awareness-raising, information dissemination (Information supply on stressing of energy management characteristics) (1.2)
Status of implementation	adopted
Effects	8-14 GWh/year (0.03-0.05 PJ/year). Estimated emission savings are included in Table 4.5 and Appendix 3

Labelling of household electrical and gas boilers for energy efficiency purposes (4.1.2.6)

Category:	(2.2) Information supply (stressing of energy management characteristics)
Regional availability:	The whole country
Description:	60% of the Hungarian households use electrical or gas boilers to heat water. Therefore, labelling is required to raise awareness about the energy management characteristics, contributing to the purchase of energy efficient appliances. It is therefore necessary to elaborate legal regulations supporting the achievement of the objectives of the measure.
Nature and time schedule of the measure:	2009 H1: Approval of legislation 2009 H2: Launch of the planned measure
Implementing entities	Hungarian Trade Licensing Office Ministry of Energy, Telecommunication and Transport
Type of policy	Awareness-raising, information dissemination (Information supply on stressing of energy management characteristics) (2.2)
Status of implementation	adopted
Effects	8-14 GWh/year (0.03-0.05 PJ/year). Estimated emission savings are included in Table 4.5 and Appendix 3

Support for the purchase of highly energy efficient 'A' labelled household fridges and highly energy efficient 'A' labelled household freezers and other domestic appliances, with phasing out old appliances

Description:	More than 90% of the Hungarian households use a fridge and almost 60% have a freezer. The majority of the fridges and freezers are obsolete, using a lot of energy. Encouraged with support, consumers will replace their obsolete fridges and freezers as well as other household appliances, achieving major consumption reduction in household electricity.
Nature and time schedule of the measure:	Planned starting date was 2008 Q3 as preparation and launch of the support scheme (NEP-2008)
Implementing entities	Hungarian Trade Licensing Office Ministry of Energy, Telecommunication and Transport
Type of policy	Financial measure (non-repayable support and/or loan with preferential interest rate) (3.1 and 3.3)
Status of implementation	adopted
Effects	14-22 GWh/year (0.05-0.08) Based on the efficiency of the electricity system, it may be achieved by 4-7 GWh/year end-user savings in electricity. Estimated emission savings are included in Table 4.5 and Appendix 3.

Increase in the dissemination of energy efficient lighting equipment (compact light tubes)

Description:	The majority of the Hungarian households uses traditional light bulbs and tubes for lighting. The life-span of compact light tube is 8-10 times longer than that of the traditional light bulbs. Their energy consumption is one-third or only 25% of that of the traditional light bulbs and tubes. However, in average they are 5-6 times more expensive. The campaign presents the available savings and promotes the dissemination of lighting equipment, with which electrical consumption related to lighting can be reduced.
Nature and time schedule of the measure:	Continuously
Implementing entities	Ministry of Energy, Telecommunication and Transport
Type of policy	Information supply (awareness-raising campaign) (2.1)

Status of implementation	adopted
Effects	19-39 GWh/year (0.07-0.14 PJ/year) Based on the efficiency of the electricity system, it may be achieved with 6-12 GWh/year end-user savings in electricity. Estimated emission savings are included in Table 4.5 and Appendix 3.

Elaboration of energy efficiency training materials for primary and secondary education

Description:	The most effective tool of awareness-raising is education. Integration of energy efficiency into education may reflect the recognition of the role of energy efficiency in the whole society. There have already been several initiatives in Hungary for integrating energy efficiency into the public education. The majority of these efforts resulted only in optional, extra curricular educational activities, without actually integrating the subject into education. Energy efficiency should be taught in several subjects such as e.g., physics, environmental protection and environmental studies. Energy efficiency should be integrated into education taking into account the experiences to date and a complex overall programme should be developed in order to maximise the effect.
Annual energy saving target:	3-14 GWh/year (0.01-0.05 PJ/year)
	Development of educational material 2008: development of educational material 2009 September: introduction of the educational subject
Implementing entities	Ministry of Education and Culture Ministry of Energy, Telecommunication and Transport Ministry of Environmental Protection and Water Management
Type of policy	Information supply (energy efficiency training) (2.5)
Status of implementation	adopted

4.3.3. Measures in the public and municipality institutions sector

Measure	End-user action triggered by the measure	Term	Planned savings by 2016[GWh/year]
Municipality training, awareness-raising, consultation based on the experiences of the UNDP/GEF municipality energy efficiency programme	reasonable energy efficiency investments	2008 - 2016	250
Third party financing - EEOP 5.2 instrument	more dynamic energy saving activities	2008 - 2016	1,750
Promoting the reduction of energy consumption in the Regional Operational Programmes	integration of the concept of energy efficiency in city rehabilitation	2008 - 2016	125-175
Promotion of ESCO type investments	more dynamic energy saving activity	2008 - 2016	125-625
Elaboration and application of energy efficiency guidelines related to public procurement	use of equipment with better energy efficiency	2008 - 2016	1,250
Elaboration of minimum energy efficiency requirements for office equipment	reduction of energy consumption in institutions	2008 - 2016	250
Total			3,750 –4,300

Table 4.10. Summary table of the measures planned in the sector
Source: KHEM

The regional development measures applicable to the municipal sector and the households may give a further boost to the energy efficiency results and may also have an impact on the reduction of energy consumption. The results of these measures can not be yet assessed.

4.3.3.1. Further application of the existing measures in public and municipality institutions

Municipality training, awareness-raising, consultation based on the experiences of the UNDP/GEF municipality energy efficiency programme

Description: The Hungarian municipalities and their institutions consume a considerable amount of energy. Based on the experiences of the training projects and information provided within the framework of UNDP projects awareness-raising among municipality experts continues even after the first project finished on 30 June 2008.
The continued project must increasingly focus on the transfer of best practices, the exchange of experiences, the actual financing options and practical issues of energy efficiency audits and feasibility studies.

Nature and time schedule 2008 H1: development of the awareness-raising system,

of the measure:	2008 H2: launch of the planned measure
Implementing entities	Ministry of Economy and Transport National Development Agency
Type of policy	Information supply, awareness-raising (consultation, training)
Status of implementation	Adopted, implemented
Effects	28 GWh/year (0.1 PJ/year). Estimated emission savings are included in Table 4.5 and Appendix 3

4.3.3.2. Planned and adopted energy efficiency measure in the public and municipality sector[*]

Third party financing - EEOP 5.2 instrument

Description:	The instruments focusing on investment projects implemented at municipality and public institutions by ESCO companies is based on the concept that the enterprise making the investment generates the funding required for the energy efficient investment from the achieved energy savings. The following technical solutions may be implemented within the framework of this Programme: external heat insulation of the facade refurbishment of doors and windows replacement of doors and windows programmed control of heating separation of the heating systems of premises used for various functions installation of thermostats calibration of boilers replacement of boilers modernisation of lighting modernisation of heating
Nature and time schedule of the measure:	Launched in 2007 as an EEOP instrument.
Implementing entities	Ministry of Energy, Telecommunication and Transport, National Development Agency,

[*] Some of the measures may be applied at the army.

	Energy Centre Ltd..
Type of policy	financial measure (non-repayable support) for energy management services (third party financing)
Status of implementation	Adopted, implemented
Effects	195 GWh/year (0.7 PJ/year). Estimated emission savings are included in Table 4.5 and Appendix 3

Promotion of reduction of energy consumption through the Regional Operational Programmes

Description:

Between 2007 and 2013 the regional development and city rehabilitation priorities of ROP (Regional Operational Programme) provide support for energy efficiency investment projects within the framework of the NHDP.

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Activities eligible for support:

- reduction of energy consumption in institutions and public buildings
- modernisation of external and internal lighting systems
- improvement of the heat technology aspects of buildings, reduction of heat loss with subsequent heat insulation and replacement of external doors and windows
- modernisation of the secondary energy supply systems
- reduction of the energy consumption of public lighting

The regional development criteria must be integrated into the future support scheme (e.g., in relation to the rehabilitation of sites allocated to construction)

Nature and time schedule of the measure:	Launched in 2008
Implementing entities	Ministry of Local Governments and Regional Development, National Development Agency
Type of policy	financial measure (non-repayable support)
Status of implementation	Adopted, implemented
Effects	14-19 GWh/year (0.05-0.07 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3.

Promotion of ESCO type investments

Description:	ESCOs cover energy efficiency market segments with their activities, which would not be reached otherwise due the lack of expertise, technology, or the lack of funding. The state regulates the operation conditions of ESCOs in order to achieve real improvement in energy efficiency.
Nature and time schedule of the measure:	2008 H1: drafting of legislation 2008 H2: elaboration of financing options supporting operation
Implementing entities	Ministry of Economy and Transport Ministry of Justice and Law Enforcement Hungarian Development Bank
Type of policy	energy management services (third party financing) regulative measure
Status of implementation	Adopted, implemented
Effects	14-70 GWh/year (0.05-0.25 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3.

Elaboration and application of energy efficiency guidelines related to public procurement

Description:	Under Act CXXIX of 2003 on public procurement the lowest price and the overall most favourable bid are specified among the evaluation criteria. The quality indicators, the operating expenses and cost-income ratio may be included among the additional criteria. In this evaluation system the energy efficiency aspects are usually not given high priority. In this context the Public Procurement Act must set a requirement to include objectively measurably energy efficiency criteria in the evaluation of the tenders received in the public procurement projects and to apply an economic evaluation method associated with it too.
Nature and time schedule of the measure	2008: drafting of the legislation 2009: application of the legislation
Implementing entities	Ministry of Economy and Transport Ministry of Justice and Law Enforcement
Type of policy	Information dissemination, awareness-raising, (exemplary rule of the public sector), voluntary commitment (in public procurement)
Status of implementation	Adopted

Effects	139 GWh/year (0.5 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3.

Elaboration of minimum energy efficiency requirements for office equipment

Description:	The contribution of the tertiary sector to the economic output is increasing. In connection with that process more and more offices use computers, photocopiers, fax machines and air conditioners. Energy efficiency categories and minimum requirements must be identified for the most frequently used office equipment (equipment category). After the minimum requirements have been defined, no investment project may be financed from public funds, which does not meet the requirements.
Nature and time schedule of the measure:	2008 H1: elaboration and definition of the energy efficiency categories and requirements for office equipment, 2008 H2: legislation
Implementing entities	Ministry of Transport, Telecommunication and Energy Ministry of Justice and Law Enforcement
Type of policy	Legislative (minimum energy efficiency requirements)
Status of implementation	Adopted, implemented
Effects	28 GWh/year (0.1 PJ/year) Based on the efficiency of the electricity system, the target may be achieved by 9 GWh/year end-user savings in electricity. Estimated emission savings are included in Table 4.5 and detailed in Appendix 3.

4.3.4. Measures in the industry sector

Measure	End-user action triggered by the measure	Term	Planned savings by 2016 [GWh/year]
Continuation of the Energy Efficiency Loan Fund with the integration of the PHARE loan instrument	preferential loans for energy efficiency projects	2008 - 2016	1,375-1,625
EIOP 2006-1.7 environmentally friendly energy management	reduction of energy consumption	2008 - 2016	375
Refurbishment of the district heat supply systems, making district heat supply more competitive	reduction of energy consumption of district heating systems	2008 - 2016	250-750
'Efficient energy consumption instrument' in the Environment and Energy Operational Programme	reduction of energy consumption	2008 - 2016	1,875-2,250
Mandatory employment of an energy manager at major energy consumers	more professional energy management	2008 - 2016	500-1,000
Mandatory energy consumption report of major consumers	increase of the economic importance of energy consumption	2008 - 2016	250-500
Voluntary agreements (audit, energy efficiency)	promotion of energy efficient projects and reasonable conduct	2008 - 2016	250-375
Reduction of transformer losses on the electricity network	reduction of the quantity of energy required for electricity generation	2008 - 2016	575-725
Use of the heat loss of transformers	replacement of other energy carriers	2008 - 2016	125-175
Total			**5,575 – 7,775**

Table 4.11. Summary table of the measures planned in the industrial sector
Source: KHEM

4.3.4.1. Existing energy efficiency measures, affecting also the industry sector, agriculture, public and municipality institutions

Continuation of the Energy Efficiency Loan Fund with the integration of the PHARE loan instrument

Description: Objective: replacement of the traditional energy carriers with

	renewable energy carriers and waste energy, putting in place conditions for economic management of energy carriers, reduction or elimination of the identified energy losses at the lowest cost. Any funds remaining in the PHARE credit programme closed in 2008 Q1 shall be integrated into the Energy Efficiency Credit Fund.
Nature and time schedule of the measure:	2008 Q1: decision on the merger of PHARE and EECF Review and continuous operation of the scheme, as well as conditions of the credit fund from 2008 Q2.
Implementing entities	Ministry of Transport, Telecommunication and Energy
Type of policy	Financial measures (non-repayable support) (3.1)
Status of implementation	Adopted, implemented
Effects	153-181 GWh/year (0.55-0.65 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3.
	EIOP 2006-1.7 environmentally friendly energy management (4.3.1.2)
Description:	increasing application of renewable energy sources, increase of energy efficiency, reduction of CO_2 emission and promotion of regional development
Nature and time schedule of the measure:	According to the call for applications applications could be submitted from 1 May 2004 to the end of 2006. The investment projects aiming at the increasing use of renewable energy sources and higher energy efficiency were mainly implemented in 2007-2008. The energy efficiency results will occur during the NHDP period. The task is to implement and maintain the projects contained in the supported applications and enforce the requirements of the support application system with regard to the project managers.
Implementing entities	National Development Agency Energy Centre Ltd.
Type of policy	Financial measures (non-repayable support) (3.1)
Status of implementation	Adopted, implemented
Monitoring indicators	Energy saved, CO_2 emissions set off
Effects	42 GWh/year (0.15 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3.

4.3.4.2. Planned measures, affecting also the industrial sector, agriculture, public and municipality institutions

	Refurbishment of the district heat supply systems, making district heat supply more competitive
Description:	The modernisation of district heat supply, reduction of the costs of supply, separation and individual meters at consumption sites should be promoted with the help of targeted state support and/or loans with preferential interest rates. Areas to be supported: • increase of the combined heat and electricity generation • modernisation of the supply (primary) side for energy purposes, loss reduction • modernisation of the heating centres, regulation on the consumption (secondary) side, distribution of costs.
Nature and time schedule of the measure:	2008 H1: elaboration of the framework system for the support, putting in place the legal and professional requirements. 2008 H2: launch of the support scheme
Implementing entities	Ministry of Local Governments and Regional Development National Development Agency Hungarian Development Bank Ministry of Transport, Telecommunication and Energy
Type of policy	Financial measure (non-repayable support and/or loan with preferential interest rate) (3.1 and 3.3)
Status of implementation	Adopted, implemented
Effects	28-83 GWh/year (0.1-0.3 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3.
	'Efficient energy consumption instrument' in the Environment and Energy Operational Programme
Description:	The 'Efficient energy consumption' instrument under the EEOP supports the following projects of institutions and small and medium-sized enterprises: • Reduction of energy consumption in buildings operated by the target group. • Reduction of the energy consumption in public lighting. • Energy efficient modernisation of the primary side of the district heat supply. • Modernisation of operational and office buildings of small and medium-sized enterprises serving energy purposes.

- Projects and complex interventions (involving several activities) implemented in combination with an increase in energy efficiency, introducing the use of renewable energy resources.
- Energy efficiency projects for the above activities, financed by third parties.

Nature and time schedule of the measure:	Following the submission of applications, projects have been accepted, processed and implemented from 24 October 2007. 2008 H1: an action plan was elaborated for the period 2009-2013
Implementing entities	National Development Agency Ministry of Transport, Telecommunication and Energy Energy Centre Ltd.
Type of policy	Financial measure (non-repayable)
Status of implementation	Adopted, implemented
Effects	208-250 GWh/year (0.75-0.9 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3.

Mandatory employment of an energy manager at large energy consumers

Description:	In terms of energy management it is very important that the parties responsible for energy management possess the required knowledge and expertise. Large energy consumers may save a considerable amount of energy by improving the quality of energy management.
Nature and time schedule of the measure:	2008: legislation on the mandatory employment of energy managers at major consumers 2009: launch of the system
Implementing entities	Ministry of Social Affairs and Employment Ministry of Energy, Telecommunication and Transport
Type of policy	Information dissemination, awareness-raising (education) (2.5)
Status of implementation	Adopted, implemented
Effects	56-111 GWh/year (0.2-0.4 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3.

Mandatory energy consumption report of large consumers

Description:	Large consumers are responsible for a considerable portion of energy consumption in the country. It is an important national interest that

	large consumers conduct appropriate energy management practices and efforts also need to be made for improving energy efficiency.
Nature and time schedule of the measure:	2008 H1: legislation 2008 H2: Launch of the new system
Implementing entities	Ministry of Justice and Law Enforcement Ministry of Transport, Telecommunication and Energy Industrial Energy Consumers' Forum
Type of policy	Regulative, Information dissemination (measurement and reminder) (2.8)
Status of implementation	Adopted, implemented
Effects	28-56 GWh/year (0,1-0,2 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3.

Voluntary agreements (audit, energy efficiency)

Description:	The state enters into agreement with groups important in terms of energy management, such as e.g., energy intensive industries, the energy industry, manufacturers producing certain end-user appliances. Under these agreements the specific groups assume an obligation to use energy efficiently, including: • the reduction of energy consumption, • application of more effective energy supply technologies, • development of products with better energy efficiency indicators.
Nature and time schedule of the measure:	system of voluntary commitments, launched in 2008
Implementing entities	Ministry of Transport, Telecommunication and Energy
Type of policy	Voluntary agreements (industrial organisations of energy intensive sectors), Information supply (performance of energy audits)
Status of implementation	Adopted, implemented
Effects	28-42 GWh/year (0.1-0.15 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3.

4.3.5. Measures in the transport sector

In establishing specific objectives of Hungarian transportation development, the Hungarian Government has taken into account the White Paper of the European Union (EU) detailing its common transportation policy, which was published in 2001.

4.3.5.1. UTDS - Unified Transportation Development Strategy (UTDS)

Regarding the whole Hungarian transportation, accession to the European Union and further enlargement of the EU had a significant effect, processes have accelerated. Investment resources from the EU Cohesion Fund and the Structural Funds, supplemented by domestic sources required the reformulation of the former concept and integration with the government programme. Therefore, in 2007, the Government elaborated the White Book on the Unified Transportation Development Strategy (UTDS), which specified a more efficient cooperation of subsectors and a uniform set of objectives of services.

4.3.5.1.1. UTDS- Rebuilding and refurbishing of train lines - technical-technological development

An important component of infrastructural development is the implementation of technical-technological development projects. In relation to this, three areas can be emphasized:

- continuation of network optimization,
- further development of interoperability and
- preparation of a high-speed network.

Aiming at an **optimal network** is a continuous task. By the period 2014-2020 the existence of viable regions can be counted on, assuring the implementation of network rationalization.

Simultaneously with the latter, the elimination of redundant capacities will be continue and the infrastructure will be adapted to market demands.

4.3.5.1.2. UTDS Road transport strategy

The goals laid down in the framework of the Unified Transport Development Strategy include the construction of an integrated traffic monitoring and controlling system, exploiting the benefits offered by intermodality, in the field of freight transport, slowing down the growth of road transport, as well as increasing bicycle traffic. One of the most important and largest scale elements among the tasks set by the road transport strategy is continuing and completing the construction of the TEN-T network serving the stable development of European transit connections.

Infrastructure development projects are linked to the following **three main sets of objectives.** The underlying motives include increasing competitiveness and improving the standards of the services provided by the public road network:

- creating missing international and national road connections and raising the standards of the services provided by the existing ones; (to improve international transit and national accessibility standards, to enable links to economically advanced regions);
- raising the standards of the services provided by road network links of regional functions, expanding capacities to eliminate bottlenecks; (to reduce or eliminate territorial inequalities, alleviate traffic loads

on towns and villages, improve environmental parameters, to provide access to micro - regional centres of employment, to help disadvantaged municipalities to catch up with more advanced regions) ;

- strengthening the underlying structure of main and secondary roads, road reconstruction/improvement (to reduce the number of accidents, to make roads be capable of bearing axle loads up to 115 kN, to prevent losses and the damage of the roads).

The horizontal goals of the UTDS related to the road transport subsector:

Sustainable development
Qualitative mitigation and alleviation of negative external impacts caused by freight transport to the natural and the economic environment and the society shall be fostered. Such negative external impacts include: air and noise pollution, accidents, congestions, segregation of habitats, infrastructure depreciation and degradation of buildings.

The competitiveness of domestic enterprises
Other major horizontal goals defined by the strategy are improving the logistics sector's position in the national economy, improving domestic enterprises competitiveness (particularly that of SMES) by raising the sector's contribution to GDP to a West European level, by increasing the number of major international logistics service providers in Hungary and by increasing the number of innovative small and medium - sized enterprises operating in the field of logistics.

The implementing entity is the National Development Agency, which is supervised by the Ministry of Transport, Energy and Telecommunication.

4.3.5.1.3 UTDS - Urban-suburban transport of Budapest

Budapest and its environment as a major international urban region have formed by now an integrated urban region due to regional and economic processes. The region will be the future central regional space. The competitiveness of this central space depends mainly on the internal cohesion and cooperation capability of the region - and as an instrument of the latter - the creation of an efficient transportation system.

In order to render the transportation system of Budapest and its environs into an entity ensuring regulation, control and sustainability of mobility, coordinated efforts are necessary in three fundamental areas:

- deficiencies in the network structure ensuring balanced regional development and traffic flow shall be corrected,
- comfort level of the transportation vehicles and instruments shall be heightened in order to satisfy the mobility and lifestyle demands of the 21. century,
- integration of the modes of transportation and transportation service providers shall be established, along with the institutional, regulatory and executive background capable of achieving the objectives in a regional dimension.

The implementing entity is the National Development Agency under the supervision of the Ministry of Transport, Energy and Telecommunication.

4.3.5.1.4. Summary of effects of UTDS in the three priority axes

The following tables summarise the expected effects of the measures relating to railway, road transportation, as well as de development of the capital region from the aspect of climate change mitigation.

Indicator	Measurement unit	Base value	Target values*	
		2007	2015	2020
CO_2 emission	kton	127	115	107

Table 4.12. Effects of railway sector development

Indicator	Unit of measure	Base value			
		2007	2015 (TransOP**)	2015	2020
Change in the extent of the gas emission with green-house effect (CO_2, N_2O, CH_4) as an effect of the programme	CO_2 in kt / year	0 (12,837)	-250 ****	-160	-

Table 4.13 Effects of road transport development

Indicator	Indicator type	Measurement unit	Base value	Target values	
			2007	2015	2020
Emission of greenhouse gases (CO_2)	effect	kt CO_2e / year	2130	2240	2300

Table 4.14. Effects of urban-suburban development

4.3.5.2. Efficiency measures in the transport sector

The following table summarises the measures planned in the transport sector:

Measure	End-user action triggered by the measure	Term	Planned savings by 2016 [GWh/year]
Paytoll for heavy vehicles	more practical transport organisation	2008 - 2016	875-1,250
Awareness-raising – training of special consumer groups	more economic transport morale	2008 - 2016	25-250
Total			90 – 1,500

Table 4.15. Planned measures in the NEEDP framework in the transport sector

Paytoll for heavy vehicles

Description:	In 2007 Hungary introduced toll for commercial vehicles exceeding 12 tons of permitted gross weight on the majority of the national road network and plans to extend the toll to other lower priority roads, too. As of 2007 vehicles with a total weight of over 3.5 tons are liable for a charge for the use of dual/single carriageways. With the toll introduced, the utilisation of commercial vehicles loaded weight capacity has improved while certain transportation tasks are being performed using more environmentally friendly and more energy efficient transportation modes that is expected to result in an energy consumption decrease of 700-1,400 GWh/year by the end of the period 2007-2015.
Nature and time schedule of the measure:	maintenance of the existing measure, extension in 2009
Implementing entities	Ministry of Economy and Transport
Type of policy	financial measure (consumption fee, tax)
Status of implementation	Adopted, implemented.
Effect	97-139 GWh/year (0.35-0.5 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3.

P+R system for energy efficient personal transportation

Description:	Establishment of safe car parks at the terminuses of the public transport network. The car parks should be used either free of charge, or with significant subsidies, if the motorist uses them regularly in the P+R system. In order to verify the use of the system, an electronic ticket and pass system needs to be introduced, with which it may also be controlled whether the driver uses public transportation means after parking his car. A good P+R system may significantly increase demand for public transport, as a result of which the energy consumption of transport may decrease.
Nature and time schedule of the measure:	Planned measure, to be launched in 2009-2010.
Implementing entities	Ministry of Local Governments and Regional Development municipalities
Type of policy	Energy efficiency service (P+R system)

Status of implementation	Adopted
Effect	3-28 GWh/year (0.01-0.1 PJ/year). Estimated emission savings are included in Table 4.5 and detailed in Appendix 3.

4.3.5.3. TDOP - Transportation Development Operational programme

The TDOP (or TransOP) is the implementation programme of the Unified Transportation Development Strategy (White Book) of Hungary. According to a field study of the Institute of Transportation Sciences, the implementation of the TDOP programme will effect greenhouse gas emissions, (for more details see Henczinger-Forgách-Török[9]). Reasons include the extension of road network and intensification of transport, as well as mitigation measures.

The OP targets sustainable transportation development. We present the relevant part of TDOP, which focuses on modality switch and community transportation.

The priority axes of the strategy are as follows:

1. Improvement of international road access
2. Improvement of international railway and maritime access
3. Improvement of regional access
4. Connection of transport methods, improvement of intermodalities and transport infrastructure of central economic areas
5. Development of urban and suburban communal transportation
6. Technical assistance

The implementing entity is the National Development Agency under the supervision of the Ministry of Transport, Energy and Telecommunication.

4.3.5.4. Support of biofuels

Considering the production of primary materials the conditions in Hungary to produce bioethanol are favourable. The average harvest of maize is 6-7 M tons a year and the quantity used for animal feeding is more and more diminishing, while the export volume and the quantity processed by the industry are increasing. Maize produced in Hungary is available in significantly bigger volume than the anticipated volume of domestic use in the near future. The volume of ethanol produced from maize can reach 700-800 thousand tons a year and that is expected to lead to the multiplication of the anticipated demand of Hungarian producers and distributors of motor vehicle fuels.
In case of biodiesel the range of primary materials is different; in Hungary sunflower and rape mean the widely used vegetable base of biodiesel. Biodiesel can also be mixed in different proportions with the traditional diesel oil for diesel engines. Fuel B5 containing max. 5% biodiesel can be practically applied

[9] The effect of the Operation Programmefor Transport on the emission of greenhouse gases in Hungary, in 2007 Annual Report of the Institute for Transport Sciences http://www.kti.hu/uploads/evkonyvek/Evk2007angol.pdf

without modifications in any diesel engine. Higher proportion of blending is also applicable in the majority of modern diesel cars, with minor modifications.

In compliance with Directive 2003/96/EC, Hungary applies reduced level taxation for the use of biofuels. Act CXXVII of 2003 on excise taxes disposed of excise tax refund for biodiesel blended into diesel fuel until 31 December 2007 and for bioethanol added to petrol until 30 June 2007. From these dates onwards, the regulation provides that tax differentiation is to be applied to fuels reaching the required blend ratio (4.4 volume percent). As a result of excise tax exemption, the production of ETBE – manufactured on a bioethanol-basis – and blending ETBE into petrol started in 2005. Fuel E85 was standardised and its bioethanol content was granted tax exemption as of 1 January 2007.

The imposition of an environmental fee is a further taxation measure indirectly facilitating the utilization of renewables. In accordance with these measures the use of fossil energy carriers will become more expensive, thus the use of renewable energy sources will be more competitive.

The responsible entity is the Ministry of Transport, Energy and Telecommunication

Estimated emission savings are also reflected in Table 4.2. The detailed effects are as follows.

		2005	2010	2015	2020
Emission reduction achieved through biofuel use	kt CO_2	15	753	1,172	1,408

Table 4.16. Mitigation impact of biofuel use as outlined in the Renewable Strategy (WEM)
Source: KHEM

4.3.6. Waste management

The treatment of municipal solid waste is defined by the regulations contained in the 1995. Act LIII. and the XLIII./2000 Act on Waste Management. In order to maintain the sustainable management of natural resources the prevention-reutilisation-disposal priority is applied in the field of waste management.

Based on the 75/442/EC guideline modified by the 91/156/EC guideline the Act on Waste Management was extended by the waste management planning system, which prescribes the preparation of a six year plan on national and regional waste management, based on the Parliamentary Decree 110/2002. (XII.12.). This resulted in a National Waste Management Plan, 7 regional waste management plans and 2080 local plans for the settlements. The national and regional plans deal with the development needs of municipal waste in a separate chapter.

By 15th of July 2009 the obligations of the accession forced almost half of the Hungarian waste disposal sites to be closed down. These obligations related to the closing down of non-insulated MSW disposal sites after this date.

Decree on Waste Management Sites

The 20/2006 GKM Decree regulates the disposal of communal waste and the process of waste derivatives.

The Decree sets the general rules for planning, implementing and managing waste disposal sites. The Decree also states that the fee of waste disposal should be set by the operator of the site to cover the costs of investment, operation, shutdown and aftercare for at least 30 years. The Decree seriously limits the range of waste allowed to be deposited in waste disposal sites and only allows management for sites which have a proper insulation and a management procedure for wastewater leakage. The Decree regulates the recultivation of the disposal site and sets the length of the compulsory aftercare period. The Decree orders the construction of a geophysical monitoring system and a protecting forest band around the site. The Decree also sets the rules for waste disposal sites receiving waste sludge and other non-inert sources, which can generate gaseous emissions, the proper collection, treatment and utilisation of which is obligatory .

Effects are indirect, as the measure is regulatory.

4.3.6.1. First period of Strategy: developments and measures until 2009

Since the National Waste Management Plan defined the tasks until 2008 and the 2009 capacity closedown requires the construction of additional facilities, the developments were defined until 2009.
This is underlined by the fact that the ISPA supported municipal waste development projects are delayed and that they are expected to be realised by 2009. This period should bring about the 25% reduction in landfill waste disposal.

For fulfilling the obligations the following tasks need to be undertaken.

Development and extension of existing facilities
Assessment of current capacities
Extension of existing locations, economic range of extension amounts to 30 ktons/year

Construction of separated collecting and treatment systems
Introduction of effective selective collecting, as well as pre-treatment methods and modes

Promotion of household composting
Reduction of household organic waste, improvement of compost supply, improvement of organic soil content. Expected composted amount will reach 160 ktons/year by 2008.

Technological and geographical upgrade of existing waste management systems
Harmonisation of existing capacities, involvement of not covered settlements, extension of system elements
Technological development in organic waste components collection, pre-treatment and utilisation, in MBT, landfill gas collection and utilisation, composting.

Organic waste treatment by implementation of ISPA projects
12 projects, 34 composting locations, additional 50 ktons/year capacity until 2008
Additional 80 ktons/year paper recycling capacity and doubling of households composting capacities, biologically stabilised organic waste increases 15-fold.

	1995	2004	2006	2009
MSW generated	4500	4 591	4692	4950
Organic waste amount	2340	2385	2440	2574
Organic waste to be separated	0	0	685	1404
Composting (on-site)	-	120	190	490
Material reutilisation (paper)	-	210	230	290
Household composting	-	80	90	160
MBT	-	20	80	310
Incineration	185	80	202	202

Table 4.17. Realised and planned separated biologically degradable organic waste treatment based on ISPA projects (ktons)

Source: KvVM, 2008

With the existing capacities and their 10-15% extension, the implementation of ISPA projects, the 2006 obligation was fulfilled. The full implementation of projects enabled the realisation of the 2009 50% reduction of land waste disposal.

4.3.6.2. Second Period of the Strategy: development measures from 2009 to 2016

With respect to the former capacities and the planned and implemented capacities there is a need for further organic waste treatment capacities until 2016.
There are regional differences in capacities, but generally it can be stated that there is a need of approximately 70% increase compared to the capacities brought about by the ISPA projects until the end of 2008. Since the ISPA projects only covered around 60% of the country and enabled a 50% reduction, the Cohesion Fund sources from the period 2007-2013 should be used for the 2016 target of the obligation of 65% waste disposal reduction.

Since the present incineration capacity is not foreseen to be enlarged over 200 ktons, therefore the household composting capacity, the on-site composting facilities should be increased and the promoting measures developed. The energetic utilisation and the renewable energy related use should also be considered.

The amount subject to mechanical-biological treatment should be increased by 2016 to 400 ktons/year.

4.3.6.2.1. Construction of new organic waste treatment facilities

In the first period the composting technologies and household composting is prioritised, in the second period the MBT pre-treatment procedures and other treatment technologies are applied aiding non-selective waste's organic component utilisation, stabilisation.

4.3.6.2.2. Measures required for the treatment of waste

The targeted 2016 waste utilisation can not be exclusively achieved by material reuse of selectively collected waste and incineration. The 2139 ktons target at least in one-third has to come from MBT processes, the stabilisation of nearly 700 ktons organic waste requires additional 1,5 Mtons of remnant

waste MBT treatment, resulting in 500 ktons energetically utilisable fuel. This solution is preferred over the full amount disposal or installation of new waste incineration facilities (at least 3 would be required).
The government makes significant efforts for energy production from waste, in the framework of renewable policy. This support enables the fulfilment of the EU obligations undertaken in the renewables field.
Practice shows that there is a potential for 250-300 ktons of good quality secondary fuel production, but this requires the installation of 2-3 facilities with 100 ktons capacity each.
With the implementation of the first and second period of the strategy the following results can be achieved by 2016:

	1995	**2004**	**2006**	**2009**	**2016**
MSW generated	4500	4 591	4692	4950	5688
Organic waste amount	2340	2385	2440	2574	2958
Organic waste to be separated	0	0	685	1404	2139
Composting (on-site)	-	120	190	490	710
Material reutilisation (paper)	-	210	230	290	335
Household composting	-	80	90	160	200
MBT	-	20	80	310	700
Incineration	185	80	202	202	202

Table 4.18. Planned separated treatment of biologically degradable organic waste (ktons)
Source: GKM, 2004

The implementing organisation is the National Inspectorate for Environment, Nature and Water under the supervision of KvVM. Impacts are not quantified, but are included in the model calculations indirectly.

4.3.6.5. Promotion of recultivation

After the mechanical-biological treatment and separation of incinerable and reusable components around 25-30% stabilised treatment waste remains and has to be disposed of. The stabilised soil-like material is ideal for recultivation purposes and as covering material for landfills.

The National Recultivation Programme (NRP) was launched based on a PHARE countrywide survey of waste disposal sites. The NRP targets the revision of waste disposal areas from the aspects of environmental conformity and the closing down and recultivation of non-conforming locations.

Considering the results of the PHARE survey the number of locations closed and abandoned but not recultivated, or locations expected to be closed in 2009 reaches around 2560.
During the recultivation of these disposal sites the stabilised treatment waste can be well utilised.

The organisation implementing the initiative is the National Inspectorate for Environment, Nature and Water.

4.3.6.6. Zero Waste Programme

The Waste Reduction Alliance (HuMuSZ), a network of Hungarian green organisations started the Zero Waste Programme on the 9th of May, 2009 aiming at reducing domestic waste generation. The Alliance calls for the attention of the inhabitants, municipalities, business and education entities.

The wide range initiative tries to highlight the need for society level cooperation and raise a new awareness on bringing the present consumption and production patterns to an environmentally conscious level.
The approaching closedown of half of the domestic waste disposal areas and the expected increase in waste removal fees and compliance with the EU directives are the most important arguments to act on the individual and society level.
In the programme the Association provides practical examples, information and consultation on waste management. A separate subprogramme was started for civil associations under the title "Let's Be Partners".
The countrywide road show represents an important part of the initiative, with 36 locations and information dispersion for the citizens. The KukaDiet Programme targets the households to improve the sustainability of everyday household life. The programme will appear in 360 schools and on the www.nullahulladek.hu webpage.
With the cooperation of several municipalities, the Association develops municipal waste strategies (Várpalota, Csór), the strategy's main element is consensus and sustainability, as well as the prevention of waste generation by composting, recycling and conscious consumption awareness development, thus minimising incineration and disposal.
The Alliance takes part in the National Environmental Programme and in the development of the National Waste Management Programme.

4.3.7. Agriculture

4.3.7.1 Policy measures

As the member of the European Union, Hungary shares the responsibility in the fight against global climate change, so the Hungarian agriculture sector contributes to the global efforts made in this field proportionally. Though the emissions of agricultural origin were almost halved in the period 1985-2005, this tendency partly stems from the shrinking of production. The condition of the long-term sustainable production (increase of production) is to establish low-emission production processes (namely causing less atmospheric emission than the current ones) as well as the practical introduction and spreading thereof.
The most important instrument of establishing agricultural production that is sustainable in terms of environmental-climate protection is the New Hungary Rural Development Programme (NHRDP).

4.3.7.1.1 Previous axes

In the course of preparing the New Hungary Rural Development Programme (NHRDP) the results and experience of the previous period (PHARE, SAPARD, ARDOP [Agriculture and Rural Development Operational Programme], NRDP [National Rural Development Plan]) were evaluated. The funds available under the PHARE, SAPARD, ARDOP and NRDP were used to start the restructuring and modernisation of Hungarian agriculture and rural economy, but soon proved to be too modest to implement the much-needed changes.

Hungary's National Rural Development Plan (NRDP) contained the rural development measures financed by the Guarantee Section of the European Agricultural Guidance and Guarantee Fund (EAGGF). It designated the objectives ensuring the sustainable development of rural areas, the measures serving their implementation and the activities which can be supported in their frameworks. The NRDP supported the environmentally friendly agricultural production, provided assistance for farming in less favoured areas and for increasing the forest cover in the country. The measures of the plan contributed to the improvement of economic viability of semi-subsistent farms and the setting up and operation of producer groups.

4.3.7.1.2 New Hungary Rural Development Plan (NHRDP)

The programme is implemented under the framework determined by the European Union as well as by the domestic development policy documents.

The European Union framework is:

- Council regulation 1290/2005/EC
- Council regulation 1698/2005/EC
- Council regulation 144/2006/EC
- the Lisbon Strategy
- the sustainability principles determined in Gothenburg

The Hungarian development policy framework is the following:

- the National Development Policy Concept
- the National Regional Development Concept
- the National Action Plan
- the National Environmental Programme and the National Forest Programme

The strategic version of the programme was compiled in January 2007, the European Commission approved the New Hungary Rural Development Programme (2007-2013) on 19 September, 2007. The amended version of the programme (New Hungary Rural Development Programme Amended version – Amendments approved by the Monitoring Committee in year 2008; Amended annexes of New Hungary Rural Development Programme) that was approved by the Monitoring Committee in 2008 was submitted to the EU Commission.

The Programme contains the strategic framework of the Hungarian rural development programme for the period 2007-2013. The overarching national priority, in line with the Community Strategic Guidelines and the general objective is the following: "Improving outlets for arable production by modernising the livestock and processing sector and diversification into energy crops and horticulture."

Four axes were elaborated in order to implement the programme. The main objectives and financial weights of the axes are the following:

- Axis I – Improving the competitiveness of the agricultural and forestry sector with the help of restructuring, development and innovation (financial weight: 47%)
- Axis II – Improving the rural environment through the support of the appropriate land use (financial weight: 32%)
- Axis III and IV – Improving the quality of life in rural areas and promoting the diversification of economic activities (financial weight: 17%)
- 4% of the sources is reserved for technical assistance

In terms of climate protection several measures of the Axis I as well as many of the measures of the Axis II could be directly or indirectly relevant. These are as follows:

Modernisation of husbandry sites
Objective of measures – the target areas of the support being important in terms of climate protection contain environment protective manure management and storage, purchase of technological machinery ensuring the production and use of good quality fodder, implementation of architectural-technological and infrastructure investments.
Type of measures – Economic; regulatory
Status of measures – Expired
Quantitative estimate of effects – see Table 4.19
Measures implementing Community legislation – Council regulation 1290/2005/EC, Council regulation 1698/2005/EC, Council regulation 144/2006/EC, the Lisbon Strategy, the sustainability principles determined in Gothenburg

Purchase of machinery and technological equipment
Objective of measures – the aim of the support is to modernise agricultural farms, to improve the age structure of the agricultural machinery stock through purchasing environmentally friendly (energy saving) machinery and technological equipment.
Type of measures – Economic; regulatory
Status of measures – Expired
Quantitative estimate of effects – see Table 4.19
Measures implementing Community legislation – Council regulation 1290/2005/EC, Council regulation 1698/2005/EC, Council regulation 144/2006/EC, the Lisbon Strategy, the sustainability principles determined in Gothenburg

Modernisation of crop production
Objective of measures – the aim of the support is to improve the technological modernisation, competitiveness of crop production, to comply with the environmental protection, air quality protection requirements
Type of measures – Economic; regulatory
Status of measures – Implemented
Quantitative estimate of effects – see Table 4.19
Measures implementing Community legislation – Council regulation 1290/2005/EC, Council regulation 1698/2005/EC, Council regulation 144/2006/EC, the Lisbon Strategy, the sustainability principles determined in Gothenburg

Support of production on less favoured areas
Objective of measures – establishment of production structure in accordance with the land conditions as well as of environmentally aware production and sustainable landscape use
Type of measures – Economic; regulatory
Status of measures – Implemented
Quantitative estimate of effects – see Table 4.19
Measures implementing Community legislation – Council regulation 1290/2005/EC, Council regulation 1698/2005/EC, Council regulation 144/2006/EC, the Lisbon Strategy, the sustainability principles determined in Gothenburg

Support of agro-environmental management
Objective of measures – the aim of the agro-environmental management measure is to establish the production structure in accordance with the land conditions, to create environmentally friendly farming and sustainable agricultural practice, to improve the state of the environment, to produce quality food as well as to maintain the viability and improve the economic efficiency of farms.
Type of measures – Economic; regulatory
Status of measures – Implemented
Quantitative estimate of effects – see Table 4.19
Measures implementing Community legislation – Council regulation 1290/2005/EC, Council regulation 1698/2005/EC, Council regulation 144/2006/EC, the Lisbon Strategy, the sustainability principles determined in Gothenburg

Animal welfare payments
Objective of measures – partial compensation of the losses of income stemming from the over-compliance of the basic animal welfare requirements as well as of the emerging additional costs; propagation and wider acceptances of the animal production practices aligning better with sustainable development, with minimisation of adverse environmental impacts and with higher quality work; projection of the expected further development of the current regulation; improvement of producers' adaptiveness through guiding the development of the regulatory approach
Type of measures – Economic; regulatory
Status of measures – Implemented
Quantitative estimate of effects – see Table 4.19
Measures implementing Community legislation – Council regulation 1290/2005/EC, Council regulation 1698/2005/EC, Council regulation 144/2006/EC, the Lisbon Strategy, the sustainability principles determined in Gothenburg

First establishment of agro-forestry systems on agricultural lands
Objective of measures – the main objectives of the measure are: to preserve the rural landscape and biodiversity, to improve biodiversity, to establish mosaic-like landscape structure, to comply with the environmental objectives. Beside these the aim of the measure is the diversification of the activities of rural population, the alternative use of agricultural areas, the enhancement of the security of forest management
Type of measures – Economic; regulatory
Status of measures – Implemented
Quantitative estimate of effects – see Table 4.19
Measures implementing Community legislation – Council regulation 1290/2005/EC, Council regulation 1698/2005/EC, Council regulation 144/2006/EC, the Lisbon Strategy, the sustainability principles determined in Gothenburg

Afforestation of agricultural lands
Objective of measures – the main objectives of the measure are: to increase the size of the afforested area, to improve the state of the environment, to strengthen the environmental, economic, social-public welfare role of woodlands, to increase the size of the afforested area of the country. Through all these the aim is to widen rural employment and the opportunities for getting income.
Type of measures – Economic; regulatory
Status of measures – Implemented
Quantitative estimate of effects – see Table 4.19
Measures implementing Community legislation – Council regulation 1290/2005/EC, Council regulation 1698/2005/EC, Council regulation 144/2006/EC, the Lisbon Strategy, the sustainability principles determined in Gothenburg

Natura 2000
Objective of measures – the objective of the measure is to maintain the good natural health of the appointed Natura 2000 sites, to ensure the protection of the natural values grounding the appointment, to encourage and support the economic activities maintaining the state of nature grounding the appointment
Type of measures – Economic; regulatory
Status of measures – Implemented
Quantitative estimate of effects – see Table 4.19
Measures implementing Community legislation – Council regulation 1290/2005/EC, Council regulation 1698/2005/EC, Council regulation 144/2006/EC, the Lisbon Strategy, the sustainability principles determined in Gothenburg

Forest-environmental payments
Objective of measures – the objective of the measure is to create and ensure the ecological basis of sustainable forest management, contributing to the maintenance and increase of biodiversity, as well as to the protection of waters and soil. The aim is the use of forest management practice most adapting to the land conditions in order to enforce the multi-purpose functions of the forests simultaneously, the propagation of the environmentally aware forest management practice. Beside these the aim is to promote the establishment of rural workplaces and employment, to introduce forest management methods ensuring the balance of the ecological-economic conditions of sustainability.
Type of measures – Economic; regulatory
Status of measures – Implemented
Quantitative estimate of effects – see Table 4.19
Measures implementing Community legislation – Council regulation 1290/2005/EC, Council regulation 1698/2005/EC, Council regulation 144/2006/EC, the Lisbon Strategy, the sustainability principles determined in Gothenburg

Restoring forestry potential and introducing preventive actions
Objective of measures – the objective of the measure is to mitigate and eliminate the factors endangering the satisfaction of the public welfare, free time and environmental demands of the society; to eliminate and prevent the abiotic and biotic damage, so to maintain and increase the variety of species through this. It is a further aim to reduce the risks of forest management, to prevent and eliminate the damage endangering the ecological, public welfare services of the forests
Type of measures – Economic; regulatory
Status of measures – Implemented
Quantitative estimate of effects – see Table 4.19
Measures implementing Community legislation – Council regulation 1290/2005/EC, Council regulation 1698/2005/EC, Council regulation 144/2006/EC, the Lisbon Strategy, the sustainability principles determined in Gothenburg

Support for non-productive investments
Objective of measures – the objective of the measure is to establish the appropriate rate of composition and multilevel stand structures in the forests, to improve the natural character, biodiversity and the health of forests, to encourage and support the conversion of the non-indigenous forest stands with a degraded structure into indigenous forest stands.
Type of measures – Economic; regulatory
Status of measures – Implemented
Quantitative estimate of effects – see Table 4.19
Measures implementing Community legislation – Council regulation 1290/2005/EC, Council regulation 1698/2005/EC, Council regulation 144/2006/EC, the Lisbon Strategy, the sustainability principles determined in Gothenburg

4.3.7.2. Quantitative estimation of effects

No estimations were performed for the concrete, single impacts of the aforementioned measures on the GHG emissions. The summarised impact of the entire measure group estimated for the period 2010-2025 is the following (see also the relevant parts of Chapter 4.):

		2010	2015	2020	2025
Decrease in GHG emission	Gg CO2-Eq.	-104.82	-715.39	-1,244.56	-1,806.47
	%	-1	-7	-11	-15

Table 4.19. Effect of measures in agriculture

4.3.7.3. The Implementation of the Nitrate Directive

Hungary's Government Decree 27/2006 (7 February) lists nitrate-sensitive areas specifying the settlements (1779 settlements) and makes reference to "Good Agricultural Practices" whereby farmers will be able to meet the criteria articulated in Directive 91/676/EC, known as the Nitrate Directive. The rules of these "Good Agricultural Practices" are set forth in Annex I of the Govt. Decree 49/2001 (3 April) as amended by Section 14 paragraph (2) of the Govt. Decree 27/2006 (7 February). The action programme includes the pursuit and enforcement of "Good Agricultural Practices," with aid and funding allocated for this purpose in the National Rural Development Plan and under the ARDOP.

The analysis of the sensibility and the nitrate concentration of waters led to the designation of nitrate-sensitive areas and the compilation of an Action Programme for the period 2002-2012. The nitrate sensitive areas with respect to underground water supplies were designated, on the basis of sensitivity categories established by Govt. Decree 219/2004 (21 July) "on the protection of the underground water supplies." In respect of surface waters, the "highly nitrate-sensitive" designation was reserved for areas subject to Govt. Decree 240/2000 (23 December) "on the designation of surface waters and their catchment areas that are sensitive to settlement waste water treatment." (watershed areas of larger lakes and watershed areas of drinking water reservoirs.) The action programmes are divided into four-year phases by enabling revision every four years based on data reported regularly by farmers and on the findings of periodic site inspections.

4.3.7.4. Agro-Environmental Programme

Hungary's National Rural Development Plan contains the rural development measures financed by the Guarantee Section of the European Agricultural Guidance and Guarantee Fund. It designates the objectives ensuring the sustainable development of rural areas, the measures serving their implementation and the activities which can be supported in their frameworks. Furthermore, it determines the conditions for making use of the supports as well as the detailed rules of implementation.
NRDP supports the environmentally friendly agricultural production, provides assistance for farming in less favoured areas and for increasing the forest cover in the country.
Furthermore, the measures of the plan contribute to the improvement of economic viability of semi-subsistent farms and the setting up and operation of producer groups.
Starting the autumn of 2004, applications were received for the following six measures:

- Agri-environment.
- Support for less favoured areas,
- Support of afforestation of agricultural lands,

- Support of compliance with the environmental, animal welfare and hygiene stipulations of the European Union (meeting standards),
- Support for semi subsistence farms undergoing restructuring,
- Support of setting up and operation of producer groups.

The supports provided in the framework of the agro-environment measure recognise the additional performance of the environmentally conscious agricultural production and land management or compensate for the losses of income incurred (and may also include a max. 20% surplus as an incentive). The supports in the form of non-refundable grants based upon area or number of animals apply for a period of 5 years at least.

The aims of the support includes the promotion of agricultural restructuring, the enlargement of rural employment and income generating opportunities, the increase of the country's forest cover over the long term and the development of the protection function of the forests for the public good (environmental protection, economic, social, public welfare).

The measure includes three different types of support: supports granted for forest plantation and the related complementary measures, the support granted for nurturing the forest plantation and the income substitution support of forest plantation, in the form of non-refundable flat rate support. The measure can be deemed successful with 44000 ha afforestation already approved. According to the forecasts afforestation of 69000 ha of agricultural land will take place during the programme period.

4.3.8. Forestry and land-use change

4.3.8.1. Forest Act

27 April 2009 a new Forest Act was passed by the Parliament (Act XXXVII. of 2009). Among others the supports climate change related efforts indirectly. Major new elements of this Act can be summarised as follows.

Target and objectives

The Act acknowledges the possible role of forests in mitigating climate change. According to the Forest Act, "The objective of the Act is, ... by establishing the conditions of sustainable forest management, ... to especially contribute to reducing the impacts of climate change".

The new Act explicitly notes that the most important task of forest management is to maintain the diversity of forests, the forests themselves, the regeneration of forests, as well as to ensure that forests can fulfil their environmental and protection purposes. These are obviously pre-requisites for adaptation to climate change.

The new Act states that any income from the non-wood benefit of forests is to be used to maintain and protect forests and to increase forest resources.

The new Act has clearly moved towards ensuring that forest management develops itself towards close-to-nature forestry. To this end, the Act defines different types of forests according to their state of naturalness and it states that this naturalness cannot be reduced, rather, it should be enhanced.

The new Act maintains and re-enforces the historical system of forest management planning, which has proved to be a useful means of ensuring sustained yield and, recently, sustainable forest management in a broader sense.

- As an important element of ensuring sustainability, the new Act requires that harvested areas are regenerated, with natural regeneration being the preferred method if applicable.

Recently, illegal logging has become a problem in many rural areas, however, only at a small scale. In order to tackle the problem, the new Act includes several provisions that aim at preventing such illegal logging.

According to the new Forest Act, "forest" is defined by the following criteria:

- it contains a stand of forest tree and shrub species and approved types of artificial and natural hybrids, listed in relevant provisions,
- its mean width, measured between the stumps of the lateral rows, is at least 20m,
- its minimum area is 0,5 ha,
- the minimum mean height of trees is 2m
- the crown closure is minimum 50%, except for soil protecting forests where this minimum closure is 30%.

The integrated EU legal background is the Forestry Strategy and the "Resolutions of the Ministerial Conference on the Protection of the Forests in Europe (MCPFE)". The new Act replaces the previous Forest Act (Act LV. of 1996).

4.3.9.2. National Afforestation Programme

The National Afforestation Programme was accepted as an inter-sectoral integrative mid-range policy, based on the 1110/2004. (X.27.) Govt. Decree, as it was presented in the previous Biannual Report. The following figures show the resulting tendencies in afforestation and wood harvest.

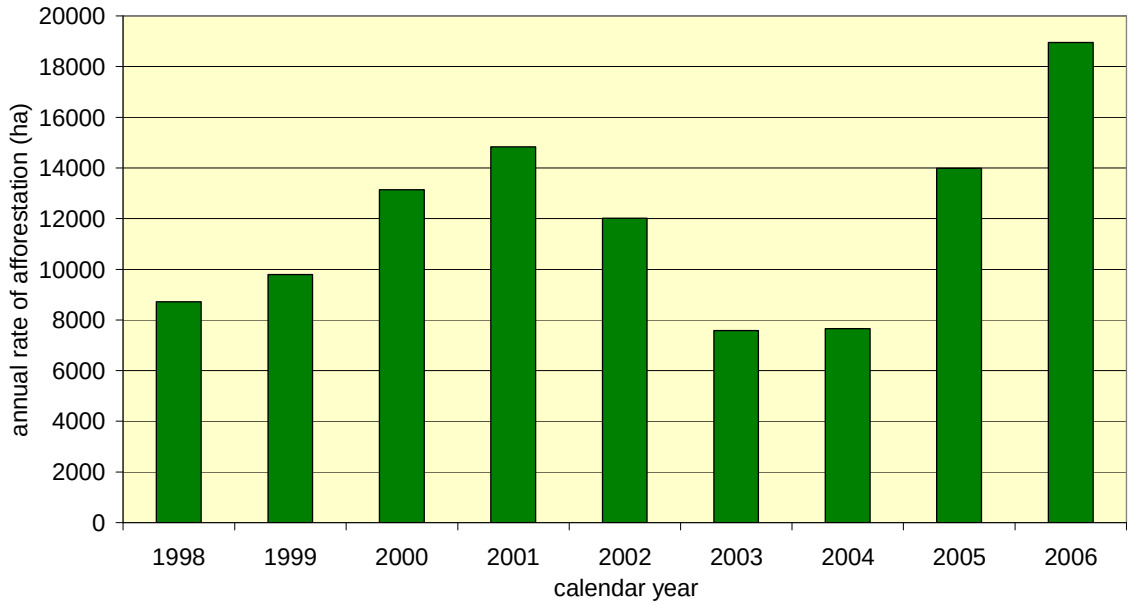


Figure 4.1 Annual rate of afforestation

Source: ERTI, 2008

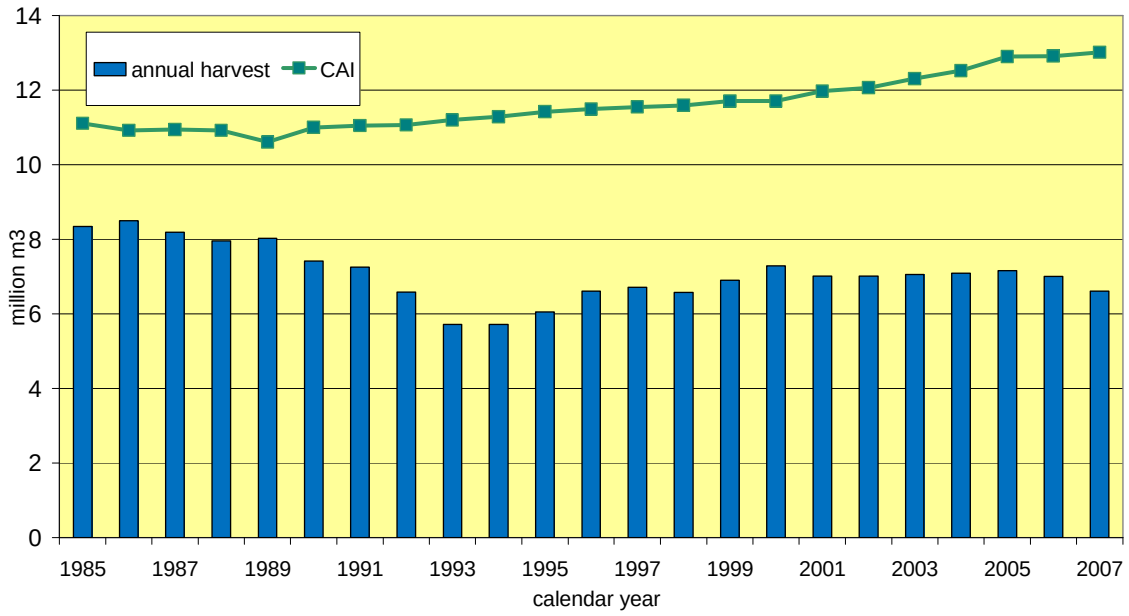


Figure 4.2 Annual harvest and current annual increment

Source: ERTI,2008

4.4. Policies And Measures No Longer In Place

Energy sector

Power Sector
The New Electricity Act replaces the old Act (Act CX of 2001).

Energy efficiency
The long-term energy savings programme started in accordance with the Govt. Resolution 1107/1999. (X.8.) The Ministry of Economy and Transport (GKM) and its legal predecessors supported 240,000 applications, the vast majority of which was aimed at modernising household energy use. In 2007, the name of the launched application system was 'For a Successful Hungary' household energy savings and credit programme. In parallel with the application system of the GKM, a number of other energy saving schemes were in operation: the Energy Saving Credit Fund and the PHARE credit provided preferential loans; the Residential Energy Saving Programme supported the modernisation of the energy systems of homes built using industrial technologies; while the Environmental Protection and Infrastructure Operational Programme provided non-reimbursable support for energy saving investments.

The previous programmes (taking into account the preferential loan opportunities that have been in operation since 1991) reduced energy consumption in Hungary by 17-18 PJ/year by providing a total HUF 40 billion of support.

ETS – 1st National Allocation Plan
Since 1 December, 2008 the 66/2006. (III. 27.) Govt. Decree on the National Allocation Plan and Allocation List for the period 2005-2007 is no more in force.

Agriculture and forestry

Energy crops support with land based subsidies
The Decree 28/2005. (IV. 1.) of the Ministry of Agriculture which allocated EUR 946,000 for the production of energy crops (both wood and herbaceous plants) and the detailed regulation of the support as codified by the Decree 74/2005. (VIII. 22.) of the Ministry of Agriculture were replaced.

Forestry legislation
The New Forest Act replaced the Act. LV. 1996, the previous Act on forests.

5. Projections And The Total Effect Of Policies And Measures And Supplementarity Relating To The Kyoto Protocol Mechanisms

5.1. Projections

The assigned amount of Hungary has been defined as 542,366,600 Mg CO_2 eq. on the basis of the base year emissions of 115.4 million tons CO_2 equivalent. It is important to note that Hungary's base year is not 1990 but the averaged value of the years 1985, 1986 and 1987 and Hungary has chosen 1995 as its base year for HFCs, PFCs and SF6. Hungary's quantified emission reduction commitment is 94 per cent as included in Annex B to the Kyoto Protocol. Base year emissions can be found in Appendix 1 of the Communication.
The forecasted emissions for the respective scenarios by gases and by sectors are summarised in the following subchapters.

5.1.1. Without measures scenario

The without measures scenario was developed with the intention to have a theoretical trendline to relate the results gained in the "With Existing Measures" and the "With Additional Measures" scenarios. This scenario should be used therefore to gain a comparison of the developed scenarios and have a basis of relation of the results achieved by the technical measures in the respective scenarios and not serve as a realistic projection.

5.1.1.2 Assumptions of baseline (frozen) scenario (without measures)

The assumptions of the frozen scenario are as follows:

- Activity changes described apply to the respective sectors
- Listed technical measures are not applied to any of the sectors of the model
- Renewable energy utilisation stagnates, share does not increase in any sector
- No increase of efficiency was foreseen in the power sector
- The energy demand rises without any energy efficiency measures

With these assumptions we generated the emissions scenarios for the respective sectors considering the activity level changes, the assumed GDP development, population change and other external factors. The fossil plants' thermal efficiency will evolve as forecasted by MAVIR

The results of the "Without Measures" scenario are presented below.

5.1.1.3. Results of the "Without Measures Scenario"

In Table 5.1 and Table 5.2. we present the results of the baseline scenario by gas and by sectors breakdown. In Appendix A Table A.1.1 and A.1.2 we present the full time series of emissions from the base year value.

GREENHOUSE GAS EMISSIONS (CO_2 eq, Gg)	2005	2010	2015	2020
CO_2, without LULUCF	61,098.9	65,366.65	71,313.62	77134,69
CH_4, without LULUCF	8,797.7	9,305,4	10,072.01	10816.56
N_2O, without LULUCF	9,557.6	10,518.81	11,547.08	12,077.51
HFCs	517.6	588,12	706,03	632,78
PFCs	209.4	3,3	14,7	20,11
SF_6	201.0	132,3	208,22	183,1
Total (including LULUCF)	***75,766***	***82,074.58***	***88,853.48***	***92307,94***
Total (excluding LULUCF)	**80,382**	**85,914.58**	**93,861.65**	**100864,8**

Table 5.1. Forecasted greenhouse gas emissions by gases in the baseline scenario

Year	Households	Industry	Transport	Waste	Tertiary	Power supply	Agriculture	All sectors
2005	10,850.94	14,418.99	12,696.43	4,142.00	5,697.42	21,668.74	9,398.28	**78,872.79**
2010	13,421.98	13,942.09	14,746.62	3,171.00	7,738.89	22,846.86	10,047.14	**85,914.58**
2015	13,627.77	16,191.75	16,766.30	3,451.00	7,833.83	25,053.40	10,937.60	**93,861.65**
2020	13,669.33	18,417.63	18,410.19	3,455.00	7,946.09	27,550.77	11,415.75	**100,864.80**

Table 5.2. The reference scenario - results of the Without Measures Scenario, Gg CO_2 quiv. emission

Figure 5.1. and Figure 5.2. illustrate the overall and sectoral tendencies respectively.

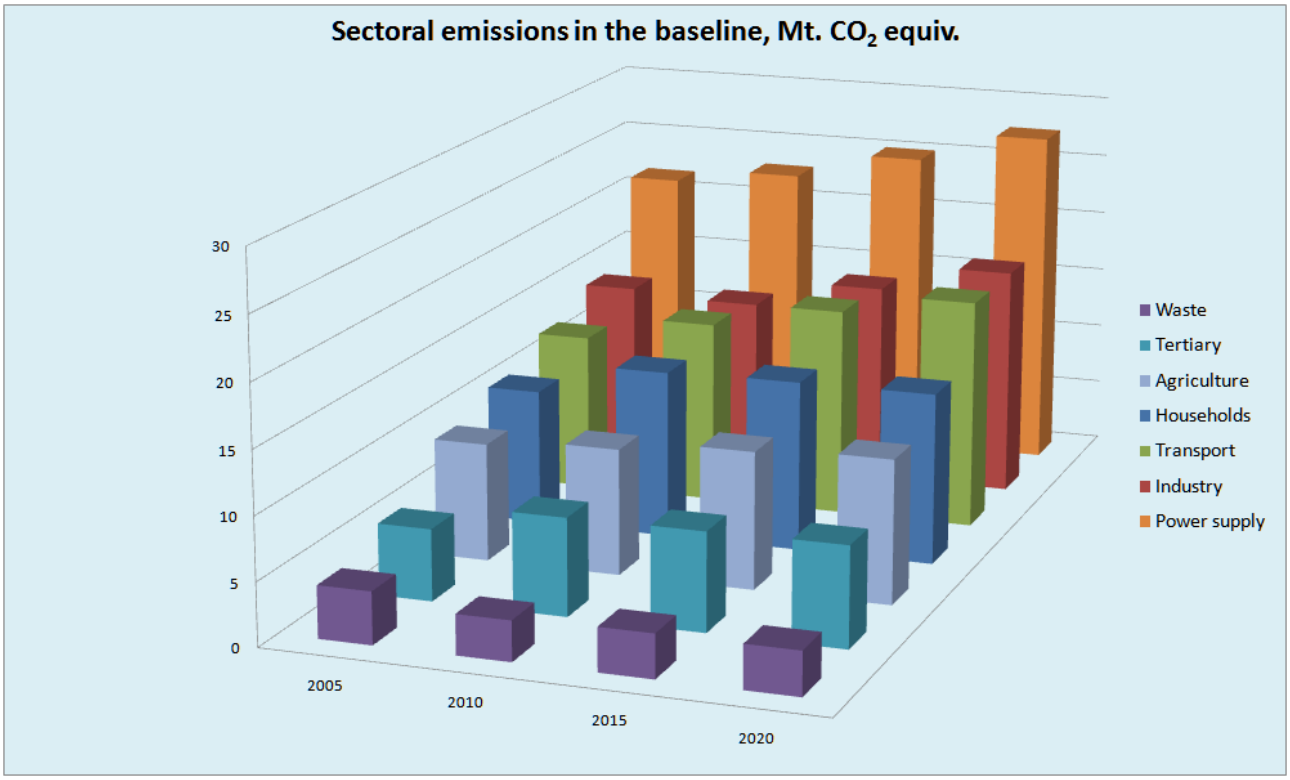


Figure 5.1. CO_2 emissions baseline in sectoral distribution

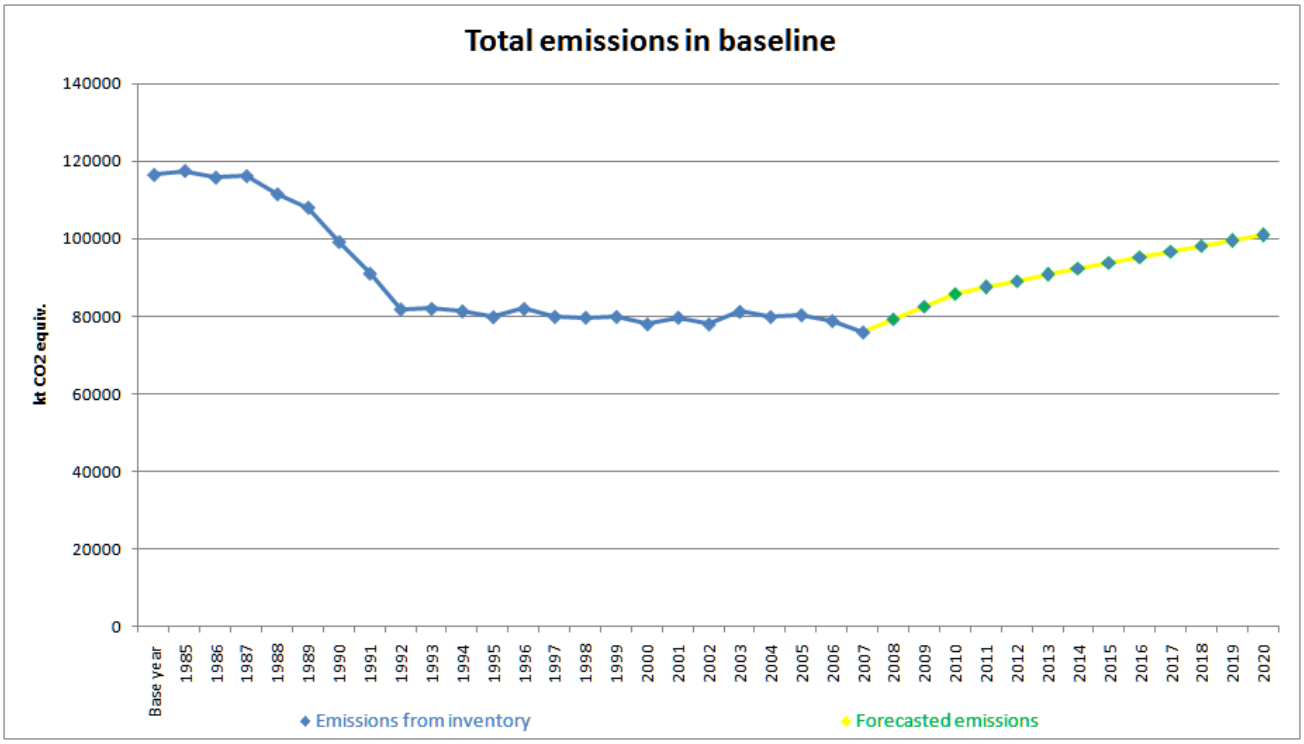


Figure 5.2. Basline total emissions in CO_2 equivalent

5.1.1.4. Agriculture

For the calculations of the baseline the WEM scenario was used. This was because no realistic estimations could be made for the emissions trends without the existing measures.

5.1.1.5. LUCF

For the baseline scenario, a constant rate of 10 thousand ha of afforestation is assumed with predominantly fast growing species. The reason for this is assumed to be that, although there is going to be an increasing interest for afforestations for various reasons (e.g. producing wood for energy, climate change mitigation, income from carbon sequestration etc.), land is going to be less and less available due to the increasing demands for food.

5.1.2. With Existing Measures Scenario

The assumptions of WEM scenario were the application of adopted/implemented policies and measures as presented in the following subchapters, with some additions as follows:

- Renewable policy targets will be achieved according to the base case in the Governmental Renewable Strategy
- Existing policies and measures, as described in the earlier chapters, will be implemented and are considered with the estimated savings potential.

- The effect of modernisation, technological measures in the respective sectors will result in decreasing energy intensity, therefore energy savings arising later will result in smaller emissions savings than those occurring at an earlier period.

Since the framework for post-2013 EU ETS is not yet officially known, we assumed that from 2013 the same measures will be considered as a lower boundary for ETS sectors that is, we assumed, the continuation of the emission cap at the present marker.

Figure 5.3. and Figure 5.4. present the emission trends in the certain sectors and in totals respectively. In Appendix A Table A.1.1 and A.1.2 we present the full time series of emissions from the base year value.

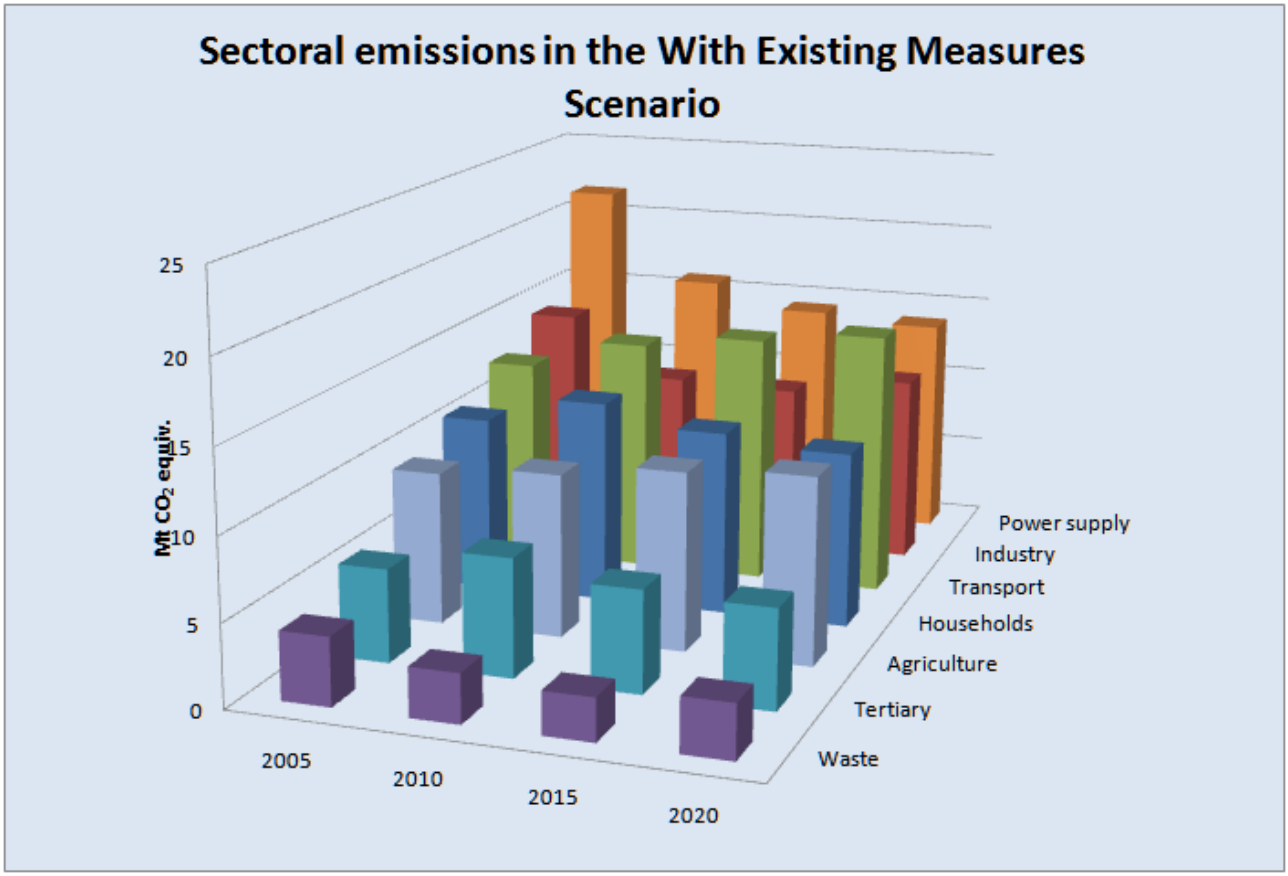


Figure 5.3. Emissions in the WEM scenario in sectoral distribution

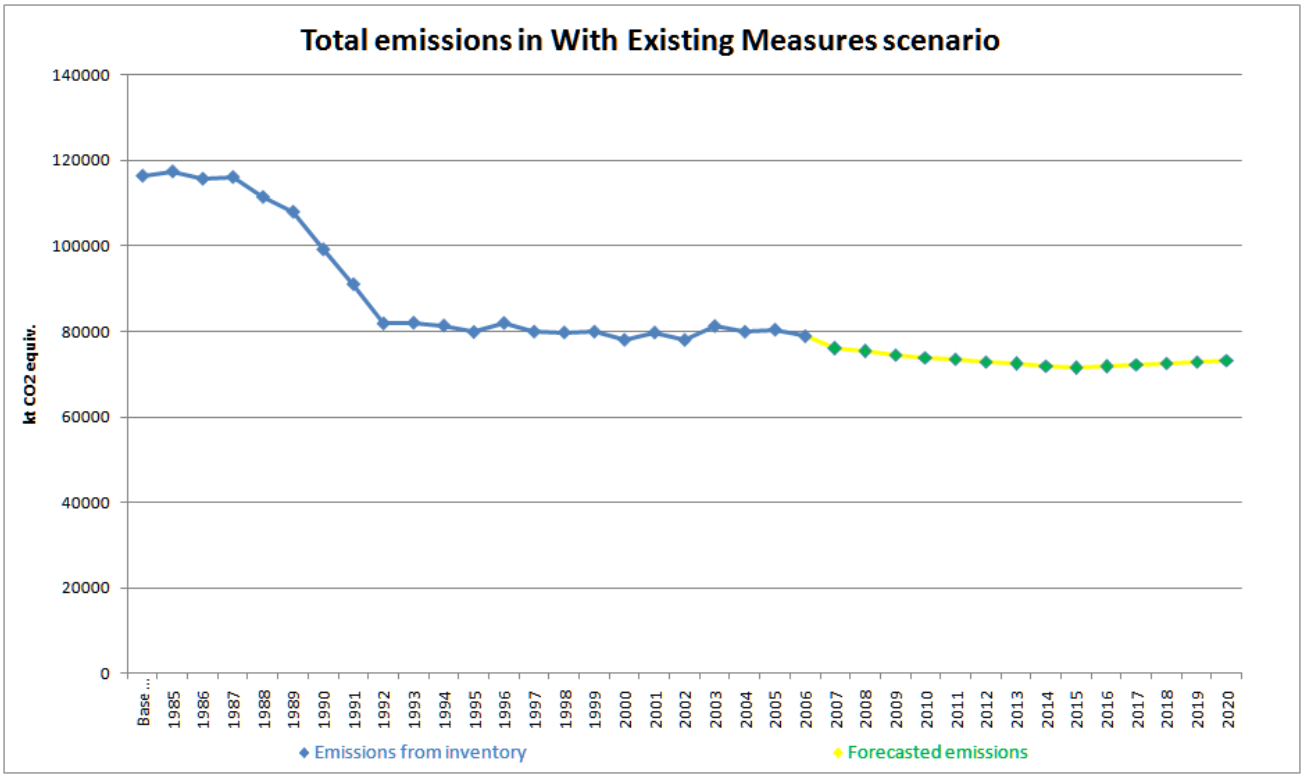


Figure 5.4. Total emissions in the WEM scenario

The following table summarises the forecast for the model run of the With Existing Measures scenario

GREENHOUSE GAS EMISSIONS (CO_2 eq, Gg)	2005	2010	2015	2020
CO_2, without LULUCF	61,098.9	54763,41	51397,13	52686,45
CH_4, without LULUCF	8,797.7	8383,854	8341,032	8691,722
N_2O, without LULUCF	9,557.6	10078,48	10719,98	11062,23
HFCs	517.6	588,12	706,03	632,78
PFCs	209.4	3,3	14,7	20,11
SF_6	201.0	132,3	208,22	183,1
Total (including LULUCF)	***75,766***	***70,109,46***	***66284,87***	***63879,07***
Total (excluding LULUCF)	**80,382**	**73,949.46**	**71,387.09**	**73,276.39**

Table 5.3. Forecasted greenhouse gas emissions by gases in the WEM scenario

Table 5.4 shows the sectoral emissions in the With Existing Measures scenario.

	Households	Industry	Transport	Waste	Tertiary	Power Supply	Agriculture	All sectors
2005	10,850.94	14,418.99	12,696.43	4,142.00	5,697.42	21,668.74	9,398.28	**78,872.79**
2010	12,565.87	10,678.92	14,614.45	2,984.92	7,209.19	15,848.98	10,047.14	**73,949.46**
2015	11,365.48	10,493.12	15,498.75	2,576.28	6,205.35	14,310.45	10,937.66	**71,387.09**
2020	10,772.46	11,685.75	16,276.00	3,265.06	6,021.60	13,839.77	11,415.75	**73,276.39**

Table 5.4. Sectoral emissions in the With Existing Measures Scenario, Gg CO_2 eq.

5.1.3. With Additional Measures Scenario

The assumptions of the WAM Scenario are as follows:

- Renewable energy utilisation will be according to the higher scenario of the Renewable Strategy.
- Measures described earlier will be realised, other planned and possible measures will be implemented
- EU ETS will be prolonged until 2020, with non-ETS sectors taking a 10% reduction obligation (burden sharing). Without any numerical estimation existing at present point, the emissions allowances surrendered can just be forecasted, however the applied modelling framework allows for an assessment of emissions savings generated in the ETS sectors along unit price assumptions made
- Mitigation measures are supported to the fullest possible extent

The following tables and charts summarise the results from the model runs in the WAM scenario:

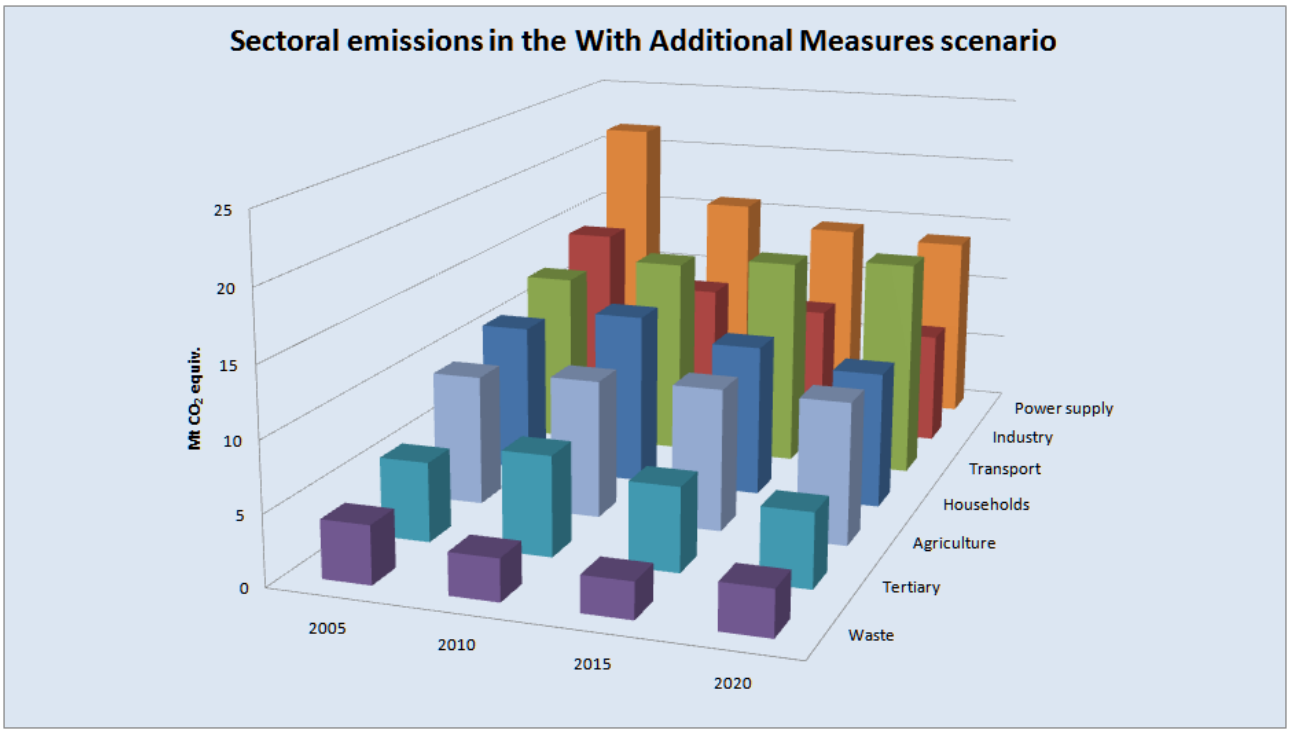


Figure 5.5 Sectoral emissions from sectors, With Additional Measures scenario, Mt Co2 eq.

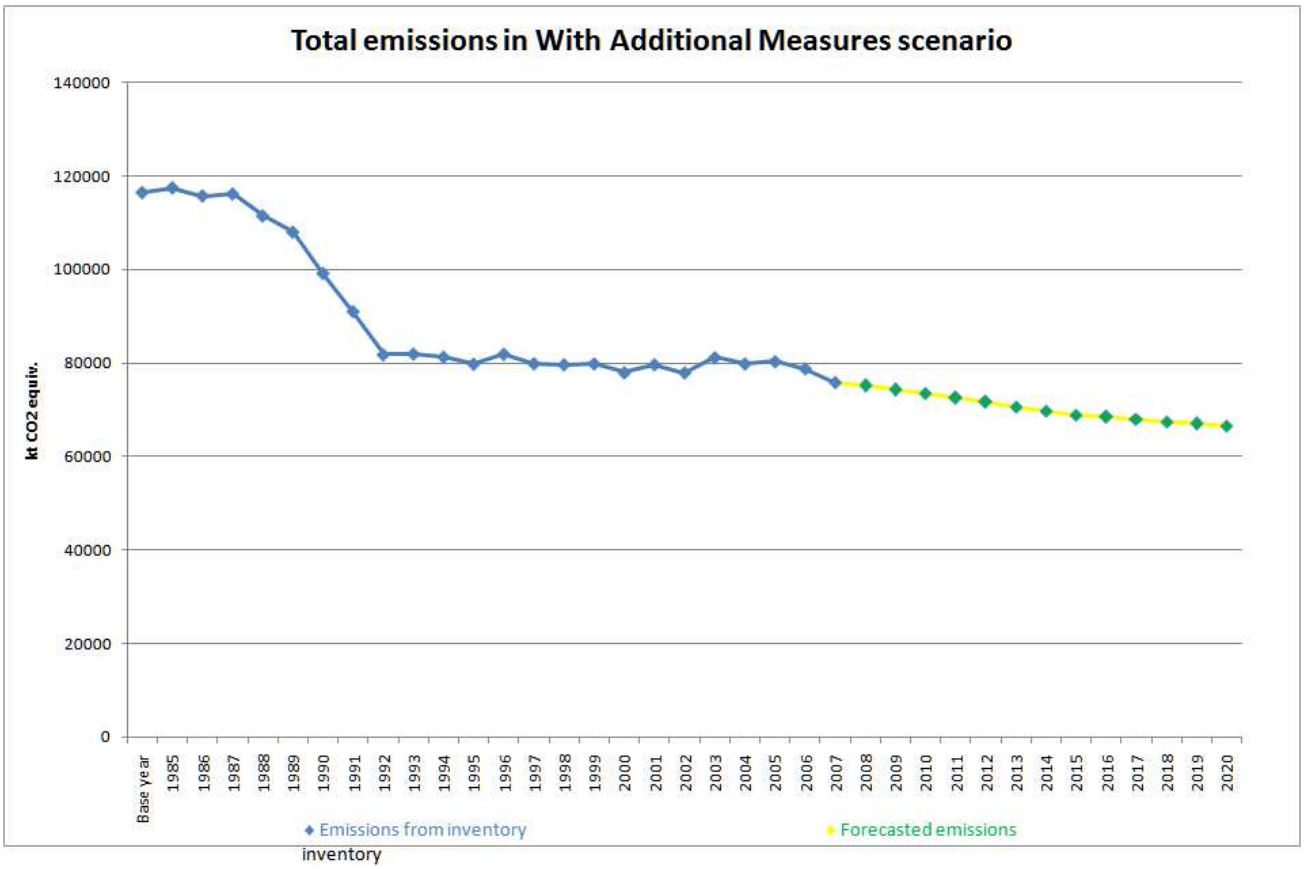


Figure 5.6. Total emissions in the WAM scenario, Mt CO_2 eq.

Table 5.5. summarises the quantified results of the With Additional Measures scenario by gases. Table 5.6. summarises the sectoral emissions in the forecasted years.

GREENHOUSE GAS EMISSIONS (CO_2 eq, Gg)	2005	2010	2015	2020
CO_2, without LULUCF	61,098.9	54459,79	49903,09	47980,81
CH_4, without LULUCF	8,797.7	8291,11	8102,917	8132,542
N_2O, without LULUCF	9,557.6	10013,94	9958,933	9612,604
HFCs	517.6	588,12	706,03	632,78
PFCs	209.4	3,3	14,7	20,11
SF_6	201.0	132,3	208,22	183,1
Total (including LULUCF)	***75,766***	***69648,55***	***62717,55***	***53288,31***
Total (excluding LULUCF)	**80,382**	**73488,55**	**68893,89**	**66561,95**

Table 5.5. Forecasted greenhouse gas emissions by gases in the WAM scenario

Year	Households	Industry	Transport	Waste	Tertiary	Power supply	Agriculture	Total emissions
2005	10,850.94	14,418.99	12,696.43	4,142.00	5,697.42	21,713.50	9,398.28	78,917.55
2010	12,479.12	10,487.53	14,558.37	2,984.92	7,155.75	15,880.50	9,942.32	73,488.55
2015	10,980.96	9,499.91	15,280.56	2,576.28	5,990.44	14,343.00	10,222.70	68,893.89
2020	9,839.29	8,259.74	15,857.36	3,265.06	5,288.28	13,881.00	10,171.10	66,561.95

Table 5.6. Emissions from sectors, Gg CO_2 eq. in the WAM scenario

Note that in Appendix A Table A.1.1 and A.1.2 we present the full time series of emissions from the base year value.

5.1.4 Forecast for other emissions

For the purpose of the following areas, expert estimations were made based on discussions with industry representatives and other field experts. Details are presented in Appendix 1. Table A.1.4.

Fluorinated gases (HFCs, PFCs, SF_6)

Results are presented in Figure 5.7.

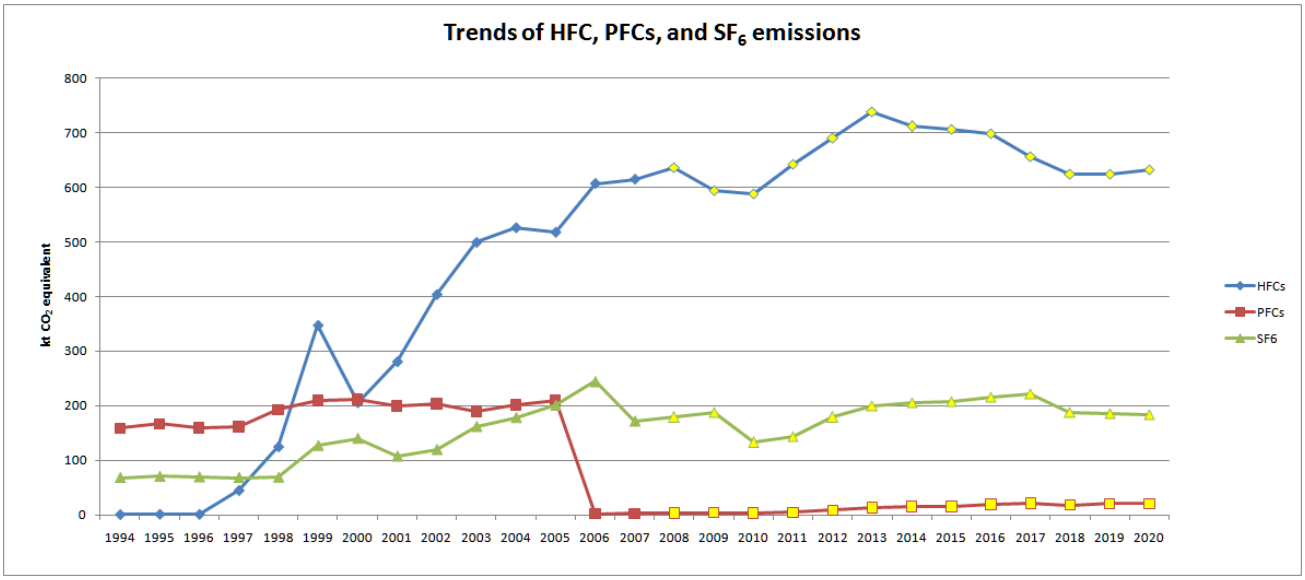


Figure 5.7. Past and forecasted emissions of fluorinated gases[10]

Solvent and other product use

Results are presented in Figure 5.8.

[10] (forecast indicated with yellow markers)

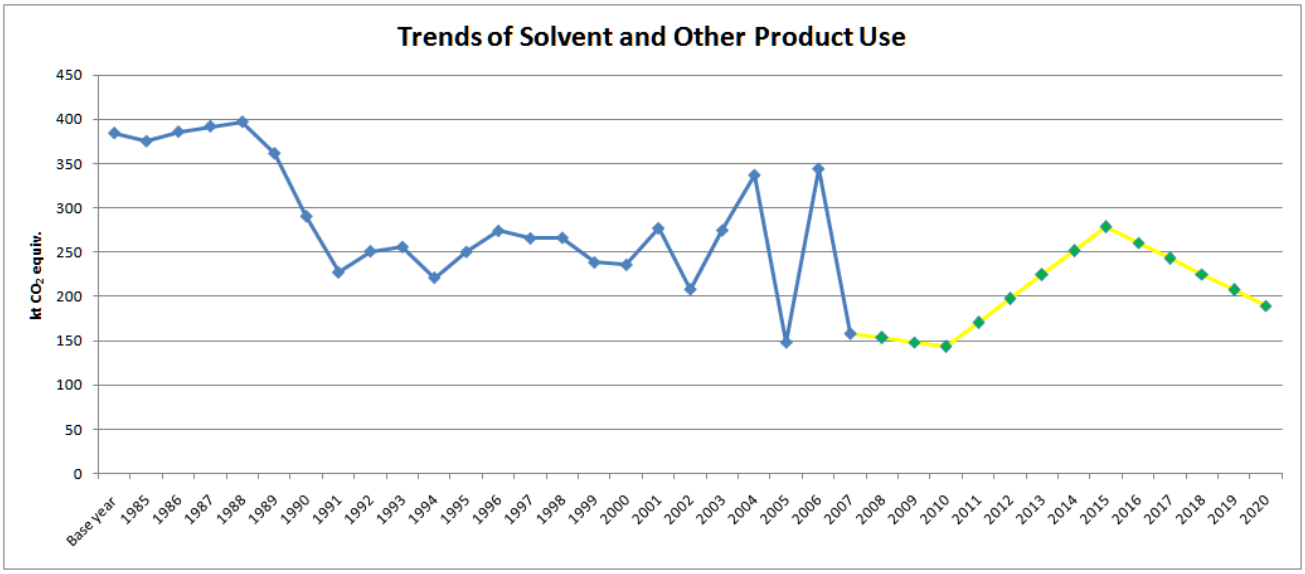


Figure 5.8. Past and forecasted emissions from solvent and other product use[10]

International bunkers

Results are presented in Figure 5.7.

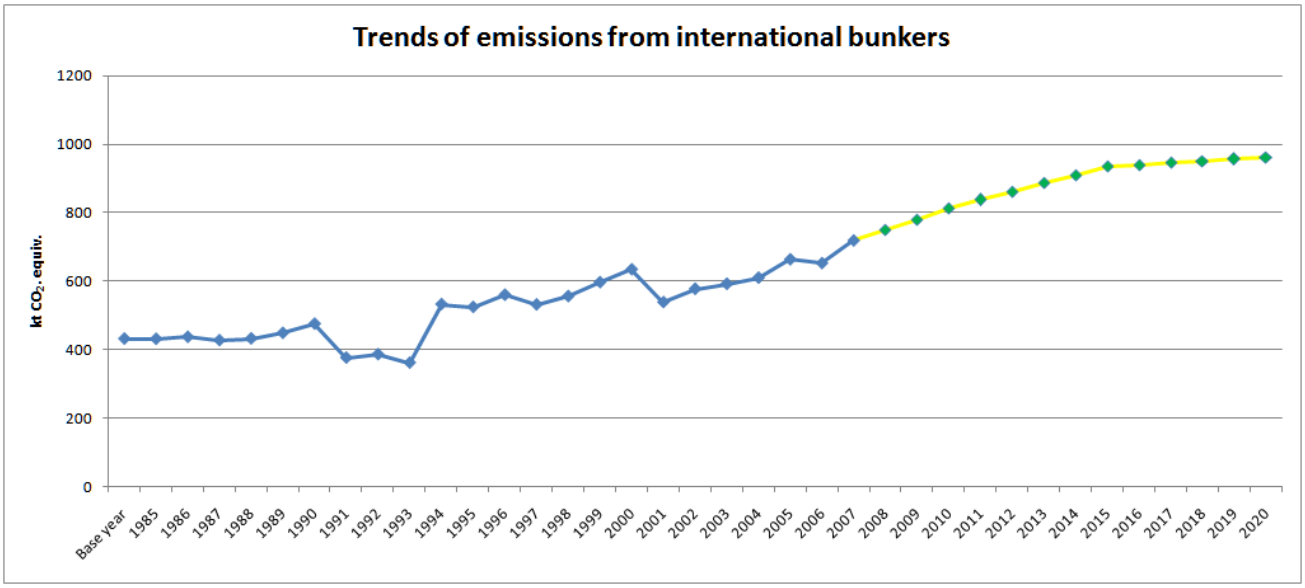


Figure 5.9. Past and forecasted emissions from international bunkers

5.1.5. Modelling assumptions

The assumptions used in modelling emissions from the energy intensive and waste sectors with the HUMIT model system are presented below. Assumptions for the agricultural and LUCF calculations are presented in separate subchapters.

(Note that all mitigation impacts – unless indicated otherwise – are given compared to the 2005 base year values, e.g. an expected savings in general terms are given for the 2005 basis values).

Key assumptions used in modelling

Table 5.7. presents the key assumptions on the main variables used for modelling. From size considerations, the full set of variables are presented in Appendix 2.

	Assumptions used for main variables		
Variable name	**2010**	**2015**	**2020**
GDP growth	+4,05%	+3,20%	+4,43%
Power production (TWh/a)	39 ,151	46, 136	52 ,544
Emission factors for electricity	729.9	691.7	668.9
Population (M souls)	10,0	9.,80	9.60
Managed waste disposal on land (Mt)	2.8	2.8	2.2
Number of kilometers by passenger cars, Mkm	2136,525	2477,872	2850,119
Fossile plants thermal efficiency (η)	0.35	0.40	0.41
Coal price development (Eur/kWh)	0.023	0.0244	0.0259
Oil price development (Eur/kWh)	0.045	0.0477	0.0506
Gas price development (Eur/kWh)	0.047	0.0498	0.0528

Table 5.7. Key assumptions and variables used in forecasting

Base year construction
A well defined base year is the starting point for a reference scenario which is determined for each (sub)sector by the following parameters:
- physical activity level
- energy use per type of fuel
- GHG emissions

Based on these parameters the energy and emission intensity is calculated for each (sub)sector.

To create this complete base year overview, individual parameters have been taken from various data sources and checked with the main statistics and literature sources as the National Inventory Report, the National Allocation Plan and the National Energy Statistics. For specific sectors other sources also have been used. PRIMES 2007 (version 3) has been used to complement national data sources and has mainly been used for identification of the activity levels.
For the construction of the emissions, the emission factors from IPCC have been used.

Future reference situation

The future reference situation is defined as the growth of the activity levels using a fixed or constant energy (or emission) intensity. The energy or emission intensity is defined as the energy use (or emissions) in the base year relative to the activity level in the base year. As a result of stock turnover (e.g. purchase of new appliances or cars, construction of a new paper plant) efficiency improvements take place in the reference scenario. Other efficiency improvements are not included. These stock turnover analyses also enable the distinction between technical measures for old and new applications.

Power & heat supply

The sector produced 16.9 Mt CO_2 emissions in 2005, 29% of the total national CO_2 emissions (NIR 2007). According to NAP (2007), 15.38 Mt CO_2 emissions were realised through power plant generation and 1.64 Mt by public district heating.

According to the Electricity Statistics Yearbook (HEO, 2006), the electricity consumption of Hungary was 42 TWh in 2005, while the total electricity production was 36 TWh, i.e. about 15% lower. The country is both exporting and importing electricity to and from surrounding countries. The net 15% import is mainly from Slovakia, Romania and Ukraine (Electricity Statistical Yearbook, HEO 2006).

The activity indicator used for the power and heat supply sector is the total amount of electricity and heat generated per plant type. In the reference scenario the power and heat supply sector increases mainly on the thermal plants. The ratio of the nuclear sector remains almost at the level of 2005.

Data are summarised below first for the electricity generation and subsequently for the heat generation.

Electricity generation

Efficiency projections of the thermal power plants and nuclear power plant are based on the projections of MAVIR Capacity Adequacy Report (2007) for 2015 and 2025. This assumes an extension of the Paks nuclear power plant in the period 2010-2015, which is in line with the resolution of the Parliament to extend the lifetime of the power plant (Resolution 85/2005 (XI. 23.) of the Parliament from November 2005 as cited in KVVM, 2007). Among the thermal power plants, existing condensation power plants are expected to be phased out by 2025, while new lignite, coal and CGGT power plants are assumed to be built. Large industrial power plants are also expected to extend their production. The production of the small power plants is expected to increase by factor four. For details of activity level changes, see Appendix 2.

Heat generation

Thermal CHP power plants dominate heat production over the whole projection period, which is in line with the projections of MAVIR Capacity Adequacy Report (2007), which are used for the projection of the reference scenario of nuclear and thermal CHP plants. The total heat generated (an aggregate of CHP heat and heat as output only) is projected based on the growth rates of Primes 2007 (version 3). The activity of Heat-only plants is a residual of Primes 2007 (version 3). Total heat projections decreased based on MAVIR's nuclear and thermal CHP projections. Projections of geothermal and biomass heat-only activity are based on RES Strategy (2008), while the biogas in small thermal power plants is based on background calculations prepared for the RES Strategy (Orbán, 2007) and Energy Centre (2008b). Fossil heat-only output is calculated as the difference of total heat-only and renewable heat-only output.

Within the thermal CHP plants the CGGT power plants are responsible for the biggest increase in heat production among the Thermal CHPs, while no new heat production is expected in coal or lignite power plants. Similarly to power generation, large industrial power plants are expected to extend their heat

production as well. Among the small power plants, both the gas engine and gas and steam turbine power plants expand further. Within the latter, the new capacity arises from renewables (biomass, biogas and waste). For details of activity level changes, see Appendix 2.

Primary energy use and CO_2 emissions in the power and heat generation
Energy use of the power and heat plants was compiled based on MAVIR (2007) projections and further disaggregated into different fuel categories based on NAP (2007). Use of renewable energy sources is based on the sources described above.

	Units	2005	2010	2015	2020
Power production	GWh_e	33 200	39 151	46 136	52 544
Existing nuclear	GWh_e	13 012	13 606	14 200	14 200
Total wind, hydro, solar	GWh_e	212	756	960	1 366
Thermal and gas turbine power plants (incl. biomass & waste)	GWh_e	19 976	24 789	30 976	36 979
Heat production	GWh_{th}	20 035	21 033	21 358	21 411
Existing nuclear	GWh_{th}	67	75	83	83
Thermal and gas turbine power plants (incl. biomass & waste)	GWh_{th}	13 187	13 282	14 332	15 000
Heat only plants	GWh_{th}	6 782	7677	6 942	6 328
Fuel use					
Total fuel use	TJ	282 621	321 519	366 124	422 473
Solids	TJ	86 198	84 355	81 442	99 979
Liquids	TJ	8 123	8 931	9 606	8 437
Gas	TJ	163 116	189 579	220 977	227 707
Solid biomass	TJ	21 258	27 139	33 588	54 699
Biogas	TJ	1 162	5 301	11 191	17 157
Waste	TJ	2 764	6 212	9 319	14 495

Table 5.8. Energy use in the power and heat supply sector officially forecasted by MAVIR-Hungarian Grid Operator

Total fuel use increases from 283 PJ (2005) to 479 PJ (2025). The share of the renewable combustibles and waste rises from 9% of the total fuel use in 2005 to 24% by 2025.

Industry

The industrial sector includes a large range of subsectors. The total list of activity indicators used in the reference scenario with their related growth factors are summarised in Appendix 2. The iron and steel industry was the largest contributor to the total CO_2 emissions (see **Hiba! A hivatkozási forrás nem található.**0.) both in 2005 and 2025. In 2005 N_2O process emissions from nitric acid production were 5.4 kt N_2O (1.7 Mt CO_2 equivalents). However, with the commissioning of a new 1,500 ton per day nitric acid production facility by Nitrogén Művek Co., replacing the existing nitric acid plants, these emissions are reduced to approximately 0.02 kt N_2O (7 kt CO_2) in 2010–2025 (information based on Nitrogen and Syngas, 2008). For details of activity level changes, see Appendix 2.

	2005	2010	2015	2020	2025
Iron and steel sector	32%	29%	26%	23%	22%
Non ferrous sector	2%	2%	2%	2%	2%
Chemical sector	16%	17%	17%	18%	19%
Non-metallic mineral sector	14%	16%	20%	22%	21%
Paper and pulp sector	2%	3%	3%	4%	4%
Food drink tobacco sector	8%	8%	8%	8%	9%
Engineering sector	5%	5%	6%	6%	6%
Textiles sector	1%	0%	0%	0%	0%
Other industries sector	3%	3%	3%	3%	3%
Mining sector	0%	0%	0%	0%	0%
Refinery production	15%	14%	13%	12%	11%
Cokeries/patent fuel and briquetting plants	2%	3%	2%	2%	2%

Table 5.9. Contribution of each of the subsector to the total industry CO_2 emissions (%)

Residential sector

In 2005, the residential sector was responsible for approximately 30% of total national carbon dioxide emissions, that is, the largest share among all energy end-use sectors in Hungary (ODYSSEE, 2007).

Modelling the residential sector, including the base year and reference scenarios, a study named "Carbon dioxide mitigation potential in the Hungarian residential sector" was accomplished with the supervision of the Ministry of Environment.

The residential sector includes emissions and fuel use from space heating, hot water and appliances. Based on the last household survey in 1996, the largest energy end-users are space heating and cooking, followed by water heating and other energy uses (such as lighting and electric appliances).

The activity indicator for the residential sector is the number of the occupied dwellings (households) and the number of appliances (including electrical appliances, water heaters).

An overview of growth rates of activity indicators for electric end-uses in the Hungarian residential sector is presented in Appendix 2.

Tertiary sector

Total final energy used in the Hungarian tertiary sector is approximately 155 PJ in 2005. Out of this amount, natural gas accounts for almost 70% of the total final energy, while electricity for 23% and district heat for 6% of the final tertiary energy use (IEA, 2008). The total CO_2 emissions from the Hungarian tertiary sector (including space heating, domestic hot water use and electricity use) amount to 5,686 kt CO_2 (NIR 2007).

The forecasting of the tertiary sector is split into a discussion on space heating and electricity consumption.

Space heating

Similarly to the residential sector, space heating is the main end-use in tertiary buildings. Water heating is important for the health care subsector. The activity indicator used for space heating is the tertiary building stock. This is similar to the residential sector, with the exception that while residential sector deals with households, the tertiary sector focuses on the buildings.

The tertiary sector is divided into seven subsectors: education, health care, public administration (PA), commercial office buildings, trade, hotels, restaurants and miscellaneous (which includes social and cultural buildings and non-heated buildings).

The building stock was constructed based on a set of various growth indicators relevant for each sub-sector and it will grow by 6% during the projected period (from 275,000 buildings in 2005 to 291,000 by 2025 (for details on projections and the building stock see Appendix 2).

The growth rates of different sub-sectors of the tertiary buildings in Hungary are presented in Appendix 2.

Appliances and lighting

In the base year 2005, electricity consumption in the Hungarian tertiary sector constituted about a third of total Hungarian electricity consumption (IEA, 2007). Moreover, electricity consumption of the Hungarian tertiary buildings has been steadily growing over the last 40 years and in the period 1995-2005 its annual growth rate was 2%, which is higher than in other sectors of the Hungarian economy (IEA, 2004, 2006, 2007). Although numerous studies predict improvements in efficiency of electrical equipment, appliances and lights, these devices are still expected to significantly contribute to increasing electricity demand due to constantly growing penetration of electric equipment and appliances as well as introduction of new equipment and devices, especially those of information and communication technologies, coupled with growing purchasing power of businesses, increasing sizes of indoor areas and facilities and other factors (Bertoldi and Atanasiu, 2007).

To estimate electricity consumption in the Hungarian tertiary sector, a stock of appliances and stock of light bulbs have been chosen as activity indicators for the sector. Electricity consumption of the following appliances and light bulbs has been considered:

- lighting,
- computers and monitors,
- office imaging equipment,
- fans for ventilation and HVAC,
- vending machines.

An overview of the activity indicators used for modelling in the Hungarian tertiary sector can be found in Appendix 2.

Transport

As in all sectors, the base year 2005 was used for the transport sector as well. The activity data used are passenger km for passenger transport and tons km for freight. The basis for the energy use and the activity indicators are from Central Statistic Office, PRIMES (2007, version 3) and the report "European energy and transport: Trends to 2030 – Update 2007" (DG TREN, 2007). The split between the different modes is done based on energy data from PRIMES and on CSO (2006). Different data have been taken for motorcycles, rail and aviation. These were based on data from CSO and from KTI Institute for Transport Sciences (2006).

The stock turnover for activity data is done in a simple approach. It is assumed that the lifetime of motorcycles is 15 years, of cars, trucks and buses it is 20 years. The distribution of the stock is assumed to be evenly distributed.

The fuel consumption for diesel and gasoline are taken from the NIR. For the remaining PRIMES (2007, version 3) data are used. To split the fuel use according to the different modes, data from the Transport Scientific Institute (2006) were taken as the basis:

The emissions are calculated based on the standard IPCC emission factors. The emissions have been compared with the NIR and the national communications. The total transport emission is 12.7 Mt compared to 11.8 Mt from the NIR (8% difference) and 12.0 Mt from the national communications.

Waste management

The emissions from the waste sector derive from anaerobic digestion of organic waste resulting in methane emissions and emissions of CO_2 from waste incineration. The activity indicator used is the amount of waste (see Table 5.12.). In the baseline it is assumed that the produced communal solid waste will grow by 2%

annually in the next decade (GKM, 2008). In the coming years it will significantly be lower, around 5‰ (MKM Consulting, 2006).

The share of land disposal both in nominal value and in percentage will drop. This decrease is on the account of growing incineration capacity (besides new incinerator capacity industrial combustion of high energy content waste is calculated, e.g. cement kilns or power plants). Some of the disposal will be replaced by composting (here the capacity is limited by the composition of the waste) and also reuse and recycling of certain part of the waste will lower disposal volumes.

5.1.6. Projections for agriculture

For the period 2015-2020 the volume of agricultural production was forecasted on the basis that the production on the long run will approximate the level adequate to the ecological potential of the country due to the increasing food demand on the world market, to the expansion of export opportunities and to the measures of the NHRDP.

As regards technical measures – out of the principally possible measures – the reduction of the agricultural nitrogen cycle load (cut-back of excess nitrogen in feeding, rationalisation of fertilizer use) and in the field of milk production the intensification of production and the increase of milk yield were taken into account.
The emissions calculated for the period 2010-2025 were calculated according to the actual NIR (National Inventory Report for 1985-2007 Hungary, April 2009) methodology.

As real emission reduction possibilities the reduction of the N-excretion of livestock, the rationalisation of N-fertilizer use as well as the increase of the milk yield of dairy cattle were taken into account both in the framework of the Scenario "With Existing Measures" and of the Scenario "With Additional Measures". Compared to the other scenario, the Scenario "With Additional Measures" uses a value of nitrogen release higher by 10-35%, of the use of nitrogen active agent lower by 5-10% and of the increase in milk yield higher by 10%.

By 2025 the entire greenhouse gas emission of the Hungarian agriculture sector will have been risen by 26% compared to the value of 2005 according to the Scenario "With Existing Measures" and according to the Scenario "With Additional Measures" by 7%. The reason for the increase is the expected increase of agricultural production. At the same time, the values expectable by 2025 hardly reach 61% (Scenario "With Existing Measures") and 52% (Scenario "With Additional Measures") of the base years (average of the years 1985-87).

	Agriculture Total, in CO_2-Eq. [Gg year^{-1}]		CH_4 [Gg year^{-1}]		N_2O [Gg year^{-1}]	
	Sc. WEM	Sc. WAM	Sc. WEM	Sc. WAM	Sc. WEM	Sc. WAM
2010	10,047.14	9942.32	128.10	125.37	23.73	23.58
2015	10,937.66	10222.27	135.47	133.27	26.11	23.95
2020	11,415.75	10171.19	145.25	143.25	26.99	23.11
2025	11,819.35	10012.88	156.15	153.93	27.55	21.87

Table 5.10. – Projected GHG-emissions from Hungarian Agriculture (2010-2025)
Sc. WEM – Scenario "With Existing Measures"; Sc. WAM – Scenario "With Additional Measures"

5.1.7 Projections in the LUCF sector

As it is not clear what land is going to be available with respect to site, two scenarios of the same afforestation rate of different species composition and site fertility will be regarded instead of just one scenario and two scenarios, one with fast growing species and better site and one with slow growing species and poorer site are regarded as the borders of the range of the baseline, which thus does not represent a line, rather, a range. In a similar fashion, two scenarios that are only different in their composition of species and site fertility will be regarded as a "with measures" scenario. "With measures" here means that it is assumed that the afforestation rate is gradually increased from the original 10,000 ha a year to 20,000 ha a year by 2025. Finally, a set of two scenarios of different composition of species and site fertility is regarded a "with additional measures" scenario where it is assumed that the afforestation rate is increased by 20,000 ha each year from 2010. This is not necessarily a scenario that will be realised; however, afforesting this amount of land **in average** in the next 15 years is very much possible if such a decision is made.

All scenarios were run by CASMOFOR. The results of the calculations to estimate the amount of carbon determined for selected years can be found in Table 5.11. below. The trends and ranges are also demonstrated in Figure 5.10.

scenario	PAMs option	scenario	scenario characteristics			amount of C fixed by calendar year (million t CO2)			
			total area (ha) by year	type	site	2015	2020	2025	2100
18	baseline	1 (lower)	10,000 constant	slow	poorer	1.2	4.7	10.7	77.8
10		2 (upper)	10,000 constant	fast	better	1.9	7.3	15.9	74.1
22	with measures	1 (lower)	10,000 -> 20,000	slow	poorer	1.3	5.6	13.7	116.7
14		2 (upper)	10,000 -> 20,000	fast	better	2.1	8.6	20.5	111.5
20	with additional measures	1 (lower)	20,000 constant	slow	poorer	2.3	9.4	21.4	155.6
12		2 (upper)	20,000 constant	fast	better	3.8	14.5	31.8	148.2

Table 5.11. The estimates of the amount of carbon fixed by PAMs options and scenarios for selected years.

Only some general conclusions that can be drawn from the data are included here. As expected, the amount of carbon sequestered strongly depends on the area afforested. Also as expected, species composition and site fertility have a strong effect, which is demonstrated by the difference between the upper and lower scenarios. As no assumption can be made with regard to the site fertility of the land that will be available in the future, the ranges are regarded as estimates for the various PaMs options. However, it is more probable that predominantly fast growing species will be used for afforestation, therefore, actual amounts of removals will be closer to the upper limits of the ranges. Finally, it is emphasized again that several years are needed until the rate of sequestration gets high. This underlines the need for an intensive afforestation as early as possible.

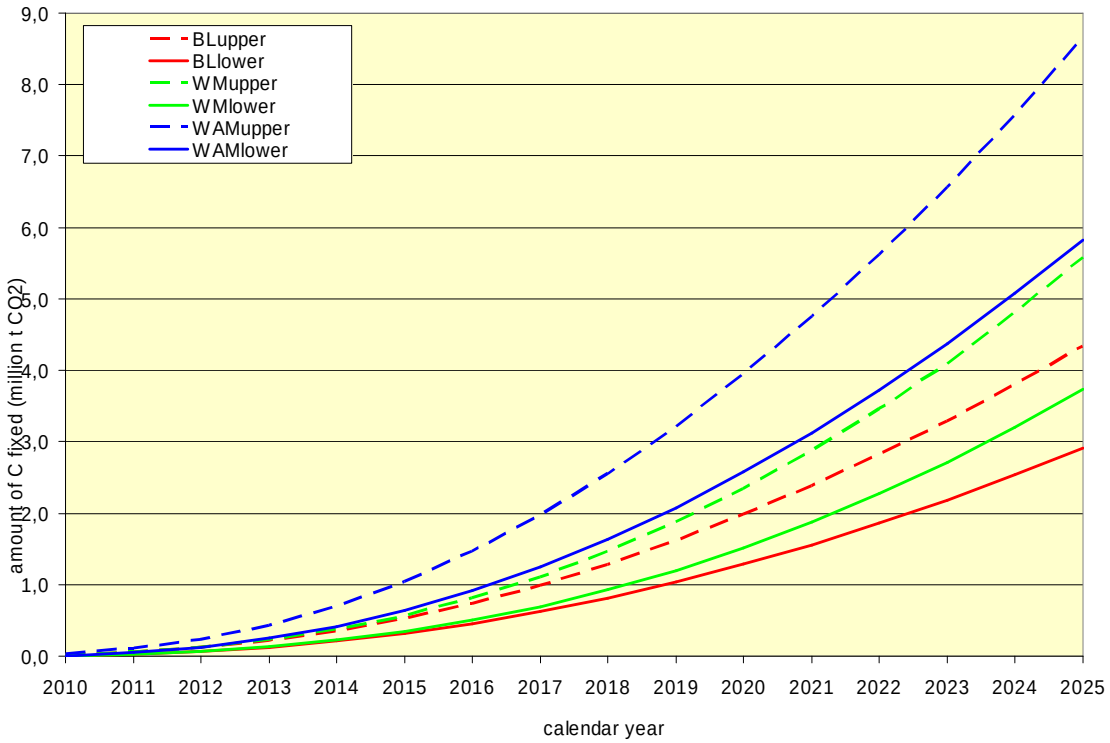


Figure 5.10. The estimates of the amount of carbon fixed by PAMs options and scenarios until 2025.

Note that for the baseline ("BL"), with measures ("WM") and with additional measures ("WAM") PaMs options there are two scenarios each: the lower one ("lower") by assuming slower growing species and poorer sites and the upper one ("upper") by assuming faster growing species and better sites.
It is also noted, however, that, based on the results of the study, the effect of the species composition depends on the length of the projection. In the short run, it seems to be superior to use fast growing species, however, forests of slow growing species sequester more carbon in the long run.

Table 5.12. presents the total net costs of sequestering 1t CO_2 by biomass per calendar year for the various scenarios.

PAMs option	scenario	scenario characteristics			total net costs (€/tCO2) of sequestering 1 tCO2 by biomass by calendar year (1000 HUF per t CO2)		
		total area (ha) by year	type	site	2015	2020	2025
baseline	1 (lower)	10,000 constant	slow	poorer	98	34.2	16.0
	2 (upper)	10,000 constant	fast	better	40.7	9.7	0.1
with measures	1 (lower)	10,000 -> 20,000	slow	poorer	109.0	40.7	21.1
	2 (upper)	10,000 -> 20,000	fast	better	45.4	13.0	2.8
with additional measures	1 (lower)	20,000 constant	slow	poorer	98.5	34.2	16.0
	2 (upper)	20,000 constant	fast	better	40.7	9.7	0.1

Table 5.12. Annual carbon sequestration costs by scenarios

5.2. Assessment of aggregate effects of policies and measures

Policy implications are summarised in Table 5.13.

Name of policy or measure	*Objective and/or activity affected*	*GHGs affected*	*Type of instrument*	*Status (a-adopted/ i-implemented)*	*Implementing entity or entities*	*Estimate of mitigation impact (kt CO_2 equivalent)*		
						2010	2015	2020
National Energy Efficiency Action Plan*	Improvement of efficiency of energy use	CO_2, N_2O, CH_4	Fiscal, economic, education and awareness	A/I	Ministry of Transport, Telecommunication and Energy, National Development Agency	1.258	4.857	5.464
Renewable Energy Strategy	Increase of renewable penetration	CO_2, N_2O, CH_4	Fiscal, regulatory, economic	A/I	Ministry of Transport, Telecommunication and Energy, National Development Agency	6710	9223	11391
Retrofit and capacity enlargement of Paks NPP	Enlargement and lifetime extension of Paks NPP	CO_2	Technical	A	National Atomic Energy Agency, Ministry of Transport, Telecommunication and Energy	-	-	800-1000[11]
EU ETS	Emission Trading	CO_2	Regulatory, economic	A/I	National Inspectorate for Environment and Water, Ministry of Environment and Water Management	2.778	3.801	6.248
TDOP	Transportation modernisation	CO_2	Economic, regulatory	A/I	Ministry of Transport, Telecommunication and Energy	-	50	-
Unified Transport Development Strategy	Transportation modernisation and modality change	CO_2	Economic, regulatory	A/I	Ministry of Transport, Telecommunication and Energy		312	180

Table 5.13. Policy implications on forecasted GHG emissions

5.2.1. Effects of policies and measures in the With Existing Measures Scenario

[11] Implementation expected after 2020

The figures resulting from existing measures in the renewable sector and applied in the respective forecasts are summarised in as follows:

Electricity production from renewables		2005	2010	2015	2020
Total	GWh	1,803	3,972	5,933	7,557
Hydro	GWh	202	196	219	243
Wind	GWh	10	560	741	1,122
Solar PV	GWh	0.1	0.3	0.4	0.5
Geothermal	GWh	0	128	331	520
Biomass	GWh	1,506	2,809	4,140	4,982
Biogas	GWh	25	178	381	547
Renewable from waste	GWh	59	100	121	142
Heat production from renewables		2005	2010	2015	2020
Total	PJ	28.30	39.35	44.03	51.39
Solar TH	PJ	0.08	0.18	0.30	0.42
Geothermal energy	PJ	3.63	4.11	4.76	5.40
Biogas + biomethane	PJ	0.07	0.46	0.91	1.82
Wood, biomass	PJ	23.94	33.55	36.80	42.27
Renewable from waste	PJ	0.57	1.05	1.27	1.49
Heat production from wood and biomass		2005	2010	2015	2020
Breakdown of wood and biomass used for heating	PJ	23.94	33.55	36.80	42.27
District heating	PJ	0.66	1.19	1.93	3.00
Residential + communal	PJ	21.88	30.06	31.59	33.85
Industry + agriculture	PJ	1.40	2.29	3.28	5.42
Total renewable energy utilisation		2005	2010	2015	2020
Total	PJ	49.92	92.39	115.25	135.93
Biofuel	PJ	0.21	10.46	16.27	19.55
Total (without biofuel)	PJ	49.71	81.93	98.98	116.38
Hydro	PJ	0.73	0.71	0.79	0.88
Wind	PJ	0.04	2.02	2.67	4.04
Solar (TH+PV)	PJ	0.08	0.18	0.30	0.42
Geothermal	PJ	3.63	4.58	5.95	7.27
Biomass	PJ	43.56	70.04	82.09	93.70
Biogas+biomethane	PJ	0.30	2.06	4.34	6.75
Renewable from waste	PJ	1.38	2.35	2.84	3.33

Table 5.14. Penetration of renewables

Assumed power production from renewables are as follows in the WEM scenario:

Electricity production		2007-2015	2015-2020	Total
Additional capacity installed	MW	736	619	1,355
Hydro	MW	3	6	9
Wind	MW	313	267	580
Solar PV	MW	0.17	0.15	0.32
Geothermal	MW	64	66	130
Biomass	MW	316	235	551
Biogas	MW	33	38	72
Renewable from waste	MW	6	7	14

Table 5.15. Electricity production from renewables

Expected CO2 savings from renewable use are summarised in Table 5.16.

kt CO_2	2005	2010	2015	2020
Power	1676	3694	5518	7028
Heat	1631	2263	2533	2955
Biofuel	15	753	1172	1408
Total	3322	6710	9223	11391

Table 5.16. Electricity production from renewables

Expected sectoral sums of emissions savings from policies and measures are as follows:

CO_2 emissions savings (Mtons)	WEM	WEM	WEM
	2010	2015	2020
Measures in the household sector	0.297	1.194	1.343
Measures in the tertiary sector	0.375	1.337	1.504
Measures in the industrial sector	0.502	1.987	2.236
Measures in the transportation sector	0.08	0.321	0.361
Horizontal and inter-sectoral measures	0.004	0.018	0.02
Total	1.258	4.857	5.464

Table 5.17. Total and sectoral CO_2 emissions savings (Mt) from policies and measures WEM/WAM

Detailed sectoral breakdown of impacts of policies and measures can be found in Appendix 3.

5.2.2. Effects of policies and measures in the With Additional Measures Scenario

Data for assumed penetration of renewables is shown in Table 5.18.

Electricity production from renewables		2005	2010	2015	2020
Total	GWh	1,803	4,023	6,912	9,470
Hydro	GWh	202	196	219	243
Wind	GWh	10	560	1,122	1,700
Solar PV	GWh	0.1	0.3	0.4	0.5
Geothermal	GWh	0	128	370	656
Biomass	GWh	1,506	2,809	4,579	6,011
Biogas	GWh	25	229	500	717
Renewable from waste	GWh	59	100	121	142
Heat production from renewables		2005	2010	2015	2020
Total	PJ	28.30	50.15	70.95	87.05
Solar TH	PJ	0.08	0.53	1.10	1.66
Geothermal energy	PJ	3.63	5.14	7.07	9.00
Biogas + biomethane	PJ	0.07	1.84	4.56	6.12
Wood, biomass	PJ	23.94	41.58	56.95	68.79
Renewable from waste	PJ	0.57	1.05	1.27	1.49
Heat production from wood and biomass		2005	2010	2015	2020
Breakdown of wood and biomass used for heating	PJ	23.94	41.58	56.95	68.79
District heating	PJ	0.66	2.85	7.72	9.01
Residential + communal	PJ	21.88	32.87	37.91	43.08
Industry + agriculture	PJ	1.40	5.87	11.33	16.70
Total renewable energy utilisation		2005	2010	2015	2020
Total	PJ	49.92	103.66	149.54	186.28
Biofuel	PJ	0.21	10.46	16.27	19.55
Total (without biofuel)	PJ	49.71	93.20	133.27	166.73
Hydro	PJ	0.73	0.71	0.79	0.88
Wind	PJ	0.04	2.02	4.04	6.12
Solar (TH+PV)	PJ	0.08	0.53	1.10	1.66
Geothermal	PJ	3.63	5.60	8.40	11.36
Biomass	PJ	43.56	78.08	107.04	130.81
Biogas+biomethane	PJ	0.30	3.90	9.06	12.57
Renewable from waste	PJ	1.38	2.35	2.84	3.33

Table 5.18. Assumed penetration of renewables and electricity production of renewables

Electricity production from renewables		2007-2013	2013-2020	Total
Additional capacity installed	MW	934	976	1,910
Hydro	MW	3	6	9
Wind	MW	448	472	920
Solar PV	MW	0.17	0.15	0.32
Geothermal	MW	64	100	164
Biomass	MW	369	340	709
Biogas	MW	44	50	94
Renewable from waste	MW	6	7	14

Table 5.19. Electricity production from renewables in the WAM scenario

The expected emissions savings from renewables are shown in Table 5.20:

		2005	2010	2015	2020
Power	ktCO2	1676	3741	6428	8807
Heat	ktCO2	1631	2884	4079	5008
Biofuel	ktCO2	15	753	1172	1408
Total	ktCO2	3322	7378	11679	15223

Table 5.20. Expected savings from renewables in assumed penetration of renewables (WEM)

CO_2 emissions savings (Mtons) from policies with additional measures are presented in Table 5.21.

	WAM	WAM	WAM
	2010	2015	2020
Measures in the household sector	0,383	1,577	2,274
Measures in the tertiary sector	0,424	1,533	2,21
Measures in the industrial sector	0,693	2,771	3,996
Measures in the transportation sector	0,134	0,535	0,771
Horizontal and inter-sectoral measures	0,004	0,018	0,026
Total	1,638	6,434	9,277

Table 5.21. Total and sectoral CO_2 emissions savings (Mt) from policies and measures in the With Additional Measures scenario

5.2.3. Assessment of EU ETS

It is difficult to estimate the emission impact of EU ETS, since the instrument is interacting with several other instruments, for example energy- and carbon dioxide taxes and the electricity certificate system. The companies are also influenced by fuel and electricity prices and economic development.

The present regulation uses a national cap (an annual amount of approximately 26 Mt CO2 eq.) but the achievable emission reduction is already at this stage fundamentally derived from the carbon price. The difference between the cap and the ETS sectoral emissions is equalised by trading of allowances (either EUA or CER/ERU).

Based on the HUNMIT model, which contains a comprehensive bottom-up database of domestic measures, it was possible to outline the potential CO_2 savings for the forecasted periods by EUA prices. We assumed a 20 EUR/t price until the end of the second period and checked the mitigation cost curves to identify the expected realised emission savings. Based on the calculations of the model this will be the expected amount to be implemented by the Hungarian entities through investments as this seems to be an economically reasonable decision for them.
Tables 5.22*a*, *b* and *c* contain the summarised and sectoral results for the years 2010, 2015 and 2020 respectively.

Calculated emission savings until 2015, Mt CO_2					
Assumed EUA price	Period	Industry	CHP Industry	Power sector	Σ
20 EUR / t CO_2	Until 2013	1.942	0.772	0.062	2.778
24 EUR / t CO_2	Until 2020	1.943	1.265	0.062	3.272
30 EUR / t CO_2	Until 2020	1.943	1.268	0.062	3.274

Table 5.22*a*. Assumed realised emission savings until 2010

Calculated emission savings until 2015, Mt CO_2					
Assumed EUA price	Period	Industry	CHP Industry	Power sector	Σ
20 EUR / t CO_2	Until 2013	1.928	1.705	0.167	3.801
24 EUR / t CO_2	Until 2020	1.929	2.8231	0.167	4.920
30 EUR / t CO_2	Until 2020	1.943	2.827	0.167	4.938

Table 5.22*b*. Assumed realised emission savings until 2015

Calculated emission savings until 2020, Mt CO_2					
Assumed EUA price	Period	Industry	CHP Industry	Power sector	Σ
20 EUR / t CO_2	Until 2013	1.922	2.467	0.1930	4.583
24 EUR / t CO_2	Until 2020	1.922	4.119	0.1930	6.236
30 EUR / t CO_2	Until 2020	1.929	4.125	0.1930	6.248

Table 5.22*c*. Assumed realised emission savings until 2020

For the With Existing Measures (WEM) scenario we considered the currently implemented and adopted regulation and we assumed that it will remain in force even after 2013 until 2020. This is in order not to assume the close-down of the mechanism and thus an increase in emissions and to have an estimation for 2020 which is based on the current state of play.

For the With Additional Measures (WAM) scenario we assumed that after 2013 a new EU cap will be introduced and that the allowance prices will be at EUR 24/30 per ton. This brings about a significant change between the WEM and the WAM scenarios.

It has to be mentioned that the end use energy efficiency measures (households, public sector, etc.) contain a large potential of energy savings according to the HUNMIT model. However, there is still a market dysfunction, because despite the wide range of measures possible and appearing at zero or close to zero marginal abatement cost, still these investments are not realised yet. There is debate over the nature of this market dysfunction, however, the potential that can be accounted for in the ETS sector if these energy efficiency measures are realised is as follows:

	2010	2015	2020
EE measures impact on ETS (estimated)	1.1672	1.8679	2.3151

Table 5.23. Estimated impact on ETS sector emissions from EE measures in end-use sectors until 2020 (second and third period), Mt CO2. equiv.

5.3. Modelling methodology

In the projections different methods were used for the respective sectors. We describe herewith the attributes and characteristics of the modelling approaches applied.

5.3.1. The HUNMIT Model

With development launched in 2008 the HUNMIT modelling framework, a comprehensive model has been developed mapping the available mitigation measures and their potential impacts concerning all major sources and sinks of GHGs. The model's aim is to provide a reliable and transparent method of forecasting effects of policies and measures in climate change mitigation. When developing the model, an important key element was the suggested enhancement of emission projections as in the in-depth review of the 4th National Communication. This was concluded by estimating demand at the level of "useful energy" or demand side and integrating these estimates into the projections, rather than projecting energy demand on the basis of fuel use.

The research team encompassed numerous domestic and international experts from the relevant areas of field research in climate change and energy. The developed model covers all relevant GHG emitting sectors of the economy, with the exception of LUCF and agriculture. The covered sectors are: energy and power sector, transport, industry, households and the tertiary sector.

The model applies a bottom-up methodology and relies on a widespread and thorough analysis of domestic mitigation options containing over 700 measures from the sectors of the economy. Expert estimations are the capstones of the model. The technical data on measures include their characteristic features, mitigation costs and effects, other economic data including investment costs, return time and the feasible and maximal implementation rate. Based on these data the model develops mitigation cost curves which enable the assessment of sectoral measures and emission allowance prices. Data and forecasts were based on estimations from the Hungarian Energy Office, Budapest University of Technology, Central Statistical Office.

Besides the mitigation options and emission factors, the developed model and thus the projection includes a mid-long term assumption for economic developments in the respective sectors of Hungary. Estimations were made in every sector and industry on expected activity change and development (consumption, etc.) until 2025. Relevant factors are as follows:

- Population change is also included in the model and was based on the trend estimation of the Central Statistical Office.
- CO_2 emissions projections are based on the respective emissions factors and the consumption of each fuel.
- Fuel prices are assessed and used as an important input factor for modelling.
- Technical development is an exogenous part of the model and is mapped in technical measures selectable by the user.
- The demand for electricity and industrial and district heating is exogenous data for the model which, through its optimisation algorithm, works out the most cost-effective fuel mix for the whole energy system, i.e. including energy use in the user sectors.

- Projections for the households sector are developed based on assumptions on household modernisation, insulation and metering measures, technological development in new houses, population trends, assumed energy prices.
- The tertiary sector energy use projections are based on assumptions on different variables such as electricity and fuel prices, economic development, population development, potential for different heating systems, investment costs of heating systems, levels of efficiency and energy efficiency improvement and commercial office products purchase trends.
- Industrial sector calculations were based on activity level changes in the subsectors, technological measures and assumed energy prices. This result complies with information from energy-intensive industries. Official statistical data was extended with information from industrial companies to gain a more realistic picture and less bias in estimation of emissions and energy use.
- The projections of the transport sector are calculated based on forecasted transport activity indicators and technological measures.
- Emissions from landfills in the waste sector are calculated using a model developed by the IPCC. The method is based on figures on quantities of landfill deposited waste from 1952, the organic content of the waste, the gas potentials of different types of waste and emissions factors.

5.3.2. Methodology applied in the forestry sector

The LUCF scenarios were analysed using a carbon accounting model called CASMOFOR. It is a powerful tool as it creates a synthesis of all the best data on the Hungarian forests at country level. It can currently be downloaded from the http://www.scientia.hu/casmofor website.

CASMOFOR stands for CArbon Sequestration MOdel for FORestations. It originally was designed as a carbon accounting model framework that uses Hungarian specific forestry data. In previous versions, it only contained some forest growth and yield tables, as well as some silvicultural data. Over the years, it has become a clearinghouse of domestic data from major research fields. Currently it contains relevant information concerning forest growth and yield, silviculture, forest economics, as well as forest carbon and carbon economics for most Hungarian forest types.

CASMOFOR is a model that was previously developed for research purposes and to support decision making concerning afforestations with the aim of sequestering carbon. The main purpose has remained the same in the latest version: to support decision makers with up-to-date information related to the amount of carbon that can be sequestered by afforested areas, as well as to how costly this type of carbon sequestration may be.

5.3.3. Methodology applied in the agricultural sector

The forecast of agriculture activity data was performed fundamentally on the basis of the data of the researchers (Udovecz et al., 2007) of the Agricultural Economics Research Institute (AERI).
The mathematical models used by the AERI were the following:

1. The development of the major macro indicators were estimated by the national and regional HUSIM model that has been used for agricultural forecasts since 1998 (e.g. Mészáros et al., 1999, 2000a, 2000b; Udovecz, 2000; Mészáros and Spitálszky, 2002; Potori and Udovecz, 2004).

2. In order to analyse the structural changes occurring as a consequence of the agricultural policy and market processes in the major production branches the FARM-T model (that was developed in the near

past) was used (more details: Potori et al. [2007]). This model is built on the relationships between the product paths, the processing industry structure, the input use, the decision-making process of the market actors, as well as on the complex system of demand and supply conditions of the internal and the external markets. Agricultural production is represented in the model by the "utility farms" established by the classification of test farms.

3. For the farm-level forecast of structural changes in agriculture MICROSIM model has been used since 2000 [e.g. Keszthelyi and Kovács, 2004; Potori and Udovecz, 2004; Törzsök et al., 2006]. The model provides the expected future state of the profit/loss statements of all test farms. The MICROSIM model was used to estimate which farms would get close to bankruptcy or cease their activities till 2010.

Beside the available international and domestic data and the estimated values regarding the future many known or probable events were taken into account. The model results reflect the common effect of such factors like competitiveness on internal and external markets (with special regard to prices, the rational transport distances, the bearable transport costs, the real logistical possibilities), biological limitations, price and income elasticity coefficients reflecting the responsiveness of market actors, the direct support system as well as the changes in market organisations, etc.

5.3.4. Sensitivity analysis

The mitigation potential and related costs are estimated based on many input parameters and model assumptions. The most important parameters are:

- discount rates,
- energy prices,
- CO_2 emission factor for electricity.

In addition, following parameters should be mentioned as having a potential impact:

- physical growth rates of activity indicators in the frozen reference baseline,
- VAT,
- measure characteristics such as scope, saving potential and costs.

In the model, the parameters listed above are adjustable. These parameters can be altered to run different growth scenarios or include different types of cost data. In terms of conclusions on future GHG mitigation potential, it is important to be aware on the sensitivity of these parameters to the overall results and conclusions.

In the section below, we show the sensitivity of the three main parameters on the total reduction potential and the reduction potential at negative costs. An overview of sensitivity analyses completed is shown in Table 5.22. Please note that the sensitivity analyses presented below does not explore the ranges of outcome (uncertainty analysis) but only the sensitivity of an outcome on the used parameters.

Parameter	Default value	Change in sensitivity analysis
Discount rates	6%	10%, 20%
Emission factors electricity	Baseline generation mix	Baseline generation mix, natural gas reference
Energy prices	Different prices per energy carrier, per sector	50%, 100% and 200% of the default energy prices

Table 5.22.: The parameters and their changes as included in the sensitivity analysis

The results of the sensitivity analyses are presented by changed parameters.

Discount rate

The discount rate has an impact on the investment costs of the technical measures and therefore on the overall costs per avoided CO_2. We have varied the discount rate from the default level of 6%, to more risk adverse discount rates of 10%, 15% and 20%. The CHP industry, transport and power sector are sensitive to discount rates as well because of the capital intensity of the mitigation measures. Industry (without CHP), waste and the tertiary sector are less sensitive to discount rate as for these sectors the mitigation measures are less capital intensive. The sensitivity depends on the share of the investment costs of the measures in different sectors.

Emission factor for electricity

All sectors use electricity in addition to direct use of primary energy carriers. The effect of changing the electricity emission factors is relatively small in the industry, CHP industry and residential sector. In those sectors the reduction potential related to electricity is small, compared to the large potential for heating related reductions. The waste and transport sectors are not affected by the electricity emissions factors.

Energy prices

Low capital mitigation measures are highly sensitive to energy prices. Energy prices are dictated per energy carrier per sector. This illustrates that high energy prices lead to large reduction potentials at 'no regret' level. This is a result of the large potential for energy saving measures, which imply cost savings. Other sectors show similar results as the residential sector for different energy prices.

Other parameters

As indicated above, some other parameters as the use of VAT, the assumed maximum level of implementation for the measures and the growth rates of the activity indicators have also an effect on the results. In a strict societal cost approach, VAT is not included. As standard setting in the study VAT was included. The Value Added Tax (VAT) is imposed on investment costs and fuel prices. As such the VAT has an impact on the costs of the measures, comparable to energy prices. The default level for VAT is 25%. Changing the level of the VAT from zero to e.g. 30% will have an impact on capital extensive measures. The amount of these measures vary per sector but for most sectors the sectoral results do not differ that much.

6. Vulnerability Assessment, Adaptation

6.1. Expected impacts of climate change

Modelling background

Over the last few years, the Hungarian Meteorological Service (Department of the Numerical Modelling and Climate Dynamics), together with the Eötvös Loránd University's Department of Meteorology, adopted four regional climate models to provide an assessment of climate change impacts in the Carpathian-basin and to quantify the expected trends and the associated uncertainty[12]. Out of the four models adopted, three referred to the same scenario (A1B-moderate impact) and are available for the period 2021-2040. In this section we present the results of these three models based on Bartholy et al. [2009].

The models include the REMO model based on the ECHAM4 global model, developed by the Max Planck Institute (MPI-M) in Hamburg. The model runs were executed in the framework of the CLAVIER project (CLimate ChAnge and Variability: Impact on Central and Eastern EuRope[13]), aimed at the analysis of the CEE region[14].

The NCAR RegCM model is based on the Pennsylvania State University's (PSU) NCAR-MM4 model, currently accessible through the Central Institute for Theoretical Physics (ICTP) in Trieste. This model was used at the Department of Meteorology of the Eötvös Loránd University through the CECILIA (Central and Eastern Europe Climate Change Impact and Vulnerability Assessment[15]) EU 6th FP project.

The ALADIN-Climate model, developed by the Hungarian Meteorological Service in international cooperation, is a regional version of the ALADIN short term constrained domain forecasting model, originating from the ARPEGE-Climate global climate model[16], also applied in the previously mentioned CECILIA project.

Assessment of regional climate scenarios aggregate impact on the Carpathian-basin for the period 2021-2040

The above mentioned three regional climate models were used to develop the climate scenarios for Hungary in the period 2021-2040. According to the annual and seasonal averages of the simulations, the forthcoming temperature rise is unquestionable.

[12] http://www.met.hu/palyazat/nkfp_klima2005.php
[13] http://www.clavier-eu.org
[14] Szépszó, Horányi, 2008
[15] http://www.cecilia-eu.org, (Torma et al., 2008)
[16] (Csima és Horányi, 2008)

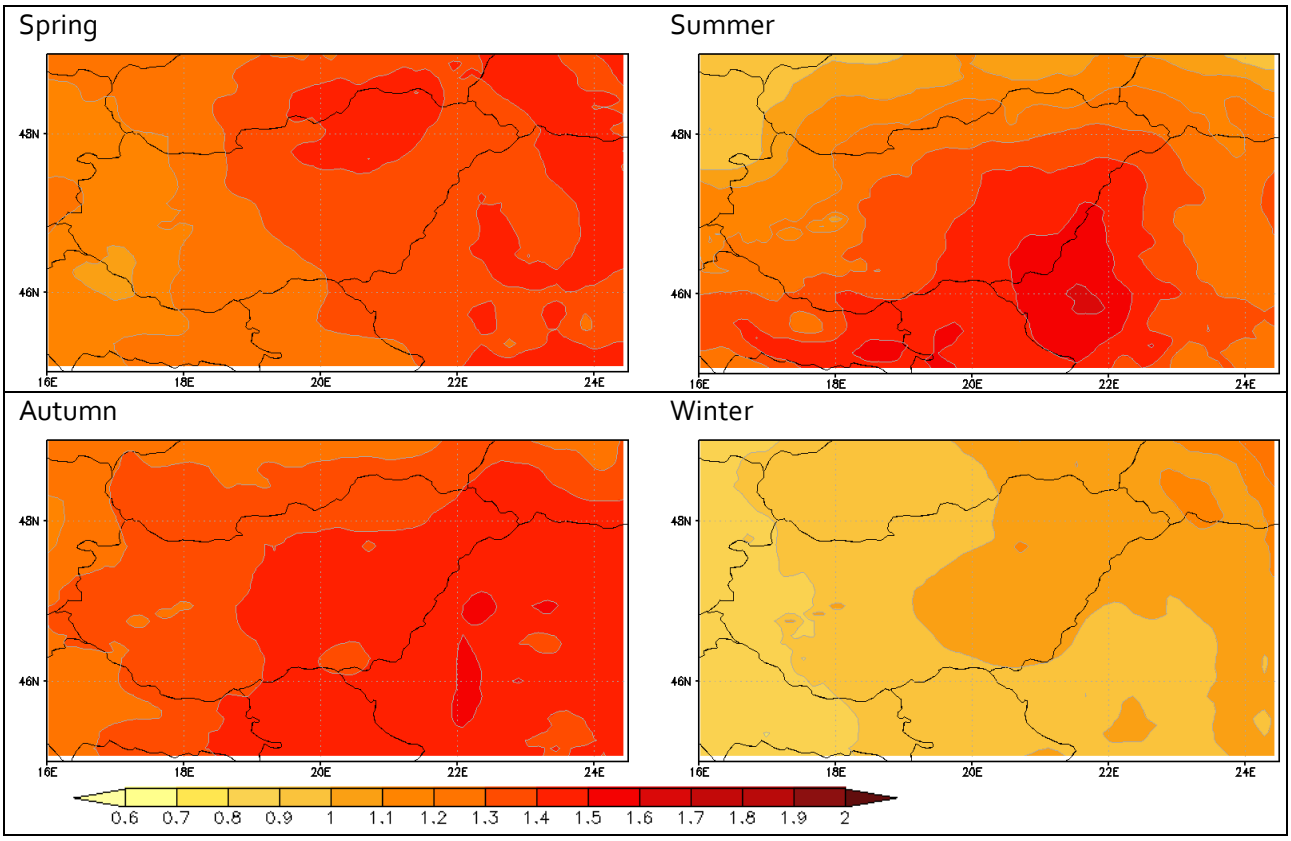


Figure 6.1. The expected seasonal temperature change (°C) in the Carpathian-basin until 2040, average maps based on three regional climate model simulations, reference period: 1961-1990.

The composite maps created based on the average annual temperature changes of the three models show that the highest rise can be expected in autumn (1.4 °C) and the lowest in winter (1.0 °C). In the Great Plain - the central and eastern region of the country - the temperature rise is higher than in the Trans-Danubian Plain (western region). The most remarkable in-country difference is expected in summer, 0.6 °C. All models forecast significant rise in temperature:

	Annual	Spring	Summer	Autumn	Winter
Average temperature rise	0.8 – 1.8 °C	1.0 – 1.6 °C	0.5 – 2.4 °C	0.8 – 1.9 °C	0.8 – 1.2 °C

Table 6.1. The annual expected temperature change for Hungary until 2040 based on the three regional models (reference period: 1961-1990).

Table 6.1. gives a summary of the results of the model runs for the Hungarian grid points, seasonal and annual interval values are given as minimal and maximal values expected. The difference (uncertainty) is minimal in winter and maximal in summer.

The monthly distribution of the expected temperature change for the period 2021-2040 is presented in Figure 6.2 with a Whisker-Box plot diagram, the vertical lines connect the two extreme values, the boxes are between the higher and lower quartiles. The larger the box size, the larger the variation of the simulation values is. It has to be noted that in almost all months the boxes are above the line indicating 0 °C change,

forecasting a definite temperature rise, nevertheless the models vary in certain months (e.g. July and August).

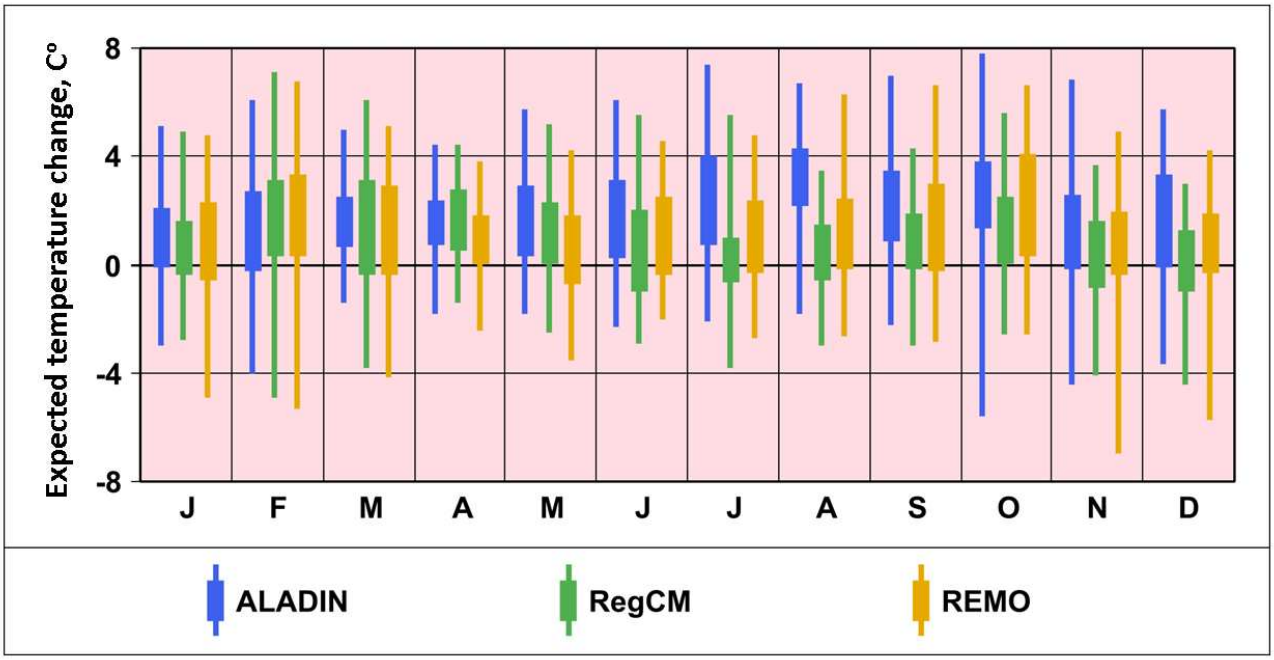
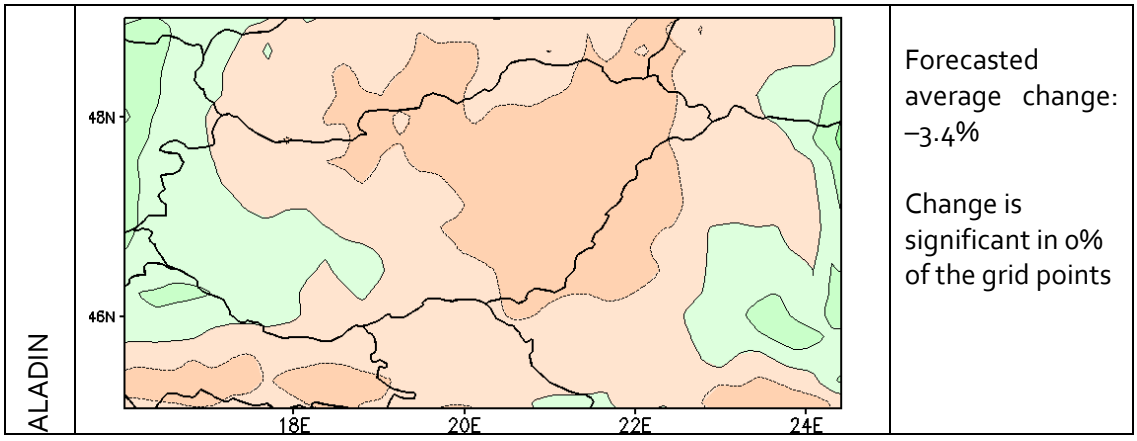


Figure 6.2. The monthly distribution of the expected temperature change by 2040. Vertical lines connect the two extreme values, the boxes are between the higher and lower quartiles. Reference period: 1961-1990.

The change in precipitation does not show such a uniform tendency: the models forecast small changes which are in most cases not significant. The results do not allow for the preparation of such uniform maps as previously, therefore in Figure 6.3. we present the results separately for the models. It has to be emphasised that the forecasted precipitation changes are not significant.



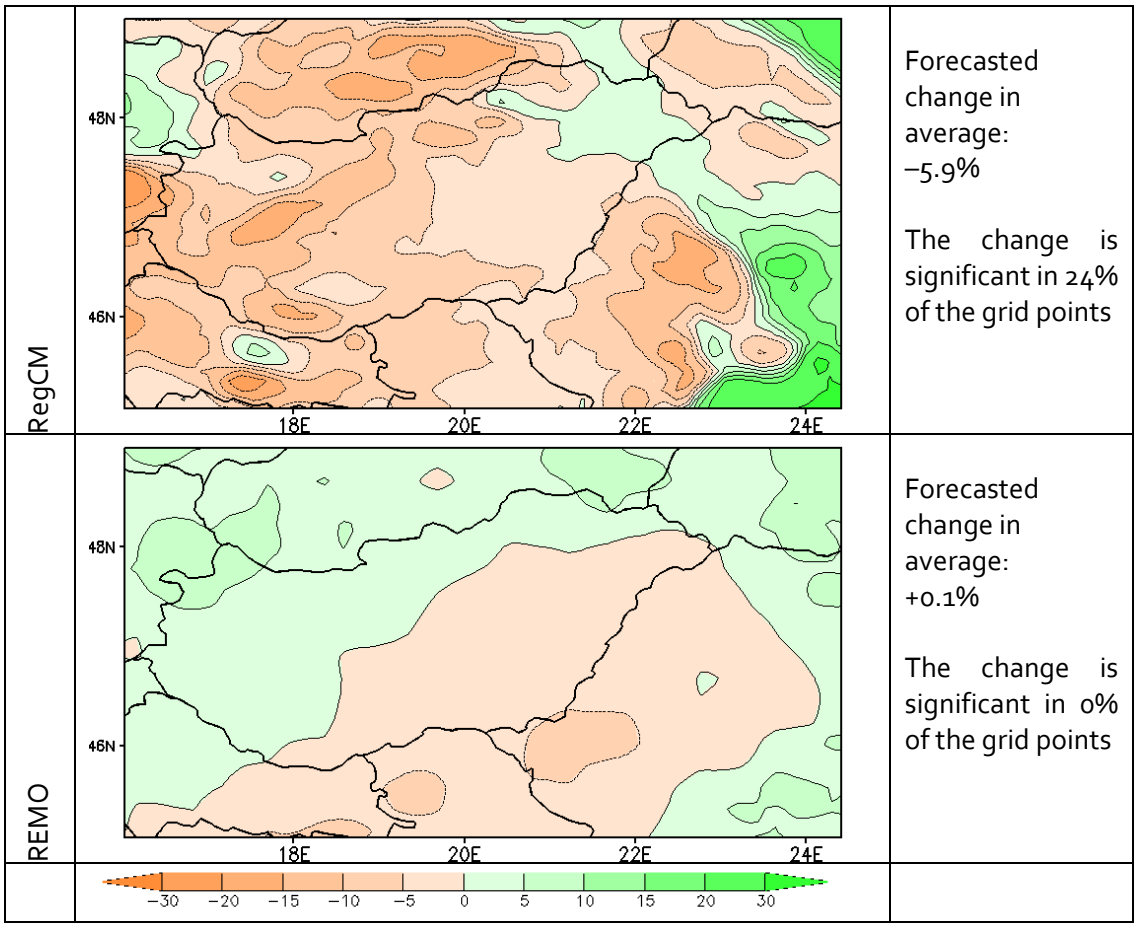


Figure 6.3. Expected annual precipitation change for the period 2021-2040 (%) in the Carpathian-basin, by the three regional models. Reference period: 1961-1990.

The intervals for the annual and seasonal average precipitation change were defined based on model runs. The annual change is expected in the interval of a (-40.8 mm; +2.4 mm), therefore a slight drought effect is expected, the biggest differences in the model results can be observed in the winter forecasts with an interval breadth of more than 33 mm and even the direction of the precipitation change is uncertain as the interval contains 0.

	Annual (mm)	Spring (mm)	Summer (mm)	Autumn (mm)	Winter (mm)
Average precipitation change	(-40.8; +2.4)	(-15.9; +6.0)	(-15.0; +3.0)	(-4.8; +5.1)	(-22.8; +10.8)

Table 6.2. Annual and seasonal precipitation change for the period 2021-2040 for Hungary in mm based on the three models (reference period: 1961-90).

In Figure 6.4. we present the expected precipitation change (in mm and in %) for 2021-2040 in a Whisker-Box plot diagram for the monthly forecasts. For each model we can observe the broad variance, in extreme cases 300% or greater change can be observed. The boxes representing the middle quartiles are around the zero line and have sizes in both directions - this also confirms that changes in precipitation are not significant in the near future.

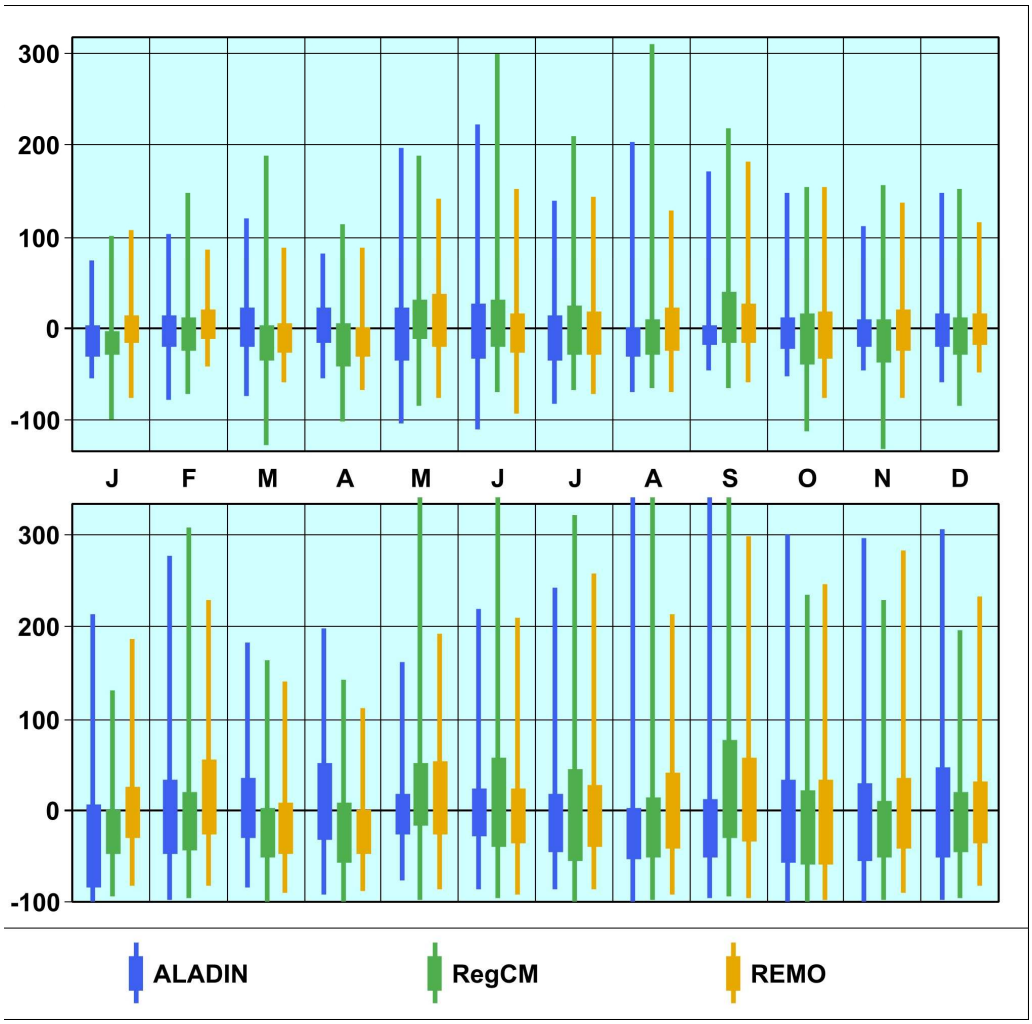


Figure 6.4. The seasonal distribution of the expected precipitation change for the period 2021-2040 by models (in mm above and in % below). Vertical lines connect the two extreme values, the boxes are between the higher and lower quartiles. Reference period: 1961-1990.

Besides the average temperature rise, the change in the frequency of extreme weather events can have significant consequences on industry, agriculture and the society as a whole. The WMO-CCl/CLIVAR workgroup which was formulated at the end of the 1990s defined 30 indicators for the characterisation of such events.

Numerous studies were undertaken globally utilising these indicators and herewith we present a few describing the impacts for the period 2021-2040 and reference taken as 1961-1990.

Figure 6.5. shows the expected change in the number of frosty days (T_{min} < 0 °C) in the period 2021-2040, based on the three simulation models. The number of frosty days is expected to decrease in all parts of the country. The areas at higher altitudes are expected to show a larger (more than 14 days in average) reduction, while the southern, lower areas are expected to show a smaller change.

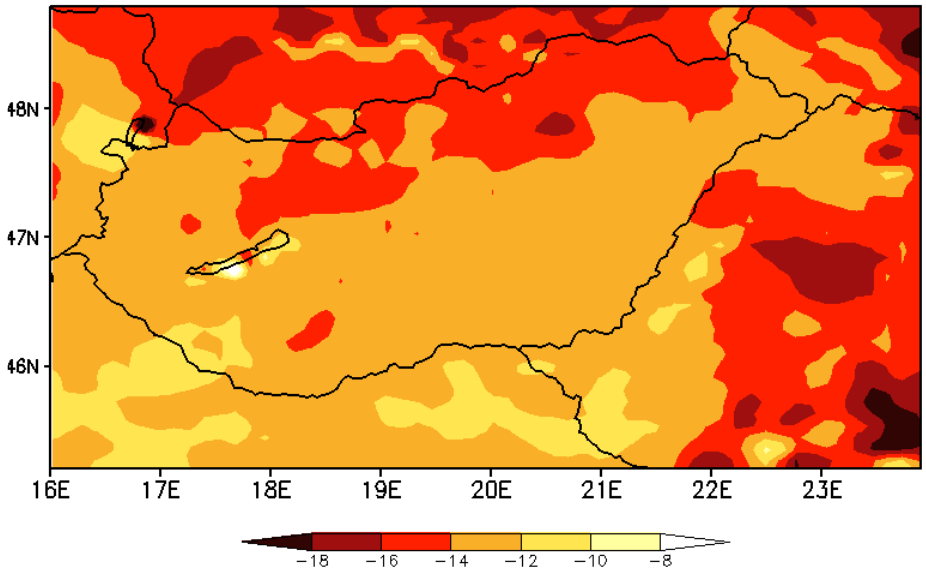


Figure 6.5. Expected change in the number of frosty days for the Carpathian-basin for the period 2021-2040, composite map based on simulation models. Reference period: 1961-1990.

The warming up can bring about consequences in human health as Figure 6.6. illustrates, with the presentation of the expected frequency change in the number of Level I. heat alerts (T_{middle} > 25 °C). A striking feature of the map is the zonal structure: the country's northern and north-western parts show smaller change, while the southern, south-eastern parts indicate a change exceeding 14 days per annum.

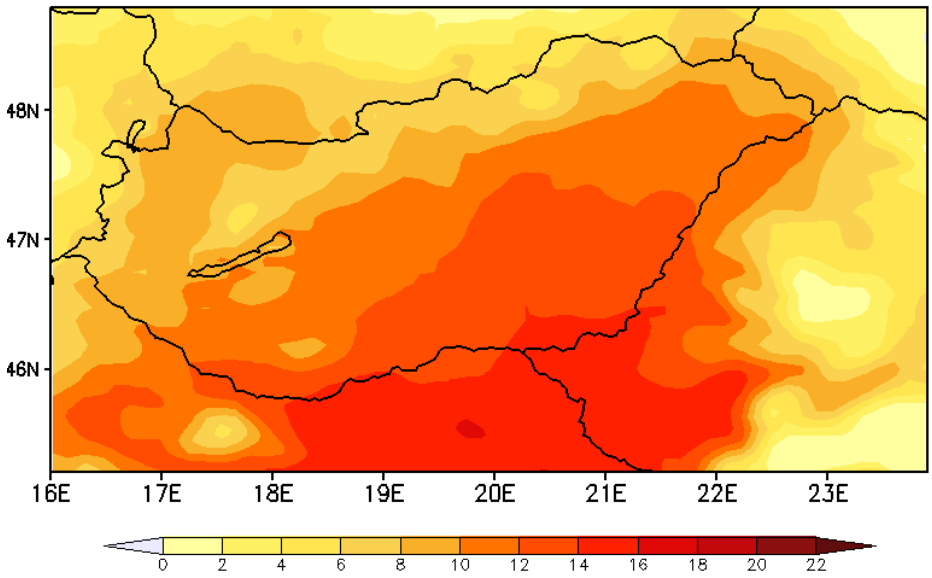


Figure 6.6. Expected change in the number of heat alert days for 2021-2040 in the Carpathian-basin. Composite map based on simulation models. Reference period: 1961-1990

The trends outlined above are in concordance with the trends summarised in Table 6.4., which gives the expected changes for three temperature indices for 2021-2040. The number of frosty days shows a definite reduction tendency, which will decrease the heat consumption due to a higher average temperature and a

shorter heating period. The number of days with heat alert shows an increasing tendency and this will cause a higher cooling demand, thus higher energy consumption.

Name and definition of index	Change interval (days)
Number of frosty days (T_{min} < 0°C)	(–28.4; –6.7)
Number of summer heat days (T_{max} > 25°C)	(–0.9; +43.0)
Number of days with heat alert (T_{mid} > 25°C)	(–1.0; +31.0)

Table 6.4. Expected change (in days) in temperature extremity indices for the period 2021-2040 in the Carpathian-basin. Composite map based on simulation models. Reference period: 1961-1990

Unlike the forecasted temperature trends, the expected changes in precipitation indices do not show univocal tendencies. All the intervals given in Table 6.5. contain zero, showing that the models are not uniform in estimating the direction of the change. This is because on one hand the forecasted changes are relatively small and not significant and even differ in signs, on the other hand different regions in the country show opposite tendencies.

	Annual (day)	Spring (day)	Summer (day)	Autumn (day)	Winter (day)
Days with precipitation over 1 mm (R_{day} > 1 mm)	(–17.2; +1.3)	(–6.4; +3.7)	(–6.1; +1.3)	(–5.5; +0.8)	(–7.1; +2.3)
Days with precipitation over 20 mm (R_{day} > 20 mm)	(–4.8; +1.8)	(–1.7; +1.0)	(–0.9; +1.3)	(–2.0; +1.2)	(–1.2; +1.0)
Maximal length of dry periods (Max (R_{day} < 1 mm))	(–3.0; +7.5)				

Table 6.5. Expected change (in days) in precipitation indices for the period 2021-2040 according to the model results (reference period: 1961-1990)

In global climate analyses the temperature rise over 2 °C is considered irreversible. Besides this, we analysed the spatial distribution of temperature change for different values (0 °C, 1 °C, 4 °C and 6 °C). For the reason of size we aggregated the results in Figure 6.7. for changes in temperature at least in the range of 2 °C, that means changes under -2 °C or over +2 °C were displayed for the present and the future climatic conditions. This also contains valuable information for readers on how frequently would the given threshold values be exceeded for different regions of the country. In line with previous research this shows that the probability of events and anomalies with negative temperature change is following an overall decreasing tendency, while probability of anomalies with positive temperature change is following an increasing tendency (from the present average 15% to beyond 40% in the eastern part of the country).

The information for all four seasons are summarised in Table 6.6. where the minimum, average and maximum of the frequencies for the Hungarian grid points are presented instead of spatial distribution maps.

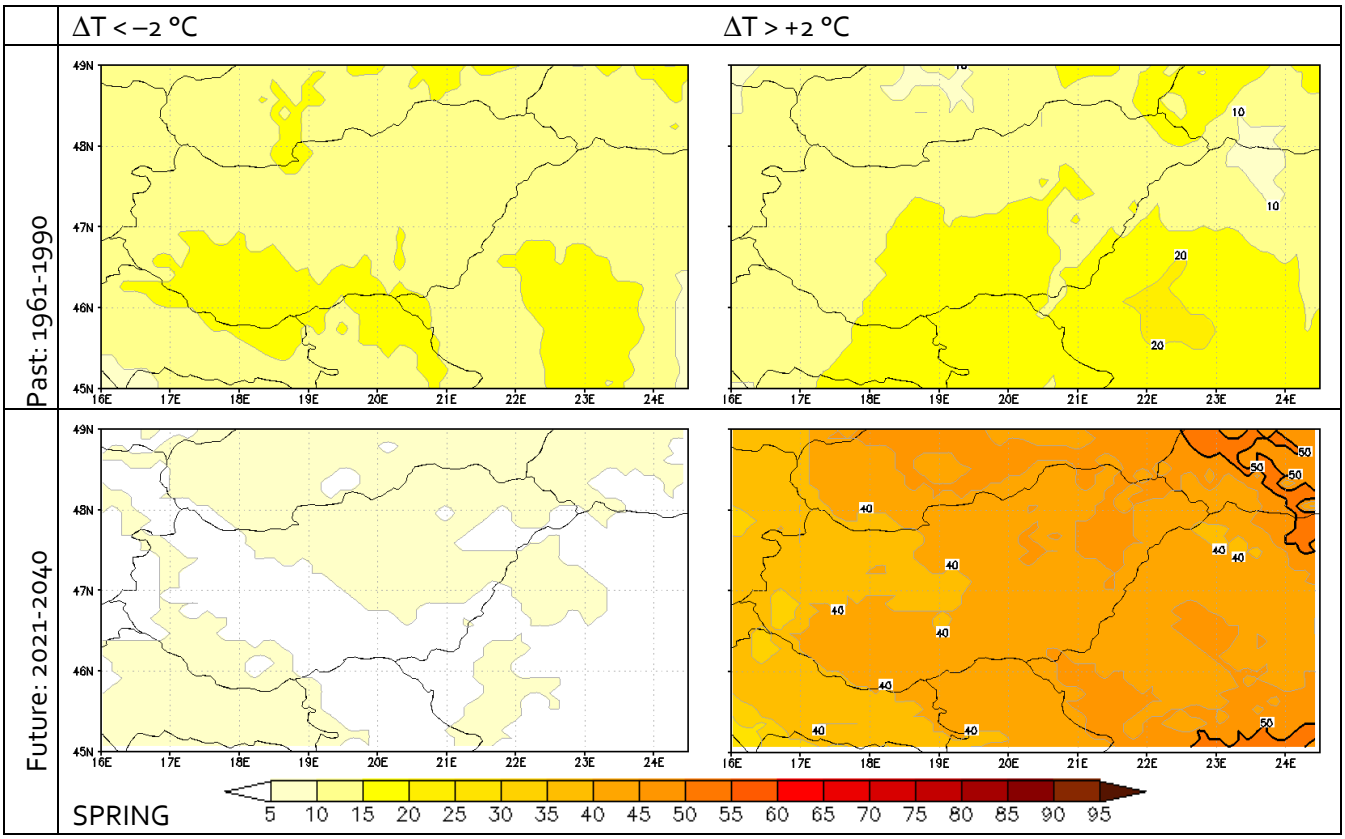


Figure 6.7. Frequency of monthly temperature anomalies under -2 °C or over +2 °C (in %) in Spring (March-April-May).

In Figure 6.7. the deviations from the monthly averages of the CRU database are displayed for the past period. For the future the deviation from the simulated fields of the RegCM model are presented.

Temperature	Period	Spring		Summer		Autumn		Winter	
		ΔT < −2 °C	ΔT > +2 °C	ΔT < −2 °C	ΔT > +2 °C	ΔT < −2 °C	ΔT > +2 °C	ΔT < −2 °C	ΔT > +2 °C
Minimum	1961-90	10%	11%	1%	2%	6%	6%	15%	15%
	2021-40	2%	33%	2%	8%	0%	18%	5%	18%
Average	1961-90	14%	14%	4%	6%	10%	8%	19%	19%
	2021-40	4%	41%	5%	15%	4%	24%	9%	23%
Maximum	1961-90	18%	18%	10%	9%	14%	12%	24%	25%
	2021-40	7%	47%	10%	22%	8%	30%	15%	38%

Table 6.6. Expected seasonal change for Hungary in the period 2021-2040 based on RegCM model simulation time series and CRU data (reference period: 1961-90).

For the past the deviation from the average of the CRU database exceeding 2 °C absolute values was considered and the probabilities were calculated for each grid point. For the calculations of future similar deviations from the simulated fields of the RegCM model representing past averages were considered. Minimum and maximum values represent respective values from the grid points; average values represent the averages of all grid point values within the country's border.

In case of precipitation we have analysed the changes arising from temperature anomalies ranging from 0% to 50%. Precipitation anomalies for winter months smaller than -20% or larger than +20% are shown in Figure 6.8. for the present and expected future climatic conditions (RegCM). The RegCM model shows a higher probability of drought and/or precipitation reduction both by indicating a higher probability of precipitation decrease in the western regions and a lower probability of precipitation increase in the south-eastern regions.

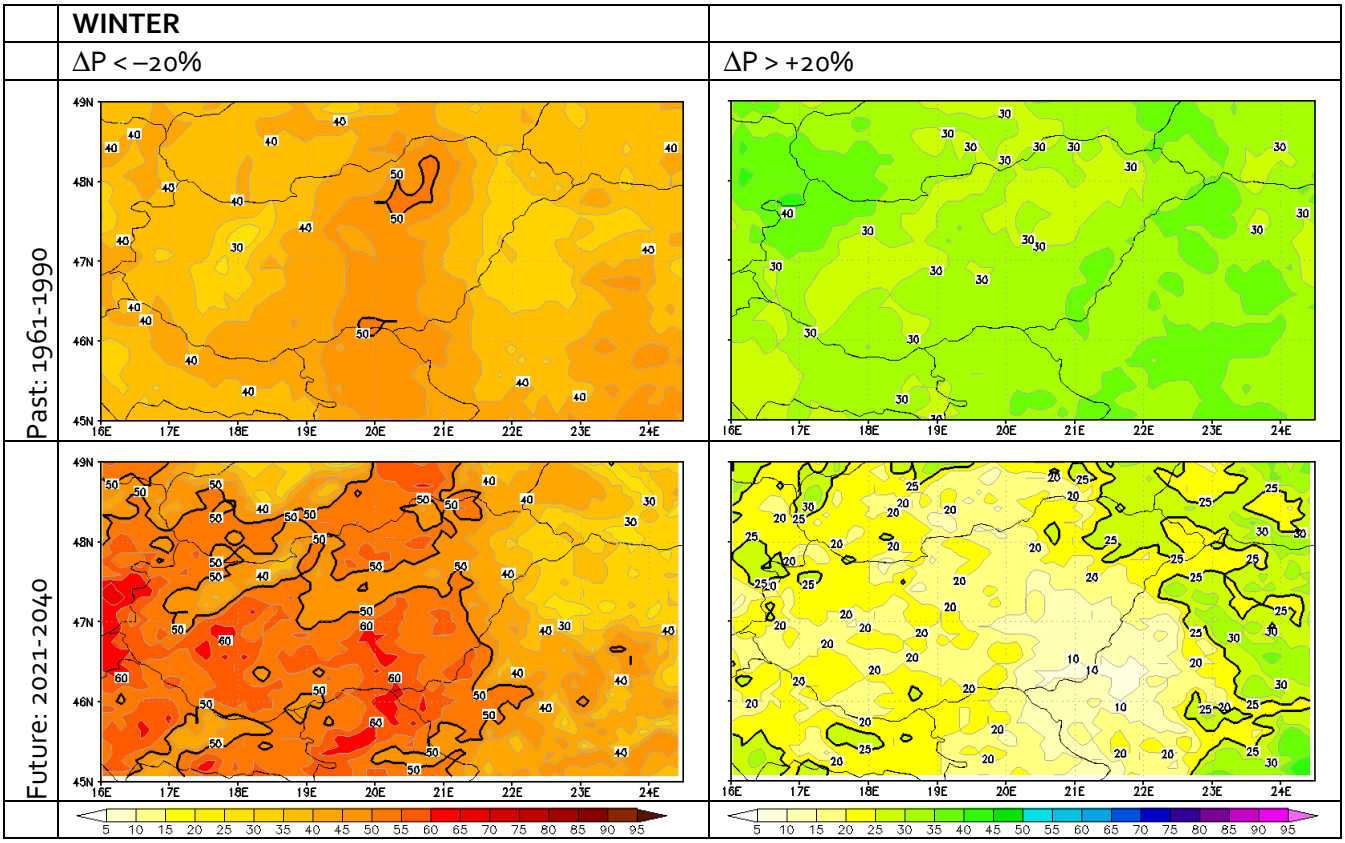


Figure 6.8. Frequency of monthly precipitation anomalies exceeding 20% for winter

For the past (charts above) the deviation of the average and actual temperatures of the CRU database are presented and the probabilities were calculated for each grid point. For the future, differences of the simulated fields of the RegCM model and the past averages are displayed.

Information for all four seasons are summarised in Table 6.7.

Precipitation	Period	Spring		Summer		Autumn		Winter	
		ΔP < – 20%	ΔP > +20%	ΔP < – 20%	ΔP > +20%	ΔP < – 20%	ΔP > +20%	ΔP < – 20%	ΔP > +20%
Minimum	1961-1990	29%	25%	30%	24%	39%	24%	29%	26%
	2021-2040	32%	13%	29%	12%	28%	15%	30%	8%
Average	1961-1990	38%	31%	36%	29%	45%	29%	41%	32%
	2021-2040	44%	26%	46%	32%	45%	30%	51%	20%
Maximum	1961-1990	41%	38%	44%	34%	53%	35%	51%	41%
	2021-2040	65%	40%	67%	47%	62%	43%	65%	30%

Table 6.7. Expected change in distribution of seasonal precipitation for Hungary based on RegCM simulated time series and CRU data (reference period: 1961-90).

For the past the deviation from the average of the CRU database exceeding 20% absolute values was considered and their probabilities calculated for each grid point. For the calculations of future similar deviations from the Simulated fields of the RegCM model representing past averages were considered. Minimuml and maximum values represent respective values from the grid points, average values represent the averages of all grid point values within the country's border.

Summary

Based on the simulations we can conclude that the expected domestic tendencies are in line with the global tendencies and the earlier regional climate change forecasts for Central-Europe. When analysing smaller regions, it is important to consider hydrological and geological factors and thus it is important to have a higher definition (e.g. 25km or 10km grids). The results from the models used above relied on such grids; REMO had 25 km, while ALADIN and RegCM a 10 km grid. The main results of the scenarios for the Carpathian-basin for the period 2021-2040 are as follows:

- A significant rise in temperature is highly probable in all seasons and in the annual average, for an extent of approximately 1.0-1.4 °C.
- The number of annual days with frost will reduce by 12-15 days.
- The number of days with heat alert might increase by 14 days in the southern regions of the country.
- The estimated annual and seasonal precipitation change is not significant. However, the regional and territorial changes might be significant and of opposite sign.

6.2. Vulnerability Assessment

Most severe problems and areas of vulnerability in the hydrology and water management area are as follows:

Climate change impact	Vulnerability effect
Increasing climate aridity, increasing surface temperature and heat dissipation, decreasing precipitation	Less drainage and water infiltration, the annual renewable hydrological reserves decrease, water balance of lakes and ponds deteriorates, water exchange cycle slows, lakes disappear.
Increasing summer temperature, decreasing summer precipitation	Less drainage on summer, reference (August) hydro reserves decrease. The natural water reserves in lakes decrease in summer, the periods with low water level increase and lengthen. Decreasing humidity of soil, lengthened dry periods.
Melting of glaciers in countries bordering Hungary	Periods of low water level on the Danube shift from autumn months to earlier months.
Rising of winter temperature, change of winter precipitation and the proportion of rain thereof, reduction of humidity stored in snow cover	Rain related drainage increases in winter, the snow related delayed drainage comes earlier and since the proportion of rain and snow can not yet be estimated reliably, floods can come earlier, the rivers peak at higher levels, with high uncertainty, the winter precipitation increase can cause increase in infiltration, ice cover on waters can reduce.
Increasing frequency and intensity of large precipitation	Intensity and frequency of floods at inhabited area are expected to increase.

The presently foreseen problems and their vulnerability rankings are as follows:

Present problems foreseen	Vulnerability level	Climatic vulnerability
Large territories are endangered by flood. The annual flood levels and the frequency of extreme floods increase. Potential of heightening the dams is limited.	High	Melting floods: winter-spring temperature, precipitation, extreme floods: large rainfalls. Significant role of non-climatic factors (e.g. deforestation)
One-third of the country's lowlands is strongly or moderately threatened by inland inundation.	High	Spring-summer temperature, precipitation, frost. Significant role of non-climatic factors (e.g. land-use)
The Great Plain lacks utilisable surface water resources. In certain areas there is no local surface water source, the water system of the river Tisza is strongly exploited. Lack of surface water limits localisation of water demand, or latter is too strongly relying on underground water sources, thereby depleting them.	High	Drying climate: reduction of precipitation, increase of temperature (and evaporation potential). Precipitation and temperature of summer months.
The concentrated, overdriven	Medium	Autumn and winter precipitation, summer

underground water extraction results in negative water balance and ecological consequences. The danger of harmful influence on thermal waters is prevalent.		temperature (and evaporation). Significant role of non-climatic factors (extreme water takeout).
Conflicts arising from water level control in big lakes (Balaton), holiday resort role of the lake, lake bank's defence require smaller fluctuations; natural habitats require larger fluctuations in lake level.	High	Water level fluctuation, change in natural water resources is sensitive to interannual precipitation and temperature variance.
Unfavourable ecological conditions of surface waters, according to statistical measurements 70-80% of surface waters have unfavourable qualifications. Most critical conditions can be found in stagnant waters, or slow flowing waters and are caused by appearance of organic and dangerous contamination, nitrogen and potassium dilution and thermal waters lead-in (salt-content and temperature).	Medium	Precipitation (evaporation) and temperature of summer months. Significant role of non-climatic factors (pollutants, hydromorphological changes).
Quality of underground water is in danger, in the vicinity of settlements. Drinkable water bases are located in vulnerable geographical areas, 40% is not secured, endangering 3.5 M population.	Medium	Precipitation. Significant role of non-climatic (soil, geological attributes, hydrological relations) and anthropogenic (pollutants) factors.
Some settlements have inadequate waterworks, 35% of dwellings are not connected to communal pipeline systems, 30% of wastewater gets to receptor waters without biological treatment, 70% without grade III. treatment. Roughly 900d settlements are supplied with water not complying with EU regulations.	Low	Decisive role of non-climatic factors (financial, institutional).
Anthropogenic regulations influencing surface waters (dams, storage formulation etc.) resulted in hydromorphological changes which led to several ecological conflicts, emphasised areas are in Szigetköz, descent of Danube's bottom, water biosphere reduction, Lake Fertő, etc.	Medium	Not well examined
Waterflows' quality and quantity from abroad are strongly influenced by foreign factors (water extraction, storage, wastewater lead-in, disastrous type of pollutions)	High	Water collecting areas beyond the country's borders. Non-climatic effects (foreign water use, wastewater lead-in, international contracts).

Figure 6.9. summarises some of the expected changes in Hungary.

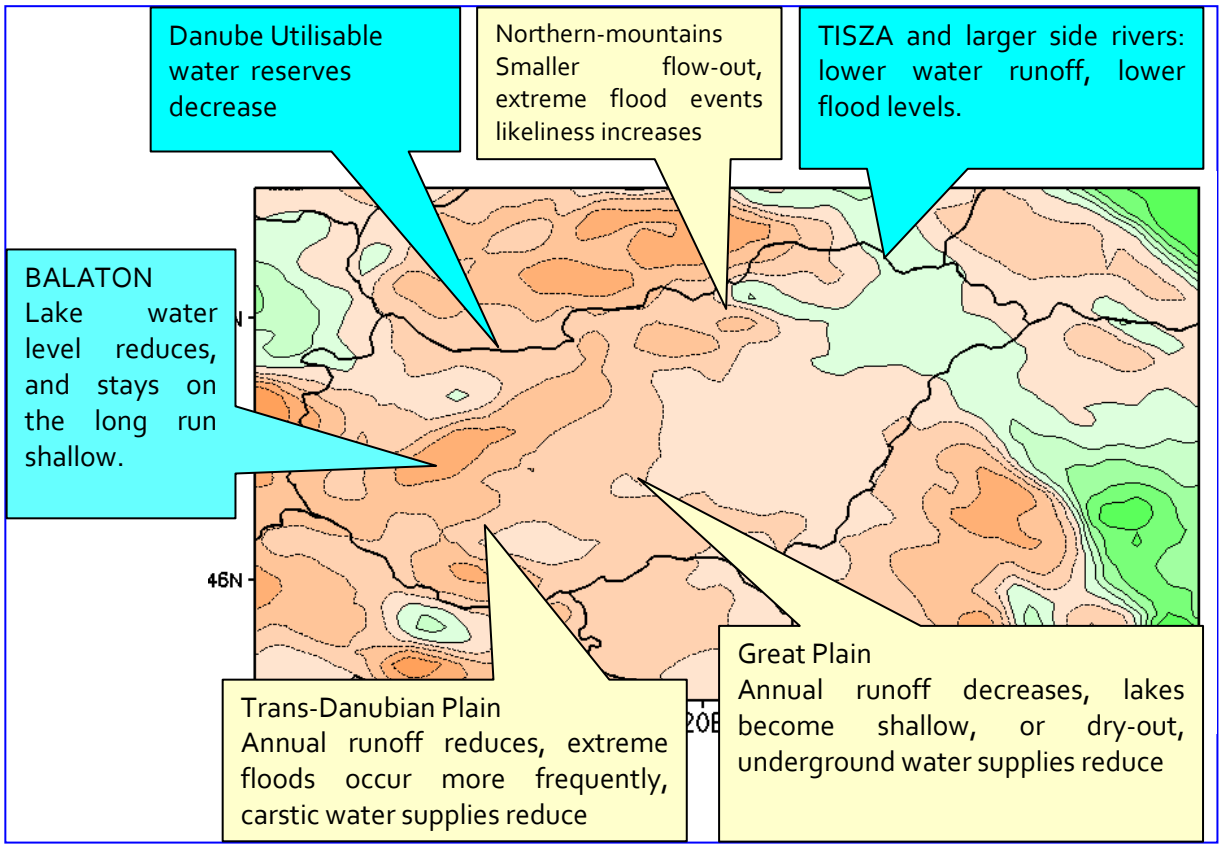


Figure 6.9. Expected change in hydrological characteristics of the country for the period 2021-2040 (background map represents the least optimistic scenario forecasted by RegCM)

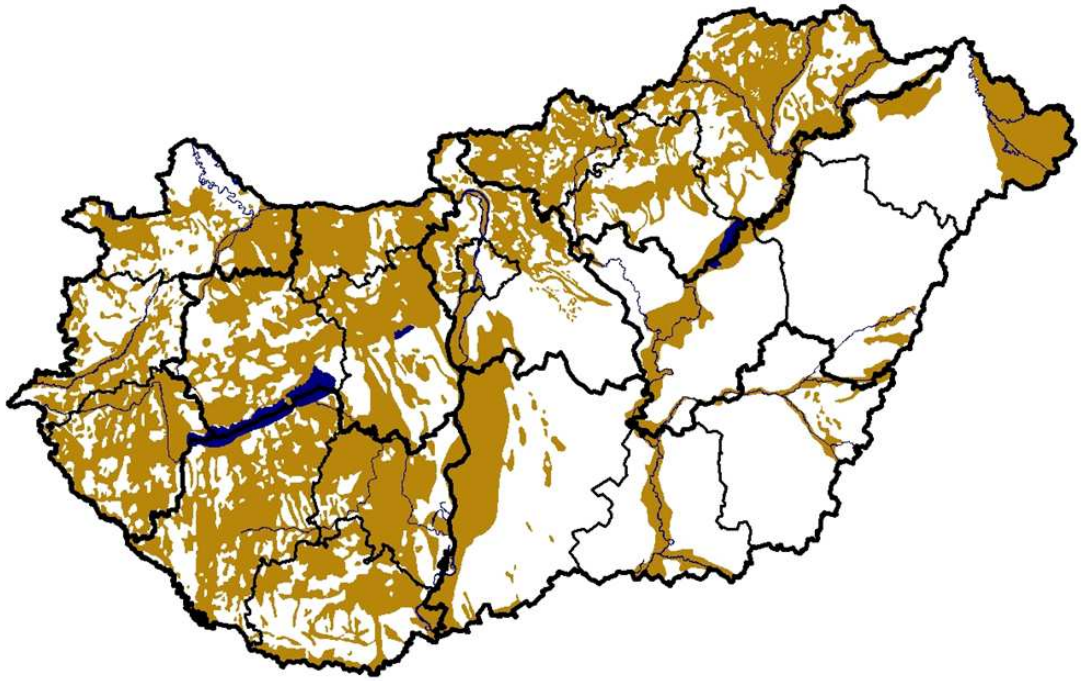


Figure 6.10. Areas threatened by erosion

Source: Szent István Egyetem, Környezet-, és Tájgazdálkodási Intézet, Térinformatikai Stúdió

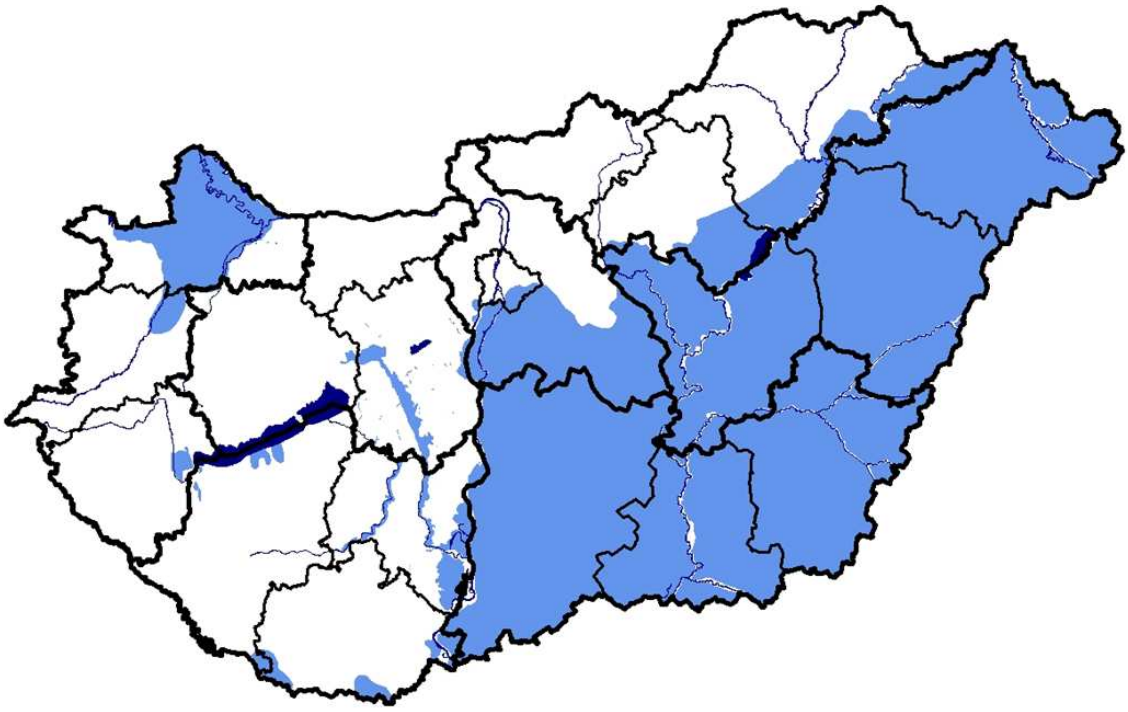


Figure 6.11. Areas threatened by inland inundation
Source: Szent István Egyetem, Környezet-, és Tájgazdálkodási Intézet, Térinformatikai Stúdió

6.3. Adaptation measures

Preparation for adaptation can not be further delayed, as the impacts in the middle of the century will be probably already prevalent and significant, afterwards the adaptation will be highly costly and time-consuming.
In Hungary the climate and security relationship needs to be examined primarily in the following areas:

- ecosystems
- agriculture, forest management
- infrastructure
- water management

Ecosystems

Changing climate definitely has an impact on natural ecosystems and through them to social and economic processes. It is an accepted and well-known fact that economic and social life relies on and enjoys the benefits of various natural resources. The ecosystems are not solely representing one sector, but all other sectors are connected through services relying on ecosystems, thus the protection of ecosystems and

biodiversity has to be treated as a task of utmost importance. Among them the protection of natural habitats, of wandering pathways, of natural water environments and habitats has to be underlined.

The following are the adaptation measures necessary in this aspect:

- Quantitative and qualitative assessment of water reserves trends, as well as water demand and supply trends has to be undertaken in order to ensure the security of underground water management
- Assessment of climate change impacts on the natural status of surface and underground waters
- Impact assessment for water catchment areas and development of indicator system for monitoring changes in the natural waters
- Ecological and economical assessment of negative impacts of climate change in Hungary, harmful reduction of non-arable lands with afforestation, ecological and economical assessment
- Climate indicative re-evaluation of domestic plans from domestic databases. Improvement of ecological monitoring, synchronisation of existing databases (meta-data collection)
- Development of simulation and strategy models based on on-site case studies and a theoretical ecosystem, modelling of long run time series based on data from the Danube region
- Development of dynamic profile indicators for many plant and insect races, integration into a programme environment
- Analysis of high definition NDVI data for assessing the vulnerability of different horticultural habitats with respect to temperature rise
- Improvement of conventional geological and pedological thematic data with the aid of hyper-spectral data

Agriculture and forest-management

Hungary, uniquely in Europe has agro-ecosystems on more than 80% of its territory; therefore the agricultural sector's vulnerability is extremely high, so adaptation measures together with mitigation are very important. It is important to formulate technologies, or if possible increase their numbers which conform with the characteristics of the production area and plant and to increase the areas of irrigated lands, which will be a great challenge for the agriculture. The correct land use and land cultivation can significantly reduce the harmful impacts of climate change. The following adaptation measures are foreseen as necessary:

- For the specific and major plant types, the climatic needs of the plant according to its phenological phases have to be presented and envisaged in a complex context with precipitation and temperature changes.
- Extending the phenological models with stochastic elements, the risk functions for races, types, regions have to be modelled and risk maps drawn. Indicator analysis can be successfully connected to modelling techniques to create model based indicators.
- During corn simulation modelling the expected biomass formulation should be assessed and the effect of irrigation and climate change to the seed production quantity.
- The climatic factors fundamentally affect the fruit harvesting plants' biological and development processes. The plants are capable of adaptation within certain boundaries, but the extreme environmental effects endanger productivity and viability. The most affected plant genotypes have

to be found, their drought and thermal stress tolerances and their relation to environmental factors have to be measured.

- Examination of autumn and spring type cereals to identify the effect of climatic factors on product quantity. Greenhouse and phytotronical modelling is necessary to analyse the capability of different genotypes in water utilisation.
- Assessment of the domestic soil types to reduce harmful impacts of climate change, quantification of potential mitigation effect.
- Assessment of correlation between annual forest growth and climate parameters, definition of effect of climate zone shifts. Risk assessment for forest health, diseases and pests.
- Development and introduction of sustainable, environment-friendly agriculture, land use and technologies. Agrotechnical analysis, selection and public production of plant types capable to adapt to different climatic conditions. Research, development and application of production technologies for such plants. Definition of quantitative and qualitative conditions of agricultural products to aid climate friendly product penetration on the market.

Critical infrastructures

It is vital in the context of climate change and security to define the location of security risks, to improve the society's risk awareness and perception of environment. The following measures are deemed necessary for adaptation in this area:

- Assessment of public administration's potential to tackle climate change challenges.
- Calculation of climate change related perils and risks to provide a basis for the national catastrophe defence organisation and other emergency organisations. Impact assessment of climate extremities to critical infrastructures, population and human health
- Analysis of potential effects of climate change on road structures (temperature change, alternation around freezing point, sizing of road structures, sizing of water drainages, selection of proper materials for road construction, etc.)
- Elaboration of prediction methods for optimal harvesting/ripening time, ripening kinetics assessments, shelf-life and storage analysis. Demand for storage technologies according to changing conditions. Assessment of investment and operation costs change for heat containers.
- Cost-benefit analysis for energy efficient solutions in tourism, involving professional organisations. Assessment of domestic inhabitants' travel habits and the potential to modify them (new holiday schedule, new destinations assessment, support of in-country tourism).
- Elaboration of area type localisation and consecutive analysis of the area-specific security risks, potential responses and preservation steps.
- Improvement of financing and education of defence bodies, acquirement of new equipment and professional training for members of security forces.
- Improvement of administration and leadership skills to handle climate change related risks.

Water management

The measures that need to be undertaken are as follows in the hydrology field:

- indicator and monitoring systems development and formulation, to follow climate change impacts on hydrology and water management, impact assessment studies preparation
- assessment of the real constraints and potential for adaptation with special regards to utilisable water reserves and flood control
- development of economic water usage, higher involvement of local water assets and precipitation
- repeated measuring and assessing of water restraint potentials and surface and under-surface water reserves
- mandatory development of detailed climate change related impact assessment for significant hydrological investments
- reduction of non-climate related impacts on hydrological reserves (land use, urbanisation, settlement policy, wastewater)

Small regional forecasting and alarm system development

Aerial convective processes are particularly sensitive to climate change. It is common knowledge and experience that the severity and intensity of precipitation increased in the last decade. The Hungarian Meteorological Service committed significant efforts to ultra-short term forecasting ("nowcasting") methodologies development, putting the MEANDER regional nowcasting and alarm system in operation from 2006. With further developments it would be possible to apply the present system to small regional scale, relying on the Hungarian Meteorological Service's (OMSZ) web infrastructure.

Preparation for the urban climate change in the XXI. century

Presently 68% of the population lives in urbanised areas and in a few years this rate is forecasted to reach 80%. It is therefore inevitable to assess the climate change related urban health problems. One of the most significant problems is the urban heat plexus problem, for which local and satellite data have to be used. Furthermore it is necessary to assess the cardiovascular morbidity with relation to forecasted extreme heat and the regional effects to the heat plexus problems in large urban areas.

6.4. Conclusions

Based on present and earlier research and mainstream modelling results Hungary's vulnerability to climate change can be considered moderate, in some aspects, however, there is a higher chance of severe impacts. The country's most affected areas are agriculture and forestry, extreme weather events present a human health risk. Relevant adaptation measures encompass a broad range of actions and mostly target agriculture, forestry, water management and human health related areas.

7. Financial resources, transfer of technology

7.1. Provision Of New And Additional Financial Resources

This is not applicable for Hungary.

7.2. Assistance To Developing Countries

This is not applicable for Hungary.

7.3. Provision Of Financial Resources, including financial resources under Article 11 of the Kyoto Protocol

This is not applicable for Hungary.

7.4. Activities related to transfer of technology

This is not applicable for Hungary.

7.5. Information under Article 10 of the Kyoto Protocol

This is not applicable for Hungary.

8. Research and Systematic Observation

8.1. General policy towards research, systematic observation and their funding

The aim of this chapter is to concentrate on research activities and research-related policy developments that have taken place since the last National Communication.

The most important Hungarian initiative to date on climate change, focusing on adaptation and vulnerability, has been the VAHAVA project[17] carried out by the Hungarian Academy of Sciences (MTA) and the Ministry of Environment and Water that was already referred to in the 4th National Communication. It was a nationwide project, involving leading researchers from a number of scientific institutions across Hungary.

The project covered several areas related to climate change, such as agriculture, meteorology, medicine, biology, socio-economic and methodological aspects. Its focus was mainly on adaptation and partly on mitigation, looking at both the potentially positive and the negative effects of climate change. Its results were published as a book in 2007 ("A globális klímaváltozás: hazai hatások és válaszok" – Global Climate Change: Impacts and Answers in Hungary), which not only featured important research results but also helped initiate further research projects. A shortened project report in English of approximately half the size of the original Hungarian report has been under preparation as of spring 2009.

Using the scientific basis laid out by the VAHAVA project, the Hungarian Parliament has adopted the National Climate Change Strategy (NCCS) for 2008-2025[18].

The National Climate Change Strategy provides a fundamental basis and coordinative background for scientific research, thus delivering efficient and concise formulation and management of future research efforts.

The Strategy includes directions for the field of climate change research, both for mitigation and adaptation. In the area of mitigation, the state aims to support demonstration projects for energy production and energy efficiency, such as carbon capture and storage or the development of passive public buildings.

There is a wider range of research topics for adaptation to climate change in the strategy:

- Mapping the gaps in knowledge on climate change adaptation and identifying the reasons;
- Research on domestic climate- and meteorology-related hydrology for more precise predictions;
- Identifying and understanding irreversible effects and their mechanism in the physical, biological and human systems due to climate change;
- Economic calculations to analyse the costs of non-action and the benefits of predictive action, particularly in relation to vulnerability and risks in every field (e.g. health, water resources management, crop production, infrastructure);
- Research on the positive interactions, complementary effects, synergies between adaptation and sustainable development;

[17] http://ec.europa.eu/environment/climat/adaptation/workshops/pdf/budapest/pres_istvan_lang.pdf

[18] http://klima.kvvm.hu/documents/14/nes_080219.pdf

- Identifying and analyzing the relationship between adaptation and mitigation, in order to select options that are mutually beneficial;
- Implementation of research results explored by international organizations and other European countries in the field of climate change adaptation, action plans to carry them out, especially exploring those flexible adaptation options that allow for enduring and treating climate shocks;
- Participating in international scientific networks on climate change adaptation;
- Identifying, analyzing and dealing with social and institutional barriers to adaptation;
- Identifying urban planning, architecture, public services and lifestyle know-how used in Mediterranean countries and studying the possibilities of domestic implementation;
- Analysis of the complex effects of climate change on cities.

The document also introduces the so-called "principle of integration", which means that climate change policies should be integrated into every governmental strategy, action plan and programme that may be related to climate change in any way, including the general strategy on research.

The implementation plan of the NCCS is formulated in National Climate Change Programmes (NCCP), which outline activities for a two-year term. Proposed research activities in the first NCCP[19] are the following:

- Database improvement:
- Improvement of the National Environmental Information System;
- Development of mitigation methodologies
- Complex risk assessment methodology to evaluate the climate effect of plans, programmes, development efforts;
- Climate model development:
- Regional climate models of Hungary, climate scenario building, better and more precise modelling, interpreting model results according to the needs of users;
- Risk Assessment:
- Risk assessment of natural disasters;
- Cooperation:
- Creating favourable conditions for organizing fora, conferences and informal negotiations;
- Development of governmental and ministry strategy guidelines, assigning research institutes and knowledge centres, implementation of the results of research projects carried out with the participation of agricultural enterprises and farmers;
- Creating the possibility of the participation of Central and Eastern European countries in European Union research projects (such as those covered by the EU's 7th Framework Programme) at the level of more developed EU countries.

In addition to the above-mentioned documents it is important to mention the 3rd National Environmental Programme (NEP) for 2009-201420. It sets the main priorities for all kinds of environment-related research in Hungary. According to the NEP, the most important tasks to enhance research efficiency are to reinforce collaboration (domestic, EU and international), to concentrate capacities, networking and support of research centres.

[19] http://www.mtvsz.hu/dynamic/NEP_skv_re.pdf

[20] http://www.kvvm.hu/cimg/documents/NKP-III_tervezet_0324.pdf

8.1.1. Coordination of research policy

As mentioned in the introduction of this chapter, the research policy's framework is set by the recently adopted National Climate Change Strategy. The Strategy provides the background for the national climate related research activities and will be coupled by the assignment of necessary resources from the government.

A significant part of all research in Hungary is carried out or coordinated by the Hungarian Academy of Sciences (MTA)[21]. Under the Presidium of the Academy there are a number of departments responsible for different fields of science. However, besides this vertically structured organization of departments there are also horizontal committees with one of them being the Presidential Committee on Environmental Sciences. Under this Presidential Committee, there is a Subcommittee on Adaptation to Climate Change.

In March 2009, the Presidential Committee adopted a declaration that lists domestic tasks related to climate change. The declaration includes four groups of new research and innovation topics that should be considered in the near future: a. Monitoring of climate change induced processes and tendencies in nature and society; b. Technologies reducing carbon emissions and increased efficiency of natural carbon sinks; c. Upgrading current methods of adaptation; and d. Raising awareness by education and training. Given the important role of the Academy in the Hungarian research scene, these topics will most likely guide researchers in their activities both formally and informally.

On the other hand, the Academy as a legal body along with the three ministries dealing with climate change (Ministry of Environment and Water, Ministry of Agriculture and Rural Development and Ministry of Health) is responsible for the coordination of climate change research and its funding in Hungary. Coordination tasks are carried out by its Office of Climate Change Research Coordination, founded in 2007, which implements decisions of the climate change subcommittee and thus acts like an interface between decision-making and research. An important function of the Office is also to lobby funding bodies in order to make more funding available for climate change-related research.

In order to implement the NCCS, the Hungarian Government recently established a "National Climate Change Committee". This Committee is chaired by the Minister of Environment and Water and part of its role is to coordinate activities related to climate change between the different ministries also with regard to research. The Hungarian Academy of Sciences is represented in the Committee as well. Initiating proposals for educational and awareness-raising measures related to climate change is also among the tasks of the Committee.

8.1.2. Funding

Funding for climate change research in Hungary mainly stems from European Union sources and the National Office for Research and Technology, while there are relatively limited funds available from other national and international sources.

National Office for Research and Technology (NKTH)

[21] http://www.mta.hu/index.php?id=406&type=0

Researchers may apply for funds at the National Office for Research and Technology (NKTH)[22] within the "Support for Strategic Research" action scheme of the National Technology Programme. The Programme is divided into five sub-programmes, two of which offer funds for research on climate change, namely those on "Liveable and Sustainable Environment" and "Defence and Security Research". These programmes publish two calls for proposals each year.

The available funds for the National Technology Programme as a whole (including all 5 sub-programmes) were 18 billion HUF in 2009.

In 2008, the two applicable sub-programmes received 9.24 billion HUF in the second round of calls (not limited to climate change-related projects). The first call of 2008 and previous calls also offered funds for climate change research, although in a different structure.

In 2005-2006, according to its own statistics, 20-30% of all project funds granted by the National Office for Research and Technology went to environmental research, which included climate change as well.

European Union funds

Funding from the European Union is available on the one hand from its 7th Research Framework Programme under the specific programme for Cooperation, which includes ten thematic priorities. Climate change is part of the Environment thematic priority[23], for which EUR 1,890 million are available throughout the lifetime of the Framework Programme (2007-2013). The National Office for Research and Technology plays an important role in coordinating and co-financing these European funds for Hungarian recipients.

On the other hand, certain smaller EU funding schemes are supporting climate change-related research in Hungary: The "Intelligent Energy – Europe" programme[24] funds research projects which are specifically targeting topics related to energy efficiency and renewable energy sources. The European joint research initiative "COST" (European Cooperation in Science and Technology) is another vehicle for supporting non-competitive research across Europe. This scheme is funding climate change-related research under its "Earth System Science and Environmental Management" action[25].

Hungarian research institutions are participating in all of these European Union schemes. It is worth noting that these always require cross-border cooperation with institutions in other EU member states to be considered for EU funding.

Other funds

Smaller grants are available from the Academy of Sciences and involved ministries, particularly for funding post-VAHAVA projects. These are primarily intended as seed funding for new research projects, which might later apply for other, more generous funding schemes.

The Ministry of Environment and Water has also funded some research and analytic studies in order to prepare for the National Climate Change Strategy and other climate-related strategic decisions, European policy initiatives (e.g. EU white paper on adapting to climate change) and national tasks related to IPCC.

[22] http://www.nkth.gov.hu/english

[23] http://cordis.europa.eu/fp7/environment/home_en.html

[24] http://ec.europa.eu/energy/intelligent/

[25] http://www.cost.esf.org/domains_actions/essem

Some additional, although rather limited funding has been made available to the Hungarian Academy of Sciences under a cooperation agreement with the Prime Minister's Office for research on specific strategic topics on behalf of the government. One of these research topics is climate change.
International organizations like UNEP (United Nations Environment Programme), WHO (World Health Organization), World Energy Council, Climate Strategies and others are also occasionally funding specific research projects in Hungary.

8.2. Specific research activities

This section briefly introduces the main players contributing to climate change research in Hungary and presents an overview of current research projects, including both exclusively Hungarian projects and joint projects by Hungarian and foreign partners, such as those supported by different funding schemes of the European Union. This is followed by a more detailed presentation of a selection of major research efforts related to climate change, divided into four main areas: climate modelling, impacts of climate change, adaptation to climate change and mitigation of climate change.

8.2.1. Main institutions involved in climate change research in Hungary

Research related to climate change is carried out at a variety of institutions across Hungary. These include the Hungarian Academy of Sciences (MTA), university and college departments, dedicated state institutions such as the Hungarian Meteorological Service, as well as NGOs and private consultancies and think tanks.

Besides its role in coordinating and initiating research activities (as outlined in 8.1.1), the MTA also carries out research through its own institutes as well as through joint research groups attached to Hungarian universities and other scientific institutions. A research group focusing on Adaptation to Climate Change exists with Corvinus University of Budapest, which has played a leading role in both the VAHAVA project (see 8.1) and its follow-up project called "KLIMA-KKT" (see 8.2.5). There are also three research groups at Szent István University (Gödöllő) which cover climate change aspects: the Institute of Mathematics and Informatics deals with mitigation methodologies and environmental informatics, the Agronomy Research Group does so particularly with regard to crop cultivation, while the Plant Ecology Research Group focuses on physiological processes in plants under different climatic conditions and CO_2 concentrations.

In May 2009, the Subcommittee on Adaptation to Climate Change of the MTA decided to prepare a concept for a new research institute for sustainability and climate change in Hungary[26].

The most important specialist institution involved in climate change research is the Hungarian Meteorological Service (OMSZ). Its research focuses on regional climate modelling (see 8.2.4) and it also plays an important role in systematic climate observation (see 8.3).

Some smaller state-funded institutions also contribute to climate change-related research, in particular the National Institute for Environmental Health with its research group on the health effects of climate change (see 8.2.5) and the Hungarian Forest Research Institute, which is involved in research related to climate change and forest management.

A particularly strong research focus on climate change can be found at the Department of Meteorology of Eötvös Loránd University in Budapest. Being the only university in Hungary to offer a degree programme in

[26] http://www.fkki.scientia.hu/

meteorology (with climate research as one possible area of specialization, see 9.3.1), they are involved in several national and international research projects related to climate change (see Table 1) and jointly run observation activities at Hegyhátsál meteorological station together with the Hungarian Meteorological Service (see 8.3.1).

Regarding energy and environmental modelling, the Szent István University's Department of Applied Informatics is practically the only academic institution focusing on energy modelling methodology development and studies in climate change related emissions and mitigation assessment. Several large-scale projects were undertaken with the involvement of international academic institutions from all over the globe utilising mainstream computer model frameworks. Special emphasis is placed on the transfer of know-how to the future generations in the frame of academic education.

A relatively new research institution is the Centre for Climate Change and Sustainable Energy Policy (3CSEP) at Central European University (CEU), an American-Hungarian international graduate university in Budapest. 3CSEP was inaugurated in early 2008 to bundle and strengthen research activities related to climate change and energy within CEU. However, even before the creation of 3CSEP several major research projects related to climate change have been carried out at CEU.

Another academic institution with a long tradition of climate change research is the University of West Hungary's Faculty of Forestry in Sopron. Their research has primarily focused on the impacts of climate change on forestry, as presented in the 4th National Communication. Recently, its research capacity has been strengthened by the newly opened Regional Focus Research Center for Non-boreal Eastern Europe of the NEESPI network (Northern Eurasia Earth Science Partnership Initiative).

The Regional Environmental Centre for Central and Eastern Europe (REC) is an international body headquartered in Szentendre, Hungary. It is running a number of programmes related to climate change and other environmental issues for the countries of the Central and Eastern European region. Besides developing its own programmes, it is also participating in numerous projects funded by the European Union or other international organizations, along with partners from other countries.

8.2.2. Hungary's contribution to the Intergovernmental Panel on Climate Change (IPCC)

Several scientists from Hungary have contributed in recent years to the work of the IPCC, which was acknowledged by the shared Nobel Peace Prize in 2007, following the publication of its 4th Assessment Report (AR4).

To strengthen Hungary's influence on the IPCC and make sure that its findings are fed back into national climate change policy-making, a National IPCC Committee (NIC) has been set up in the wake of AR4 and the Nobel Prize, which meets regularly and brings together scientists involved in IPCC work with representatives of the Ministry of Environment and Water as well as the Hungarian Academy of Sciences. The Hungarian government aims at encouraging scientists from Hungary to participate in as many IPCC activities as possible and hosted a plenary session of the Panel in Budapest in April 2008. A successful IPCC outreach event was also organized in Budapest that month, hosted by Central European University in order to bring together key representatives of politics, science, business and civil society in Hungary to discuss the key messages of the 4th Assessment Report.

The Hungarian government is supporting the work of IPCC through a voluntary financial contribution to the international body, whereas individual IPCC-related activities of Hungarian scientists need to be funded from other sources.

8.2.3. Specific research activities in Hungary

Box 8.1. The VAHAVA Network

Although the VAHAVA project (see 8.1) was finished in 2006 and its final report published in 2007, the Hungarian Academy of Sciences and the Ministry of Environment and Water recommended starting a mobilizing network that includes individuals and organizations active in the field of research, innovation and policy on climate change mitigation, adaptation and greenhouse gas emissions.

Participation in the network is voluntary and open to any interested parties. The network currently consists of around 243 individual researchers and 117 institutions. The topics within climate change mitigation and adaptation include:

- Meteorology
- Wildlife conservation
- Water management
- Geographical landscape
- Agriculture
- Forestry
- Energy
- Traffic
- Urban development
- Regional and subregional development
- Environmental health
- Tourism
- Economy
- Legislation
- Sociology
- Insurance
- Environmental awareness
- Education, behaviour, awareness-raising, technical assistance
- Disaster recovery
- Communications

The main objectives of the network are:

- Collecting and distributing information on domestic research and innovation topics and events
- Collecting and distributing information from abroad
- Reinforcing domestic research and innovation
- Providing information on domestic climate research and climate policy
- Representative body at research funding institutions
- Cooperating with partners in organizing meetings in the field of climate change

The network has its own webpage at www.vahavahalozat.hu and also aims to publish the most important research and innovation results in its journal called "Klíma-21 Füzetek" ("Climate-21 Booklets"). The network is coordinated by the Office of Climate Change Research Coordination at the Hungarian Academy of Sciences and financed by the Ministry of Environment and Water.

The table below provides an overview of selected research projects related to climate change carried out at Hungarian research institutions as of 2009. In addition to those listed, there are many more European Union projects in which Hungarian partners are involved, often only playing a smaller role in the project consortium. To keep the table readable and the Communication concise, only a few flagship research projects are included.

Table 8. 1. Overview of current research projects on climate change in Hungary

Area				Institution and funding sources (if applicable)	Project	Website
Climate modelling	Impacts of climate change	Adaptation	Mitigation			
●				Hungarian Meteorological Service	Regional climate modelling	www.met.hu
●				Hungarian Meteorological Service, Eötvös Loránd University Budapest, University of Pécs, funded by NKTH	Dynamic investigation of Hungary's climate and methodology development for regional climate predictions based on numeric models	http://nimbus.elte.hu/res-h.html
●	●			Hungarian Meteorological Service, Eötvös Loránd University and further partners (EU project)	Central and Eastern Europe Climate Change Impact and Vulnerability Assessment (CECILIA)	www.cecilia-eu.org
●	●			Hungarian Meteorological Service with European partners	CLIVAGRI: Impacts of Climate Change and Variability on European Agriculture (COST Action 734)	www.cost734.eu
●	●			NEESPI Regional Focus Research Centre for Non-boreal Eastern Europe at University of West Hungary	Effects of terrestrial energy, water and biogeochemical cycles and human impacts on the regional and global climate and on the dynamics of ecosystems	http://neespi.nbeeu.nyme.hu/
	●	●		Corvinus University of Budapest with Hungarian Academy of Sciences and further Hungarian partners, funded by NKTH	KLIMA-KKT (Climate change: Environment, Risk, Society)	www.uni-corvinus.hu/index.php?id=18320
	●	●		Hungarian Academy of Sciences and Corvinus University of Budapest	Joint research group on adaption to climate change (risk analysis and health effects)	http://epi.univet.hu/portal/climadapt
	●	●	●	Corvinus University of Budapest with further partners (EU project)	ADAM (Adaptation and Mitigation Strategies: supporting European climate policy)	www.adamproject.eu
	●			Hungarian Academy of Sciences in strategic cooperation with Prime Minister's Office	Examination of the state of the environment in Hungary with particular regard to climate change	www.mta.hu
	●	●		National Institute of Environmental Health, WHO and EU	Direct and indirect health-threatening effects of climate change	www.oki.antsz.hu/index_en.html
	●			Hungarian Academy of Sciences and Szent István University, Gödöllő	Joint research group on agronomy, focusing on cultivation factors of the environmental and climate protection	www.mta.hu/index.php?id=3046
	●			Hungarian Academy of Sciences and Szent István University, Gödöllő	Joint research group on plant ecology, focusing on plant physiological processes under different climatic conditions and increasing air CO_2 concentrations	www.mta.hu/?id=2005&passpars=view_group.php%3Fc_id=239
	●	●		Hungarian Forest Research Institute with European partners	Greenhouse gas budget of soils under changing climate and land use (COST Action 639)	www.cost639.net
	●	●		Central European University, Budapest, on behalf of WWF	Overview study on the impacts of and adaptation to climate change in the Danube-Carpathian region	http://3csep.ceu.hu/node/37
	●			University of Szeged, Eötvös Loránd University Budapest, supported by Hungarian Scientific Research Fund (OTKA)	Urban climate research (heat island, temperature and humidity differences, bioclimatological alterations)	www.sci.u-szeged.hu/varosklima/

Area				Institution and funding sources (if applicable)	Project	Website
Climate modelling	Impacts of climate change	Adaptation	Mitigation			
	●		●	University of Debrecen	Wind climatology and utilization of wind energy	http://meteor.geo.klte.hu/index2-hu.html
		●	●	Hungarian Academy of Sciences	Social aspects of climate change, climate-friendly municipalities	www.socio.mta.hu/site/index.php?id=68&L=2
		●		Szent István University, Hungarian Meteorological Service and further partners, funded by National Technology Programme of NKTH	Prevention, forecasting and reduction of negative effects of climate change on agriculture and food production	www.szie.hu/node/1017
		●	●	Hungarian Forest Research Institute, funded by Operational Programme for Economic Competitiveness (GVOP)	Development of forest management methods for reducing the negative impacts of climate change and protecting the nature	www.erti.hu/temak.php?id=1&kn=gvop&fn=gvop
		●		University of West Hungary, Sopron	FORMAN: Adaptation possibilities to climate change effects on forests	www.nyme.hu/index.php?id=320
			●	Budapest University of Technology and Economics	Development of environment-friendly solar energy technologies	www.energia.bme.hu/index.php/tudomanyos-munka/109-tudomanyos-munka/145-kutatasi-temak
			●	Consortium of researchers on behalf of Ministry of Environment and Water	Carbon Dioxide Mitigation Potential in the Hungarian Public Sector	www.kvvm.hu
			●	Consortium of researchers on behalf of Min. of Env. And Water	Greenhouse Gas Mitigation Scenarios for Hungary for the Period up to 2025	www.kvvm.hu
			●	Central European University, Budapest, on behalf of UNEP	Assessment of policy instruments for reducing greenhouse gas emissions from buildings	http://3csep.ceu.hu/proects/reducingghg2
			●	Central European University, Budapest, with funding from Ministry of Environment and Water	CO_2 mitigation potential in the Hungarian residential sector	http://3csep.ceu.hu/node/74
			●	Central European University, Budapest, with Joanneum Research, Austria, on behalf of Climate Strategies	Green Investment Schemes: Maximizing their benefits for climate and society	http://3csep.ceu.hu/node/68
			●	Regional Environmental Centre for Central and Eastern Europe with UNEP	Clean Fuels and Vehicles in Central and Eastern Europe	www.rec.org/rec/programs/pcfv/
			●	Systemexpert Ltd. With Intelligent Energy for Europe	4EM Motor Challenge Programme	www.mcpeurope.net
			●	Systemexpert Ltd. And ESD Ltd. With EBRD/JASPERS	Sustainable Energy Financing Facility in Hungary	http://ef.sysexpert.hu
		●		Systemexpert LTD.	CIRCLE APM project	http://www.circle-era.net/

8.3. Systematic observation

The main issues of systematic observation in Hungary have been extensively discussed in the previous National Communications and recent changes in this area are less significant than in the field of climate change research. The bulk of observation activities is still carried out by the Hungarian Meteorological Service (OMSZ) and the Department of Meteorology at Eötvös Loránd University (ELTE), which have both been introduced in 8.2.1 and 8.2.4.

8.3.1. Atmospheric observation

Hungary's most important observation site for atmospheric constituents is the Hegyhátsál meteorological station[27], which is jointly operated by scientists from OMSZ and ELTE. Established in 1994, it was among the first European tall-tower stations to take up continuous observation of greenhouse gas concentrations from different levels of its tower (at heights of 10 m, 48 m, 82 m, 115 m) and has produced an invaluable time-series of measurement data since then.

Apart from observation activities at Hegyhátsál, the OMSZ has been granted funding from the National Office for Research and Technology to establish a dedicated network of measuring stations for very precise tracking of the effects of global climate change on Hungary. These stations are being set up between 2006 and 2009 and are designed to be precise enough to make long-term coherent climate change observation possible.

In the field of satellite observation, it has been an important step for Hungary to become a full member of EUMETSAT, the European Organisation for the Exploitation of Meteorological Satellites, in October 2008.

8.3.2. Terrestrial observation and carbon balance

Hungarian institutions have participated in several international research efforts on carbon balance in recent years. The Department of Meteorology of ELTE as well as Szent István University of Gödöllő were partners in the "CarboEurope-IP"[28] project which ran from 2004 until 2008, a huge European project with almost 100 partners that worked together on an Assessment of the European Terrestrial Carbon Balance. Goals of the project were to advance the understanding of the role of the European continent in the global carbon cycle and to significantly enhance the understanding of and the methodologies for the observation, quantification and prediction of the terrestrial carbon cycle of Europe. Key research products of CarboEurope-IP included improved quantitative estimates of the European carbon balance and new technologies to help reduce the associated uncertainties.

[27] http://nimbus.elte.hu/hhs/

[28] http://www.carboeurope.org/

The OMSZ was also involved in the European project called "Carbon-Pro" (Carbon balance drafting and new resources management tools according to Kyoto Protocol) in 2006/2007. Its overall objective was to assess the characteristics of the main agricultural and forest systems in the CADSES area (Central Adriatic, Danubian and South-eastern European Space) in relationship to the strategies set up by the Kyoto Protocol for agricultural and forest systems and to evaluate their sink capacity.

Through the OMSZ and the University of Pannonia, Hungary continued to participate in COST Action 725 (already introduced in the 4th National Communication) on Establishing a European Phenological Data Platform for Climatological Applications, which was concluded in April 2009. The main objective of the project was to establish a European reference data set of phenological observations to be used for climatological purposes, especially climate monitoring and detection of changes.

The newly established NEESPI Regional Focus Research Centre at the University of West Hungary in Sopron is likely to also contribute to terrestrial observation activities in Hungary in the future as the NEESPI initiative is focusing on the ability to measure, monitor and model processes that will provide accurate future projections of climatic and environmental changes in the Northern Eurasian region.

8.4. Conclusions

Both the political and organizational framework conditions for climate change research and observation have advanced significantly since the previous National Communication. After important groundwork done by the VAHAVA project (see 8.1) the importance of research related to climate change has been recognized by Hungary's National Climate Change Strategy adopted in 2008 and also found its way into the country's first National Climate Change Programme.
The coordination of climate change-related research has also become more institutionalized with the establishment of the Office of Climate Change Research Coordination at the Hungarian Academy of Sciences as well as the National Climate Change Committee (see 8.1.1) and the National IPCC Committee (see 8.2.2).

The research activities themselves have significantly increased in recent years, traditionally strong players in this field have been joined by new institutions and the process towards establishing a dedicated Hungarian research institute for sustainability and climate change has been initiated (see 8.2.1). The research projects cover an ever wider range of topics related to climate change, although both the political statements and the distribution of research activities clearly indicate a stronger focus on impacts and adaptation research than mitigation-related research.

9. Education, Training and Public Awareness

9.1. General policy towards education, training and public awareness

The 3rd National Environmental Programme (NEP, see 8.1) claims that while Hungarian citizens value the environment, their individual actions still do not reflect sustainable thinking and lifestyles.

According to the NEP there are three main areas of environmental education and information where it is important to take action:

- Environmental education
- Ensuring appropriate form and content of publicly available environmental information
- Strengthening the role of the media in raising awareness

The National Climate Change Strategy (NCCS) highlights that besides providing general knowledge on climate change, it is extremely important to enhance skills for adaptation and problem-solving. The main priorities in raising awareness are life-long learning of sustainable lifestyles and regular transfer of knowledge about adaptive behaviour, especially focusing on the importance of how society, business and politics could benefit from new adaptive actions.

The NCCS puts special emphasis on the information dissemination for future generations and the Ministry of Environment launched several dissemination and awareness-raising programmes to aid this objective. Besides the work done by the Ministry, significant funding of NGO's was realised through the National Civil Fund for educational, training, awareness-raising and information dissemination purposes.

9.2. Primary and secondary education

The system of climate change education in primary and secondary schools has not changed significantly since NC4 and is still embedded into some of the 10 integrated topics as a cross-cutting issue in the National Base Curriculum.
However, climate change education appears in many further school activities other than the official educational programme.

The Hungarian Ecoschool Network[29] introduced in NC4 continues to recruit schools to adopt the principles of sustainability, not only in their educational programme, but throughout all of their activities and currently has more than 350 schools as members.
"Forest Nursery Schools" and "Forest Schools" are schools that provide special environmental and sustainable lifestyle education to their pupils. They are certified by the Association of Environmental and Wildlife Conservation Educational Centres on behalf of the Ministry of Education and Culture.

Having realized that there was no comprehensive and sufficiently simple educational material that could help teachers transfer knowledge about climate change to students, the

[29] http://www.okoiskola.hu/

Corvinus University of Budapest edited a book titled "Klímaváltozásról mindenkinek" ("On Climate Change for Everyone"). Many renowned scientists who had participated in the VAHAVA research project (see 8.1) and its follow-up project "KLIMA-KKT" (see 8.2.5) contributed to this publication. The book has been distributed free of charge to Hungarian schools, thanks to generous sponsoring from a big insurance company.
An online project by Eszterházy Károly College of Eger called "Földrajz Netszközkészlet"[30] (Internet Toolbox for Geography) serves a similar purpose for geography teachers offering freely accessible teaching materials in all areas of geography, including climatology and meteorology.

The Hungarian Institute for Educational Research and Development[31] (Hungarian acronym: OFI), one of the background agencies of the Ministry of Education and Culture, carries out research, development and innovation activities and provides related services to enhance the development of education in Hungary.

9.3. Higher education

Aspects of climate change are more and more widely taught at Hungarian universities and colleges, either as part of degree programmes on broader subjects such as environmental sciences etc., or as elective courses freely available to students of any subject. However, only one university in the country offers a degree programme which really puts climate change at the core of the curriculum: the Department of Meteorology at Eötvös Loránd University in Budapest[32] offers Climate Research as one of two possible areas of specialization in its MSc programme in meteorology. This study programme will be introduced in more detail in 9.3.1. The following subsections focus on degree programmes which include climate change into their curricula to some extent at least and on climate change-related offerings open to a more general student audience.

Meteorology and climate science

Eötvös Loránd University (ELTE), based in Budapest, is the only educational institution in Hungary to offer a degree programme in meteorology. This is a 2-year MSc programme and offers its students the choice between two specialization branches, weather forecasting or climate research. This MSc programme is offered for the first time in the 2009/10 academic year. The Department of Meteorology is expecting to accept 10-15 MSc students per year and would like to see roughly half of them choose the climate research branch.

The Szent István University in the framework of the Environmental Engineering M. Sc. Programme puts special emphasis on the education of climate change related energy modelling and thrives to provide real life applications in every aspect of climate related problems for the students.

The University of Debrecen is the only other Hungarian university offering a meteorology specialization on bachelor level, namely in its earth science BSc programme, but it doesn't offer a full degree programme in meteorology[33]. However, its BSc graduates choosing this

[30] http://netszkozkeszlet.ektf.hu
[31] http://www.ofi.hu/index.php?lang=eng
[32] http://nimbus.elte.hu/index-en.html
[33] http://meteor.geo.klte.hu/index2-en.html

specialization should be well prepared to continue their studies in the meteorology MSc programme at ELTE. In Debrecen, after being introduced to meteorology and climatology they are taught several subjects related to climate change, such as environmental climatology, global climate change and agricultural climatology.
At PhD level, the Earth Sciences PhD programme at ELTE offers a meteorology branch, in which currently about 18 doctoral students are enrolled altogether. Roughly half of them are researching climate topics.

Climate change-related studies in other degree programmes

Degree programmes at both bachelor and master level as well as PhD programmes which focus on environmental issues have become more and more widespread at Hungarian universities and colleges in recent years.

At bachelor level, there are mainly three environmental subjects on offer: "Environmental Studies" is an interdisciplinary programme with a strong focus on natural and life sciences, which can be studied at 9 different universities and colleges in Hungary. "Environmental Engineering" is offered by 10 institutions of higher education and familiarizes students with a wide range of environmental technologies relevant for areas from waste management till nuclear safety. 8 universities and colleges offer a subject called "Agricultural-environmental Management Engineering". This combines agricultural studies with a strong focus on sustainability and protection of the environment.

The above-mentioned programmes are not specifically geared to climate change but usually include individual courses related to climate change either in the core curriculum or as electives. A few selected examples of such courses are shown below in Table 2.

There are also several PhD programmes focusing on environmental research: 7 Hungarian universities have established specific doctoral schools in the field of environmental sciences. These are Central European University (CEU) in Budapest, Eötvös Loránd University in Budapest, the University of Pannonia in Veszprém, the University of Debrecen, the University of Szeged, Szent István University in Gödöllő and the University of West Hungary in Sopron. It is generally possible to do climate change-related PhD research at these institutions, although this area is only playing a marginal role in many cases. Besides the PhD programme of the Department of Meteorology of Eötvös Loránd University (see 9.3.1), the one at Central European University has the strongest focus on climate change and over a dozen PhD students of its Department of Environmental Sciences and Policy[34] have been doing climate change-related work there so far. At CEU, PhD students with an interest in climate change can do their research at the university's Centre for Climate Change and Sustainable Energy Policy (see 8.1.1).

CEU is playing a special role also because it is an American-Hungarian institution offering English-language environmental MSc and PhD programmes to a very international student body. Its degree programmes include a 1-year Master in Environmental Sciences and Policy as well as "MESPOM" (Masters of Environmental Science, Policy and Management)[35], a joint 2-year programme with partner universities in the United Kingdom, Sweden and

[34] http://web.ceu.hu/envsci/
[35] http://www.mespom.org/

Greece supported by the European Union under the Erasmus Mundus scheme. Both programmes contain several courses related to climate change and its mitigation.

The following table gives an exemplary overview of what kinds of courses related to climate change are offered by Hungarian universities and colleges to students in degree programmes which are otherwise not fully focused on climate change. This is not intended to be a complete listing, but aims to highlight typical examples at major institutions in this field and show the diversity of climate change-related studies at Hungarian institutions of higher education.

Institution	Department/Unit	Courses offered (examples)
Corvinus University of Budapest	Department of Environmental Economics and Technology	Basics of sustainability; Environmental law; Environmental policy; Green economic policy
Budapest University of Technology and Economics	Department of Electric Power Engineering	Energy efficiency in practice
Budapest University of Technology and Economics	Department of Energy Engineering	Renewable energy sources
Central European University, Budapest	Department of Environmental Sciences and Policy	Air pollution and climate change; Energy challenges for 21st century; Introduction to international environmental policy & law; Policies for sustainable transport
Eszterházy Károly College, Eger	Department of Geography	Climate change, impacts, reaction; Meteorology and climatology; Renewable energy sources
Szent István University	Department of Informatics	Applied environmental informatics Modelling energy and environmental processes External costs of energy production
Szent István University, Gödöllő	Department of Environmental Economics	Agriculture and energy production; Economics of renewable energy sources; Environmental policy and law; Global problems of sustainability
College of Nyíregyháza	Institute of Environmental Sciences	Renewable energy sources; Sustainable development
University of Pécs	Department of Soil Sciences and Climatology	Geographical impacts of climate change

Institution	Department/Unit	Courses offered (examples)
University of Szeged	Department of Agricultural and Environmental Law	Instruments of the Community against the climate change; International environmental law
University of Szeged	Department of Climatology and Landscape Ecology	Changes in climate; Environmental climatology; Renewable energy sources

Table 9.2. Courses related to climate change at Hungarian universities and colleges

Other activities in higher education related to climate change

As climate change issues have played an even smaller role for earlier generations of students, some institutions of higher education are tapping into the resulting need for further education and offer special adult education programmes like an energy auditor qualification offered by the Budapest University of Technology and Economics[36], or several summer schools on topics related to climate change. Although not strictly an institution of higher education, it is worth mentioning that the Hungarian Meteorological Service is organizing an international summer school on climate modelling for professionals in this field[37].

9.4. Awareness-raising

More and more activities are taking place in Hungary to raise public awareness on climate change and spread advice for more climate-friendly behaviour. Both the government sector and the civil society (through a number of NGOs) are active in this area. Their most important activities are presented below.

Government

Climate Road Show[38] (Klímakörút) was a countrywide event, organized by the Ministry of Environment and Water, during which citizens were informed on climate change, its effects and the National Climate Change Strategy. The event included public seminars, film screenings, distribution of information materials etc.

The estimated impact of the series of event was significant, major media organs were also active in propagating the event, it can be stated that the younger generations were well represented in and enthusiastic about the event. Many schools and all the significant urban areas gave place to the event's venue.

The objective was to increase awareness in the stakeholders and to improve communication about the problem.

[36] http://www.mti.bme.hu/tanfolyam/12-001.html

[37] http://www.met.hu/omsz.php?almenu_id=omsz&pid=seminars&pri=1&mpx=1&tfi=-1

[38] http://klima.kvvm.hu/index.php?id=98

There is also a government-administered website called Liveable Environment[39] (Élhető Környezet), dedicated to public awareness-raising and education on climate change, while Coolers Served[40] (Hűsítők tálalva) is a publication providing useful tips on how one can change one's lifestyle to a more climate-friendly one. This publication reaches out for the environment conscious populace and provides constant information on government efforts and climate change related activity.
The Government also takes an indirect yet remarkable effort in awareness-raising by providing constant funding to NGOs in dissemination and awareness-raising activities.

European Union

As part of the "You Control Climate Change"[41] campaign of the European Union, a massive advertising and TV campaign was launched in order to raise awareness in Central and Eastern European countries including Hungary, where there is a lower level of concern for the global climate change according to a Eurobarometer survey by the European Commission. On the campaign website they offer knowledge materials (videos, quizzes etc.) on climate change, guides and tips on how to reduce one's carbon footprint and educational materials for teachers.

The campaign includes the "Be a Changer! challenge, in which participants are encouraged to make commitments to the fight against climate change by registering on the website and uploading pictures of their activities to meet their commitments.

Church

The Catholic Church in Hungary has compiled a small book titled "Felelősségünk a teremtett világ" ("Our Responsibility for the Created World"), which aims at informing and educating the believers on environmental matters. In its section on climate change the book references the VAHAVA research project (see 8.1).

NGOs

Business Council for Sustainable Development

The Business Council for Sustainable Development[42] in Hungary was founded in 2005 by seven companies as the local chapter of the World Business Council for Sustainable Development and has successfully invited more and more business companies into its network. Among their goals are sharing of best practices and awareness-raising in the field of sustainable development, within which one of their main themes is energy and climate.

Challenge Europe Climate Advocates

Challenge Europe is the European element of the British Council's global climate programme. Hungary is one of 15 European countries in which a team of young "climate advocates" is supported by this program[43]. The Hungarian climate advocate team,

[39] http://www.elhetokornyezet.hu/
[40] http://klima.kvvm.hu/documents/102/husitok_talalva_080318_2.pdf
[41] http://ec.europa.eu/environment/climat/campaign/index_hu.htm
[42] http://www.bcsdh.hu/index.php?page=2&l=1
[43] http://challengeeurope.britishcouncil.org/index.php/country-network/94-hungary

established in 2008, has so far initiated three projects, which are all related to education and awareness-raising.

Their biggest project is the so-called "Climate Office"[44], which is a carbon-neutral information centre showcasing best practices and motivating Hungarian students to get involved into practical climate protection and carbon mitigation projects. The first Climate Office opened in March 2009 within Szent István University of Gödöllő, but the climate advocates are planning to expand this into a wider network of several similar offices at institutions of higher education.

As another project, they published a "low-carbon guide" circulated among students and young people to promote a low-carbon lifestyle with the support of Hungarian celebrities. They are also running a weblog[45] to share their experiences as well as useful informational materials.

Clean Air Action Group

Transport and its effects and energy efficiency are main focus areas of Clean Air Action Group[46] (Levegő Munkacsoport). The primary target of their activities are decision makers, however, they do work on raising public awareness as well, mostly through their publications. "Éghajlatvédelem" ("Climate Protection") was a brochure on what the population could do to combat climate change, followed by another one that aims to raise awareness among young people in a more humorous form.
The Action Group received a government funding of approximately HUF 84 M in the last 5 years through the National Civil Fund.

Climate Club (Klíma Klub)

The Climate Club provides a forum for its members from corporate, civil and scientific sectors with the aim to facilitate communication and partnerships among the members of these sectors. Its most conspicuous activity is the Hungarian Climate Change Summit[47], which took place for the first time on February 27, 2009. The main goals are to increase public awareness on climate change and its damaging effects, promote social responsibility taking and educate people to achieve environmentally conscious thinking and a change of perspective.

Energy Club

Energy Club has a wide selection of public awareness-raising programmes ranging from educational materials for primary schools to guidelines for local governments on developing and implementing their own climate strategy.

The Climate Change Educational Package is available for primary schools to assist teachers in their efforts to teach pupils about climate change. At the time it was first developed (2004) computers were not widespread in schools, therefore the main content is on overhead slides, but the package has since been upgraded with digital content. In addition to the overheads, large posters that present five different topics related to climate change

[44] http://www.klimairoda.hu/
[45] http://klimairoda.blog.hu
[46] http://www.levego.hu/index.php?event=Language
[47] http://www.klimaklub.hu/hu/rovat_show/11

can be included in the package. These posters are available in an interactive form on their website[48], too.
"Check It Out!" is a European project that helps schools find ways to save energy by performing energy audits and then giving advice on how to improve their energy efficiency. Students and teachers are involved throughout the whole process from the audits to the implementation of the new measures based on the advice they receive from professionals, thus they become more informed about energy efficiency and climate change.
The Energy Club received a government funding of approximately HUF 42 M in the last 5 years through the National Civil Fund for among others information dissemination and awareness-raising activities.

Greenpeace Hungary
Activities of Greenpeace often have a dual purpose, aiming to raise public awareness and, often using public awareness as a tool, putting pressure on decision makers with regard to particular environmental questions. The most prominent example of this is the "Road to Copenhagen" campaign launching in mid-2009, which tries to persuade government to represent the three most important goals of Greenpeace (at least 40% reduction of carbon dioxide emissions in developed countries by 2020, financial support for developing countries for CO_2 abatement measures and the protection of rainforests) at the United Nations Climate Change Conference and at the same time inform the public on why this is of crucial importance.
Besides their campaigns and demonstrations, Greenpeace regularly publishes brochures and other publications. One of them is the Hungarian version of their Energy Revolution paper, which is a document on energy issues aimed at professionals. "Save the Climate!", which was a special edition of a well-known youth magazine, was a more accessible publication for the public offering everyday tips on how to tackle climate change as an individual.

Hungarian Energy Efficiency Association (META)
This association[49] provides a forum for all stakeholders interested in energy efficiency and also runs information campaigns for consumers, a newsletter and other communication activities related to climate change and its mitigation through improved energy efficiency.

Hungarian Society for Environmental Education (MKNE)
The Society was established in 1992 and has attracted more than a thousand members by now. They play an important role both in organizing trainings on the methodology of environmental education for teachers and in organizing events in schools for pupils and their families[50].
MKNE is also of crucial importance due to their role in drafting the National Environmental Education Strategy of Hungary, of which the latest review is currently in progress in 2009.

[48] http://www.energiaklub.hu/hu/ismeretek/oktatas/
[49] http://www.meta.org.hu/
[50] http://www.mkne.hu/index_english.php

National Society of Conservationists – Climate Act by 2010

The National Society of Conservationists[51] launched a public campaign in 2008 aiming for the support of the people in urging the Hungarian Parliament to pass a law on climate change by 2010 that would, for example, make it mandatory to decrease the use of fossil fuels by an annual 1% from 2012. They have visited numerous cities during their campaign and published many informational materials especially on their website[52]. Their petition has already been signed by the Minister of Environment and Water, several Members of Parliament and other NGOs.

The idea of a climate law has also been adopted by the National Council for Sustainable Development, which was set up by the Hungarian parliament in 2008 primarily to prepare a sustainability report for Hungary and also has a dedicated subcommittee on energy and climate.

The Society received a government funding of approximately HUF 90 M in the last 5 years through the National Civil Fund for environment and climate related dissemination practices.

Védegylet

The goal of Védegylet ("Protect the Future") is to go a step further than showing what an individual can do to battle climate change and instead emphasize the power of community action. Their events and public awareness campaigns reflect this philosophy.

Their first important festival focusing on climate change was Globfeszt II, where Wolfgang Sachs, a well-known expert from Wuppertal Institute for Climate, Environment and Energy was one of the keynote speakers talking about climate issues.

Summer Camp was a meeting for university students already active in green and social movements at their campus on climate change and climate justice. The UK group People & Planet was invited to the Camp to help in capacity building and to inspire the students.

"Wake up to Climate Change"[53] (Klímaébresztő) film festival was a nationwide film week with about 20 movies on climate change shown in 46 towns and cities. Posters, press statements, leaflets etc. were provided by Védegylet to assist the more than 90 organizers around the country. The film screenings were followed by discussions on how to advance at the community level.

WWF

WWF (Worldwide Fund For Nature) has organized a wide range of climate change-related awareness building activities during the last 2 years addressing households, companies and also decision makers. WWF organized the Earth Hour[54] in Hungary both in 2008 and 2009. This symbolic event was started in 2007 by WWF in Sydney and asked people to switch off their lights and electric appliances for one hour to signal their commitment to keeping global warming below the critical value of 2°C. The event has been a success in Hungary in

[51] http://www.mtvsz.hu/index_en.php

[52] http://www.klimatorveny.hu/

[53] http://www.klimaebreszto.net/

[54] http://www.earthhour.org/about/hu:hu

both years, in 2008 Pécs made it to the top 10 cities in the world based on the share of the population joining.
In 2008 WWF launched its innovative Climate Change Survival Kit[55]. This Kit includes a range of climate saving appliances, such as efficient bulbs, insulation tapes, rechargeable batteries with charger, a solar lamp and a range of printed materials about climate change and energy efficiency. In an intensive media campaign close to 10,000 people joined WWF in making written pledges.

9.5. Training

Several organisations in Hungary offer training related to climate change and particularly its mitigation and a large number of conferences and expert workshops are regularly taking place to address such topics. These are partly geared towards a general public, but more often to professionals in fields like construction and engineering. Since issues like climate-friendly and energy-efficient construction haven't been core subjects in most architectural and engineering study programmes at Hungarian universities and colleges so far, there is a particular need for further training in this area. Some major institutions and activities addressing this need are introduced below, but there are many more one-off or smaller-scale training activities taking place in addition to these.

Energy Centre[56]
The Centre besides its core activities is also active in the field of training, providing a wealth of information, technical assistance and knowledge transfer on energy efficiency and renewables.

Hungarian Green Buildings Council[57]
The Hungarian Green Buildings Council was founded in early 2009 to become the official Hungarian member organisation of the World Green Building Council. Their main goal is training in the field of environmental and climate-friendly building technologies.

KÖVET (Association for Sustainable Economies)[58]
One of the main goals of KÖVET, a non-profit organisation and Hungarian member of the International Network for Environmental Management (INEM), is training and education for companies about sustainable development, including climate change mitigation, through conferences, seminars and publications. One of their most successful programmes is "Green Office"[59], which comprises distance learning materials on improving workplace sustainability and a yearly competition among offices for the most successful greening efforts. This scheme is supported by the Leonardo da Vinci programme of the European Union.

[55] http://wwf.hu/index.php?p=vedelem□=44&alal=44&id=178
[56] http://www.energiakozpont.hu/intro.php
[57] http://www.hugbc.org/Hungary%20Green%20Building%20Council.aspx
[58] http://www.kovet.hu/
[59] http://www.zoldiroda.hu/

Passive House[60] *& Zero Emission Building*[61] *Conferences*
Passive house conferences are regular training events organized by the Hungarian Association of Construction Material Producers and the Hungarian Association of Passive House Builders and are accredited as vocational training by the Chamber of Hungarian Architects. They usually feature international experts in the field and serve the purpose of promoting and supporting the idea of climate-friendly passive houses and low-energy buildings in Hungary as well.

9.6. Conclusions

The domestic organisations and institutions backed by significant government support provide a solid background for climate change training and education and through their awareness-raising activities and campaigns contribute significantly to the efforts of the government to accelerate public participation in climate change related efforts.

[60] http://www.passzivhazkonf.hu/english/index.html
[61] http://www.zeroco2.hu/index_eng.htm

Appendix 1. Summary tables for emissions

GREENHOUSE GAS EMISSIONS (CO_2eq, Gg)	BY fixed	1990	1995	2000	2003	2004	2005	2006	2007
Energy	84,006	70,887	61,375	58,188	61,688	59,589	60,623	59,242	56,936
Industrial Processes	10,440	8,650	4,991	5,812	5,394	6,007	6,071	5,695	5,236
Solvent and Other Product Use	384	290	250	236	275	337	148	344	158
Agriculture	17,496	16,026	9,576	9,922	9,995	9,989	9,398	9,417	9,477
LULUCF	-2,736	-4,210	-8,618	-827	-4,489	-4,201	-4,616	-4,109	-4,138
Waste	3,070	3,356	3,653	3,858	3,882	3,981	4,142	4,167	4,136
Total (including LULUCF)	**112,661**	**95,000**	**71,227**	**77,188**	**76,744**	**75,703**	**75,766**	**74,756**	**71,806**
Total (excluding LULUCF)	**115,397**	**99,210**	**79,845**	**78,016**	**81,233**	**79,904**	**80,382**	**78,865**	**75,944**

Table A.1.1 Greenhouse gas emissions by sectors

GREENHOUSE GAS EMISSIONS (CO_2eq, Gg)	BY fixed	1990	1995	2000	2003	2004	2005	2006	2007
CO_2, without LULUCF	85,795.5	72,470.8	61,501.8	58,491.8	61,640.2	59,897.9	61,098.9	59,757.5	57,751.8
CH_4, without LULUCF	10,139.2	11,153.1	9,224.5	9,368.3	9,257.6	8,921.0	8,797.7	8,710.5	8,545.3
N_2O, without LULUCF	19,223.7	15,275.3	8,880.2	9,598.6	9,485.2	10,180.0	9,557.6	9,544.3	8,857.9
HFCs	1.74	0.0	1.74	205.7	498.9	525.8	517.6	606.9	614.5
PFCs	166.8	270.8	166.8	211.3	189.6	201.1	209.4	1.5	2.4
SF_6	70.2	39.9	70.1	140.1	161.9	178.2	201.0	244.4	171.6
Total (including LULUCF)	**112,661**	**95,000**	**71,227**	**77,188**	**76,744**	**75,703**	**75,766**	**74,756**	**71,806**
Total (excluding LULUCF)	**115,397**	**99,210**	**79,845**	**78,016**	**81,233**	**79,904**	**80,382**	**78,865**	**75,944**

Table A.1.2. Greenhouse gas emissions by gases

The assigned amount of Hungary has been fixed as 542,366,600 Mg CO_2 eq. on the basis of the base year emissions of 115.4 million tons CO_2 equivalent. It is important to note that Hungary's base year is not 1990 but the averaged value for the years 1985, 1986 and 1987 and Hungary has chosen 1995 as its base year for HFCs, PFCs and SF6. Hungary's quantified emission reduction commitment is 94 per cent as included in Annex B to the Kyoto Protocol.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1985-87) CO_2 equivalent (Gg)
1. Energy	82 758,39
2. Industrial Processes	10 837,62
3. Solvent and Other Product Use	384,14
4. Agriculture	19 399,14
5. Land Use, Land-Use Change and Forestry(5)	-3 595,89
6. Waste	3 073,30
7. Other	NA
Total (including LULUCF)(5)	**112 856,70**
Total (excluding LULUCF)	**116 452,59**

Table A.1.3 Base year emissions of Hungary

Source: Hungarian Meteorological Service, (OMSZ) National GHG inventory

Gg CO2. equiv	Base year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Solvent and Othe	384.1381333	374.96031	385.64913	391.80496	396.8233	361.30166	290.33274	227.20676	250.85661	255.71698	221.03171	250.11618
International bur	431.387385	430.72673	436.60188	426.83355	432.07164	448.13984	475.03814	375.86835	385.84904	361.14507	532.23242	523.87979
HFCs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0663	0.0663	1.1206	1.7446
PFCs	268.4862693	266.1554	269.2718	270.03161	263.51982	285.10089	270.83	233.71961	134.8214	145.7288	158.93492	166.82386
SF6	81.01622	100.46126	77.32845	65.26134	83.65	24.5692	39.8652	52.7234	48.9711	51.7913	67.9477	70.1465

Table A.1.4. Various emission forecasts based on expert estimations

Gg CO2. equiv	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Solvent and Othe	266.01109	238.3132	235.5815	276.76783	208.0508	274.50235	336.60355	148.21728	343.83549	158.09132	153.16592	148.24051
International bur	555.591465	596.29284	634.02125	538.10757	576.89775	591.62103	609.45885	663.11388	651.92985	718.11383	749.62365	781.13348
HFCs	125.06961	347.26955	205.73002	280.73077	403.55363	498.92216	525.79511	517.57744	606.85235	614.50434	636.7	593.88
PFCs	192.56622	209.57216	211.26	199.09587	203.26042	189.5956	201.10238	209.39191	1.533	2.3814	3.2	3.65
SF6	68.46633	126.82296	140.10658	107.4305	119.55258	161.91772	178.1745	201.0229	244.4492	171.6498	178.32	187.11

Table A.1.4. Various emission forecasts based on expert estimations

Gg CO2. equiv	2016	2017	2018	2019	2020
Solvent and Othe	260.5040998	242.7082	224.9123	207.1164	189.3205
International bur	940.6508467	945.87169	951.09254	956.31339	961.53423
HFCs	698.5	656.31	624.22	624.22	632.78
PFCs	18.8	21.22	17.76	20.43	20.11
SF6	216.3	221.44	188.12	185.31	183.1

Table A.1.4. Various emission forecasts based on expert estimations

Appendix 2. Assumed activity rate changes used in modelling emission forecasts

Activity indicator	'05-'10	'10-'15	'15-'20	'20-25
Net Electricity Generation	3.4%	3.3%	2.6%	2.3%
Nuclear	0.9%	0.9%	0.0%	0.0%
Total wind, hydro, solar	29.0%	4.9%	7.3%	6.3%
Hydro	-0.6%	2.2%	2.1%	1.3%
Wind	123.7%	5.8%	8.7%	7.2%
Solar	24.6%	5.9%	4.6%	13.2%
Thermal and gas turbine power plants (incl. biomass & waste)	4.4%	4.6%	3.6%	3.0%
Existing condensation power plants	0.0%	0.0%	-12.9%	-100.0%
CCGT	6.9%	5.1%	4.2%	3.5%
Lignite power plants[i]	3.6%	3.1%	-1.2%	-1.2%
Coal power plants[ii]	-7.6%	-12.4%	35.5%	12.2%
Peak power plants	16.7%	9.0%	4.6%	3.7%
Industrial large power plants	-8.2%	71.5%	0.0%	0.0%
Small thermal power plants	10.2%	7.1%	5.6%	4.3%
	2.4%	2.1%	1.2%	1.1%
Gas and S	13.4%	8.0%	1.6%	1.5%
	19.7%	10.9%	12.0%	7.2%
Biomass small thermal power plants	15.5%	9.0%	13.7%	8.1%
Biogas small thermal power plants	51.3%	16.5%	7.5%	5.4%
Waste small thermal power plants	17.6%	8.4%	9.2%	4.0%
Geothermal small thermal power plants		20.9%	9.5%	6.4%

Table A.2.1.: Growth rates of the power generation according to the division into different power plants

I – In "Lignite power plants" we only included new lignite units that are already decided upon or expected as very likely by Mátra Plant and MAVIR to be built.

Ii – New coal power plants included in "Coal power plants" may be either hard coal or lignite; though the choice of lignite is more likely, it is not definite yet. It is up to the future decision of private investors as to who dares to make this step and with which coal type.

	'05-'10	'10-'15	'15-'20	'20-25
Heat Generation in GWh_{th}	4,1%	0,3%	-1,6%	1,5%
Nuclear	2,4%	2,1%	0,0%	0,0%
CHP thermal and gas turbine power plants (incl. biomass & waste)	0,1%	1,5%	0,9%	0,9%
Existing condensation power plants				
CCGT	-2,2%	-2,4%	3,2%	2,7%
Lignite power plants	1,6%	1,5%	0,0%	0,0%
Coal power plants	-7,2%	-11,4%	-12,9%	-100,0%
Peak power plants				
Industrial large power plants	-10,0%	7,0%	0,0%	0,0%
Small thermal power plants	5,7%	4,4%	1,0%	0,9%
Gas engine	9,0%	6,2%	0,7%	0,6%
Gas and steam turbine	2,1%	1,9%	1,0%	1,0%
of which biogas, biomass and waste	18,2%	9,4%	1,9%	1,8%
Heat only plants	2,5%	-2,0%	-1,8%	0,0%
Fossil heat only plants	1,9%	-4,0%	-5,2%	-3,2%
Biomass, biogas, waste and geothermal heat only plants	5,7%	5,6%	6,0%	4,6%
Biomass heat only plants	12,5%	10,2%	9,2%	6,3%
Biogas heat only plants	68,3%	14,6%	14,9%	8,4%
Geothermal heat only plants	2,5%	3,0%	2,6%	2,3%

Table A.2.2. Growth rates of the heat production per plant subcategories

Industry

		'05-'10	'10-'15	'15-'20	'20-25	'25-'30
Iron and steel sector						
Sectoral production						
integrated steelworks	kt	0.0%	0.0%	0.0%	0.0%	0.0%
electric processing	kt	0.0%	0.0%	0.0%	0.0%	0.0%
Non ferrous sector						
Sectoral production						
primary aluminium	kt	0.0%	0.0%	0.0%	0.0%	0.0%
secondary aluminium	kt	2.0%	4.1%	0.6%	1.9%	-1.0%
copper	kt	0.5%	2.4%	4.3%	3.0%	2.0%
Chemical sector						
Sectoral production						
total chemical industry	indicator	0.0%	1.0%	0.7%	0.4%	0.2%
nitric acid	kt	3.4%	0.0%	0.0%	0.0%	0.0%
ammonia	kt	3.7%	1.7%	0.9%	0.0%	0.0%
Non-metallic mineral sector						
Sectoral production						
cement	kt	7.6%	5.0%	5.4%	6.0%	6.0%
clinker	kt	7.6%	5.0%	5.4%	6.0%	6.0%
ceramics	kt	0.2%	4.5%	3.2%	2.6%	2.6%
lime	kt	3.7%	-0.2%	-0.2%	1.1%	1.1%
glass	kt	8.9%	16.2%	9.6%	11.5%	11.5%
other non-metallic minerals	indicator	1.2%	1.3%	1.9%	1.8%	1.7%
Paper and pulp sector						
Sectoral production						
paper	kt	5.7%	6.3%	6.6%	6.2%	6.2%
Food, drink, tobacco sector						
Sectoral production						
food drink tobacco	indicator	1.1%	2.5%	2.9%	2.6%	2.1%
Engineering sector						
Sectoral production						
engineering	indicator	3.5%	3.3%	2.6%	2.4%	2.1%
Textiles sector						
Sectoral production						
textiles	indicator	-1.6%	-0.7%	-0.4%	-0.1%	0.4%
Other industries sector						
Sectoral production						
other industries	indicator	2.9%	3.0%	2.7%	2.4%	2.0%
Mining sector						
Sectoral production (coal produced)						
mining	kt	0.0%	0.0%	0.0%	0.0%	0.0%
Refinery production						
Sectoral production (crude input)						
Refineries	TJ	0.0%	1.2%	0.5%	0.0%	0.0%
Cokeries/patent fuel and briquetting plants						
Sectoral production						
Coke production	kt	10.7%	0.0%	0.0%	0.0%	0.0%

Table A.2.3: Overview annual growth rates activity levels industry

Residential sector

	'05-'10	'10-'15	'15-'20	'20-25
SPACE HEATING				
Households in industrialized houses	-0.3%	-0.4%	-0.6%	-0.8%

Households in traditional houses	-0.2%	-0.3%	-0.6%	-0.9%
Family houses built until 1992	0.1%	-0.2%	-0.3%	-0.4%
1993-2007 multi-residential and single-family	8.2%	5.1%	4.7%	4.8%
After 2008 multi-residential and single-family		21.5%	11.6%	9.2%
HOT WATER SUPPLY				
District hot water	0.0%	0.0%	0.0%	0.0%
Central building hot water	18.8%	7.2%	5.4%	5.2%
Appliances – supplied by district heating (DH)	68.4%	1.2%	1.1%	1.4%
Linked to boilers – primary combi-boilers, before 2008	-0.3%	-3.6%	-4.0%	-3.5%
Linked to boilers – primary combi-boilers, after 2008		20.0%	9.0%	5.3%
Linked to boilers – primary indirect cylinders, before 2008	-0.3%	-3.6%	-4.0%	-3.5%
Linked to boilers – primary indirect cylinders, after 2008		20.0%	9.0%	5.3%
Dedicated – primary electric storage, before 2008	-3.5%	-4.5%	-4.7%	-4.7%
Dedicated – primary electric storage, after 2008		19.7%	8.0%	4.1%
Dedicated – primary gas instantaneous, before 2008	-3.6%	-5.1%	-5.6%	-6.3%
Dedicated – primary gas instantaneous, after 2008		20.6%	8.6%	4.8%
Dedicated – primary gas storage, before 2008	-3.4%	-4.5%	-5.0%	-5.5%
Dedicated – primary gas storage, after 2008		20.4%	8.9%	5.2%
Dedicated – secondary electric storage, before 2008	-3.6%	-4.1%	-3.7%	-2.8%
Dedicated – secondary electric storage, after 2008		16.3%	5.9%	1.6%
Dedicated – secondary gas instantaneous, before 2008	-2.1%	-1.9%	-1.9%	-1.8%
Dedicated – secondary gas instantaneous, after 2008		19.5%	9.5%	4.9%
APPLIANCES				
Stock of fridges bought before 2005	-6.3%	-9.9%	-22.4%	-100.0%
Stock of fridges bought after 2005	45.3%	13.3%	8.3%	3.2%
Stock of freezers bought before 2005	-4.7%	-6.3%	-9.5%	-19.5%
Stock of freezers bought after 2005	45.3%	12.9%	7.9%	5.9%
Stock of clothes washers bought before 2005	-5.0%	-7.6%	-14.1%	-100.0%
Stock of clothes washers bought after 2005	46.0%	13.9%	8.9%	5.9%
Stock of TV-related appliances bought before 2005	-4.7%	-20.7%	-100.0%	
Stock of TV-related appliances bought after 2005	19.3%	21.0%	9.3%	6.1%
Stock of PC-related appliances bought before 2005	-8.5%	-100.0%		
Stock of PC-related appliances bought after 2005	22.7%	19.2%	6.5%	8.0%
Stock of light bulbs	0.6%	0.4%	0.4%	0.5%

Table A.2.4. Overview of the growth rates of the Hungarian household stock and stock of appliances

Tertiary sector – space heating

	'05-'10	'10-'15	'15-'20	'20-25
TOTAL TERTIARY BUILDINGS	0.1%	0.3%	0.3%	0.3%
Public buildings	-0.7%	0.03%	0.05%	0.1%
Educational buildings TOTAL	-0.2%	-0.12%	-0.09%	0.01%
Small: Kindergartens & nurseries	-0.3%	-0.07%	-0.06%	0.01%
Primary. secondary and tertiary education	-0.2%	-0.14%	-0.10%	0.00%
Health care buildings TOTAL	0.3%	0.4%	0.4%	0.5%
Doctor's offices & ambulance stations	0.4%	0.6%	0.6%	0.7%
Large health care buildings: Hospitals & Medical centres	0.01%	0.12%	0.14%	0.2%
Public administration buildings TOTAL	-3.0%	0.04%	0.04%	0.04%
Small public office buildings	-3.0%	0.04%	0.04%	0.04%
Large public office buildings	-3.0%	0.04%	0.04%	0.04%
Commercial buildings	0.2%	0.4%	0.4%	0.4%
Commercial office buildings TOTAL	0.3%	0.6%	0.6%	0.6%
Small commercial office buildings	0.3%	0.6%	0.6%	0.6%
Large commercial office buildings	0.3%	0.6%	0.6%	0.6%

Trade buildings TOTAL	0.3%	0.4%	0.4%	0.4%
Shopping centres & Hypermarkets	11.7%	10.9%	8.2%	2.8%
Retail shops	0.2%	0.4%	0.4%	0.4%
Hotels & Restaurants TOTAL	-0.2%	0.2%	0.2%	0.2%
Hotels	1.0%	1.4%	1.4%	1.4%
Pensions & Hostels	-1.1%	0.3%	0.3%	0.3%
Restaurants	-0.2%	0.2%	0.2%	0.2%
Miscellaneous	0.2%	0.3%	0.3%	0.3%
Miscellaneous / Requiring heating	0.6%	0.7%	0.7%	0.7%
Miscellaneous / Not requiring heating	0.1%	0.1%	0.1%	0.1%

Table A.2.5. Projections of the tertiary building stock in 2005-2025

Tertiary sector – electrical appliances

APPLIANCES AND LIGHTS		'05-'10	'10-'15	'15-'20	'20-'25
Vending machines	bought before 2005	-25.1%	-100.0%		
	bought after 2005	71.3%	26.6%	14.1%	7.8%
Fans for ventilation & HVAC					
Axial, ≤ 300 Pa (static pressure)	bought before 2005	-8.5%	-15.0%	-100.0%	
	bought after 2005	44.5%	14.0%	7.7%	2.0%
Axial, > 300 Pa (static pressure)	bought before 2005	-8.5%	-15.0%	-100.0%	
	bought after 2005	44.5%	14.0%	7.7%	2.0%
Centrifugal, forward curved blades (with casing)	bought before 2005	-8.5%	-15.0%	-100.0%	
	bought after 2005	44.5%	14.0%	7.7%	2.0%
Centrifugal, forward curved blades (no casing)	bought before 2005	-8.5%	-15.0%	-100.0%	
	bought after 2005	44.5%	14.0%	7.7%	2.0%
Centrifugal, forward curved blades (scroll housing)	bought before 2005	-8.5%	-15.0%	-100.0%	
	bought after 2005	44.5%	14.0%	7.7%	2.0%
Other, box fans	bought before 2005	-8.5%	-15.0%	-100.0%	
	bought after 2005	44.5%	14.0%	7.7%	2.0%
Other, roof fans	bought before 2005	-8.5%	-15.0%	-100.0%	
	bought after 2005	44.5%	14.0%	7.7%	2.0%
Other, cross-flow fans	bought before 2005	-8.5%	-15.0%	-100.0%	
	bought after 2005	44.5%	14.0%	7.7%	2.0%
Computers & monitors					
Desktop	bought before 2005	-100.0%			
	bought after 2005	44.4%	1.1%	0.5%	0.2%
CRT	total stock	-15.3%	-100.0%		
LCD	bought before 2005	-100.0%			
	bought after 2005	46.4%	2.5%	0.9%	0.3%
Laptop	bought before 2005	-100.0%			
	bought after 2005	47.6%	8.7%	6.1%	4.2%
Office imaging equipment					
EP mono printer	bought before 2005	-100.0%			
	bought after 2005	41.6%	-2.3%	-2.6%	-3.0%
EP colour printer	bought before 2005	-100.0%			
	bought after 2005	57.7%	17.8%	8.1%	7.5%
EP mono copier	bought before 2005	-100.0%			
	bought after 2005	41.4%	-2.7%	-3.1%	-3.6%
EP colour copier	bought before 2005	-100.0%			
	bought after 2005	80.8%	26.4%	12.3%	5.5%
IJ SFD printer	bought before 2005	-100.0%			
	bought after 2005	20.5%	-13.6%	-15.2%	-17.0%
IJ MFD printer	bought before 2005	-100.0%			

	bought after 2005	55.0%	20.9%	17.0%	13.8%
Fax SFD	bought before 2005	-100.0%			
	bought after 2005	30.4%	-18.9%	-18.5%	-18.2%
Lighting					
Incandescent		3.4%	3.4%	3.4%	3.4%
T12 fluorescent magn. ballast		3.0%	4.2%	4.2%	4.2%

Table A.2.6.. Technical and market parameters of appliance and light bulb stocks in the Hungarian service sector

Waste management

		'05-'10	'10-'15	'15-'20	'20-25
A. Solid Waste Disposal on Land					
Managed Waste Disposal on Land	Mt	-7.2%	0.0%	-4.7%	-1.9%
B. Wastewater Handling					
Industrial Wastewater	kt COD[i]	3,5%	0.0%	0.0%	0.0%
Domestic and Commercial Wastewater	kt BOD[ii]	-1.1%	-0.5%	-0.5%	-0.5%
C. Waste Incineration					
Waste incineration	Mt	13.3%	8.9%	8.8%	4.0%

Table A.2.7. : Activity indicator in the waste management sector and growth rates

[i] COD – Chemical Oxygen Demand
[ii] BOD – Biological Oxygen Demand

Appendix 3. Detailed sectoral impacts of policies and measures

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimated mitigation impact by gas (Mt CO_2 equiv.)		
						2010	2015	2020
National Energy Efficiency Action Plan*	End-user energy efficiency measures, demand management	CO_2	Fiscal, economic, regulatory	Adopted, implemented	Ministry of Local Governments and Regional Development, Energy Centre, Ministry of Transport, Telecommunication and Energy	0.297	1.194	1.343
Support to the energy efficient modernisation of residential buildings constructed with industrial technology*	Energy efficient modernisation of homes built with industrial technologies	CO_2	Financial	Adopted, implemented	Ministry of Local Governments and Regional Development	0,0997	0,401	0,451
'For a Successful Hungary' household energy efficiency support and credit programme (NEP application system)*	Energy efficient modernisation of homes built with traditional technologies	CO_2	Financial	Adopted, implemented	Ministry of Transport, Telecommunication and Energy, Hungarian Development Bank, Energy Centre Ltd.	0,0665	0,2673	0,3007
Use of individual measurements and mini heating centres in district heat supply	Reduction of the district heat demand	CO_2	Financial, regulatory	Adopted	Ministry of Transport, Telecommunication and Energy Ministry of Local Government and Regional Development Hungarian Development Bank	0,0332	0,1337	0,1503
Development of the operation of the energy efficiency consultation network	Incentives for energy efficient modernisation	CO_2	Dissemination, regulatory	Adopted	Ministry of Transport, Telecommunication and Energy	0,0332	0,1337	0,1503
Energy efficiency certificate of buildings	Promotion of energy efficient modernisation	CO_2	Regulatory	Adopted	Ministry of Transport, Telecommunication and Energy	0,0111	0,0446	0,0501

					Ministry of Local Government and Regional Development			
Regular review of household boilers	Incentive for the exchange and refurbishment of boilers	CO_2	Regulatory	Adopted	Ministry of Transport, Telecommunication and Energy, Hungarian Trade Licensing Office	0,0111	0,0446	0,0501
Labelling of household boilers and air conditioning equipment	Replacement of boilers, purchase of more efficient boilers	CO_2	Regulatory	Adopted	Ministry of Transport, Telecommunication and Energy	0,0066	0,0267	0,0301
Labelling of household electrical and gas boilers for energy efficiency purposes	Replacement of boilers, purchase of more efficient boilers	CO_2	Regulatory	Adopted	Ministry of Transport, Telecommunication and Energy	0,0066	0,0267	0,0301
Support for the purchase of highly energy efficient 'A' labelled household fridges and highly energy efficient 'A' labelled household freezers and other domestic appliances, in exchange of the old appliance	Replacement of household appliances, purchase of more efficient appliances	CO_2	Regulatory	Adopted	Ministry of Transport, Telecommunication and Energy	0,0111	0,0446	0,0501
Increase in the dissemination of energy efficient lighting equipment (compact light tubes)	Replacement of lighting tubes	CO_2	Regulatory	Adopted, implemented	Ministry of Transport, Telecommunication and Energy	0,0155	0,0624	0,0702
Elaboration of energy efficiency training materials for primary and secondary education	Laying down the foundation for energy conscious behaviour	CO_2	Dissemination	Adopted	Ministry of Education and Culture Ministry of Transport, Telecommunication and Energy Ministry of Environmental Protection and Water Management	0,0022	0,0089	0,01

Table C.1 Summary of policies and measures in the households sector

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimated mitigation impact by gas (Mt CO_2 equiv.)		
						2010	2015	2020
Municipality training, awareness-raising, consultation based on the experiences of the UNDP/GEF municipality energy efficiency programme	Reasonable energy efficiency investments	CO_2	Information supply, awareness-raising	Adopted, implemented	Ministry of Transport, Telecommunication and Energy, National Development Agency	0,0218	0,0777	0,0874
Third party financing – EEOP 5.2 instrument	More dynamic energy saving activities	CO_2	financial	Adopted, implemented	Ministry of Transport, Telecommunication and Energy, National Development Agency, Energy Centre Ltd..	0,1526	0,5441	0,6121
Promotion of reduction of energy consumption in the Regional Operational Programmes	Integration of the concept of energy efficiency in city rehabilitation	CO_2	Financial	Adopted, implemented	Ministry of Local Governments and Regional Development, National Development Agency	0,0153	0,0544	0,0612
Promotion of ESCO type investments	More dynamic energy saving activity	CO_2	Regulative	Adopted, implemented	Ministry of Transport, Telecommunication and Energy, Ministry of Justice and Law Enforcement Hungarian Development Bank	0,0545	0,1943	0,2186
Elaboration and application of energy efficiency guidelines related to public procurement	Use of equipment with better energy efficiency	CO_2	Dissemination, awareness, voluntary	Adopted	Ministry of Transport, Telecommunication and Energy, Ministry of Justice and Law Enforcement	0,109	0,3887	0,4372
Elaboration of minimum energy efficiency requirements for office equipment	Reduction of energy consumption in institutions	CO_2	Legislative	Adopted, implemented	Ministry of Transport, Telecommunication and Energy, Ministry of Justice and Law Enforcement	0,0218	0,0777	0,0874

Table C.2 Summary of policies and measures in the tertiary and public sector

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimated mitigation impact by gas (Mt CO_2 equiv.)		
						2010	2015	2020
Continuation of the Energy Efficiency Loan Fund with the integration of the PHARE loan instrument	Preferential loans for energy efficiency projects	CO_2	Financial	Adopted, implemented	Ministry of Transport, Telecommunication and Energy	5,522	21,857	24,596
EIOP 2006-1.7 environmentally friendly energy management	Reduction of energy consumption	CO_2	Financial	Adopted, implemented	National Development Agency, Energy Centre Ltd..	1,506	5,961	6,708
Refurbishment of the district heat supply systems, making district heat supply more competitive	Reduction of energy consumption of district heating systems	CO_2	Financial	Adopted	Ministry of Transport, Telecommunication and Energy, Ministry of Local Governments and Regional Development National Development Agency Hungarian Development Bank Ministry of Economy and Transport	1,004	3,974	4,472
'Efficient energy consumption instrument' in the Environment and Energy Operational Programme	Reduction of energy consumption	CO_2	Financial	Adopted, implemented	Ministry of Transport, Telecommunication and Energy, National Development Agency Energy Centre Ltd.	7,53	29,805	33,54
Mandatory employment of an energy manager at major energy consumers	More professional energy management	CO_2	Regulatory, disseminative	Adopted	Ministry of Transport, Telecommunication and Energy, Ministry of Social Affairs and Employment	2,008	7,948	8,944
Mandatory energy consumption report of large consumers	Increase of the economic importance of energy consumption	CO_2	Regulatory	Adopted, implemented	Ministry of Transport, Telecommunication and Energy, Ministry of Justice and Law Enforcement, Industrial Energy Consumers' Forum	1,004	3,974	4,472
Voluntary agreements (audit,	Promotion of energy	CO_2	Voluntary	Adopted,	Ministry of Transport, Telecommunication and	1,506	5,961	6,708

energy efficiency)	efficient projects and reasonable conduct		agreement, dissemination	implemented	Energy			
Reduction of transformer losses on the electricity network	Reduction of the quantity of energy required for electricity generation	CO_2	Regulatory	Adopted, implemented	Ministry of Transport, Telecommunication and Energy	2,3092	9,1402	10,2856
Use of the heat loss of transformers	Replacement of other energy carriers	CO_2	Regulatory	Adopted, implemented	Ministry of Transport, Telecommunication and Energy	0,502	1,987	2,236

Table C.3 Summary of policies and measures in the industrial sector

Name of policy or measure	**Objective and/or activity affected**	**GHG affected**	**Type of instrument**	**Status**	**Implementing entity or entities**	**Estimated mitigation impact by gas (Mt CO_2 equiv.)**		
						2010	**2015**	**2020**
UTDS Railway modernisation	Rebuilding and refurbishing train lines – technical-technological development	CO_2	Economic policy, investment subsidies	Adopted, implemented	National Development Agency, Ministry of Transport, Telecommunication and Energy	0	0,115	0,107
UTDS Road transport strategy	Creating missing international and national road connections and raising the standards of the services	CO_2	Economic policy, investment subsidies	Adopted, implemented	National Development Agency, Ministry of Transport, Telecommunication and Energy	0	0,25	0,16
UTDS – Urban-suburban transport of Budapest	Integration of the modes of transportation and transportation service providers	CO_2	Financial	Adopted	Ministry of Transport, Telecommunication and Energy, Ministry of Local Governments and Regional Development National Development Agency	0	0,0022	0,0023

					Hungarian Development Bank Ministry of Economy and Transport			
Paytoll for heavy vehicles	Toll for commercial vehicles exceeding 12 tons of permitted gross weight, as well as for vehicles with a total weight of over 3.5 tons as regards carriageways	CO_2	Financial	Adopted, implemented	Ministry of Transport, Telecommunication and Energy, National Development Agency Energy Centre Ltd.	0,0622	0,2497	0,2808
P+R system for energy efficient personal transportation	Establishment of safe car parks at the terminuses of the public transport network	CO_2	Financial	Adopted, implemented	Ministry of Transport, Telecommunication and Energy	0,0178	0,0713	0,0802
TransOP	Transportation modernisation	CO_2	Economic, regulatory	Adopted, implemented	Ministry of Transport, Telecommunication and Energy	-	0,05	-
Renewable strategy – support of biofuels	Increasing of share of renewable fuel and tax levy on ethanol and biodiesel	CO_2	Fiscal	Adopted, implemented	Ministry of Transport, Telecommunication and Energy	0,753	1,172	1,408

Table C.4 Summary of policies and measures in the transport sector

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List of Abbreviations

4CE	Consumer Choice and Carbon Consciousness for Electricity
5FP	See FP_5
6FP	See FP6
ACFBC	Atmospheric Circulated Fluid Bed Combustion
ATOMKI	Institute of Nuclear Research of the Hungarian Academy of Sciences, Debrecen
AVOP	Agriculture and Rural Development Operational Programme
BAT	Best Available Technology
BAU	Business As Usual
CAAG	Clean Air Action Group
CAC	Command and Control
CASMOFOR	Carbon Sequestration Model for Forestations
CCGT	Combined Cycle Gas Turbines
CDM	Clean Development Mechanism
CEE	Central and Eastern Europe
CEEWEB	Central and East European Working Group for the Enhancement of Biodiversity
CER	Certified Emission Reduction
CEU	Central European University
CHP	Combined Heat and Power
COP-9	the 9th Conference of the Parties
COST	European Cooperation in the Field of Scientific and Technical Research
CRT	Cathode ray tube
CCS	Carbon Capture and Storage
CSO	Central Statistical Office (KSH, Központi Statisztikai Hivatal)
DG	Directorate General
DH	Distric heating
DRI	Direct Reduced Iron
EAP	Environmental Action Programme
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EDOP	Economic Development Operational programme (GOP)
EE	Energy Efficiency
EECPO	ProgrammeOffice for Environmental Education and Communication (Könkomp, Környezeti Nevelési és Kommunikációs Programiroda)
EEOP	Environment and Energy Operational Programme
EIB	European Investment Bank
EIOP	Environment and Infrastructure Operational programme
EiT	Economies in Transition
EP	Electro Photographic Technology
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Contracting
ESCO	Energy Services Company
ESD	Energy Savings Directive
ETS	Emission Trading Scheme
EU	European Union

EUA	EU Allowance Unit
EU-ETS	European Union Emission Trading Scheme
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EuP	Energy-using Products
EUR	Euro
FFV	Flexi-Fuel Vehicle
FP5	EU Fifth Research and Development Framework Programme (1999-2002)
FP6	EU Sixth Research and Development Framework Programme (2003-2006)
GCCP	Global Climate Change and Vegetation
GCTE	Global Change and Terrestrial Ecosystems
GHG	Greenhouse Gas
GIS	Green Investment Scheme
GKM	Ministry of Economic Affairs (Gazdasági és Közlekedési Minisztérium)
GOP	Economic Development Operational programme
HEO	Hungarian Energy Office (Energia Hivatal)
HSRFR	Hungarian Scientific Research Fund Programmes (OTKA, Országos Tudományos Kutatási Alapprogramok)
HUF	Hungarian Forint
HVAC	Heating, Ventilation and Air-Conditioning
HVD	Hungarian Forestry Database
IEA	International Energy Agency
IEF	Industrial Energy Consumers' Forum (Ipari Energiafogyasztók Fóruma)
IGBP	International Geosphere and Biosphere Program
IGCC	Integrated Gasification Combined Cycle
IMF	International Montery Fund
IPCC	Intergovernmental Panel on Climate Change
IPCC	Intergovernmental Panel on Climate Change
IRR	Internal rate of return
ISPA	Instrument for Structural Policies for Pre-Accession
JI	Joint Implementation
KHEM	Ministry of Transport, Telecommunication and Energy (Közlekedési, Hírközlési és Energiaügyi Minisztérium, descendant to GKM)
KSH	Hungarian Central Statistical Office (Központi Statisztikai Hivatal)
KTI	Institute for Transport Sciences Non-Profit Ltd. (Közlekedéstudományi Intézet)
KvVM	Ministry of Environment and Water (Környezetvédelmi és Vízügyi Minisztérium)
LCD	Liquid crystal display
LRRT	Low Rolling Resistance Tyre
LTER	Long Term Ecological Research (Hosszú távú ökológiai vizsgálatok)
LULUCF	Land Use, Land-Use Change and Forestry
M	Million
MAC	Marginal Abatement Curve
MAVIR	Hungarian Transmission System Operator Company Ltd.
MBT	Mechanical Biological Treatment
MOL	Hungarian Oil Company
MSW	Municipal Solid Waste
MTA	Hungarian Academy of Sciences (MTA, Magyar Tudományos Akadémia)
Mtoe	Million tons of oil equivalent

MVH	Agricultural and Rural Development Office (Mezőgazdasági és Vidékfejlesztési Hivatal)
MVM	Hungarian Power Companies
NAP	National Allocation Plan
NBC	National Base Curriculum (Nemzeti Alaptanterv)
NC_3	Third National Communication to the UNFCCC
NC_4	Fourth National Communication to the UNFCCC
NCCS	National Climate Change Strategy
NE(E)AP	National Energy Efficiency Action Plan
NEP(P)	National Environmental Protection Programme
NEP I	First National Environmental Programme(NKP I., Első Nemzeti Környezetvédelmi Program)
NEP II	Second National Environmental Programme(2003-2008) (NKP II., Második Nemzeti Környezetvédelmi Program)
NFGM	Ministry for National Development and Economy (Nemzeti Fejlesztési és Gazdasági Minisztérium, descendant to GKM)
NGO	Non-governmental Organization
NHDP	New Hungary Development Plan
NHRDP	New Hungary Rural Development Plan
NHRSP	New Hungary Rural Development Strategic Plan
NIR	National Inventory Report
NKTH	National Office of Research and Technology (NKTH, Nemzeti Kutatási és Technológiai Hivatal)
NMS	New EU Member States (Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia)
NOAA	National Oceanic and Atmospheric Administration
NPP	Nuclear Power Plant
NUTS	Nomenclature of Territorial Units for Statistics
O&M	Operation and Maintenance
ODYSSEE	Database on energy efficiency data and indicators, for the EU-15 members and Norway
OECD	Organisation for Economic Co-operation and Development
OKTVF	National Inspectorate for Environment, Nature and Water (Országos Környezetvédelmi, Természetvédelmi és Vízügyi Főfelügyelőség)
OMSZ	Hungarian Meteorological Services (Országos Meteorológiai Szolgálat)
PaMs	Policies and Measures
PHARE	Poland and Hungary: Assistance for Restructuring their Economies (EU programme)
PJ	Petajoule
PPA	Power Purchasing Agreement
PV	Photovoltaic
QA/QC	Quality Assurance/Quality Control
R&D	Research and Development
REC	The Regional Environmental Centre for Central and Eastern Europe
REEEP	Renewable Energy and Energy Efficiency Partnership
RES	Renewable Energy Sources
RES-E	Renewable Energy Sourced Electricity
RES-H	Renewable Energy Sourced Heat
RFMRE	Research Fund Management and Research Exploitation
RTIF	Research and Technology Innovation Fund
SAPARD	Special Accession Programme for Agriculture and Rural Development
SAPS	Single Area Payment Scheme
S&T	Science and Technology
SEFF	Sustainable Energy Financing Facility

SME	Small and Medium Enterprise
SROP	Social Renewal Operational Programme
TDOP	Transportation Development Operational Programme
TPES	Total Primary Energy Supply
UEC	Unit electricity consumption
UNDP GEF	United Nations Development Programme, Global Environment Facility
UNEP	United Nations Environmental Program
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
UTDS	Unified Transportation Development Strategy
ÚMVP	New Hungary Rural Development Plan
VAHAVA	VÁltozás-HAtás-VÁlaszadás (Change-impact-response) Research Project
VET	Electricity Act
WAM	With Additional Measures
WEM	With Existing Measures
WHO/ECEH	World Health Organization - European Centre for Environment and Health
WRI	World Resources Institute