HUNGARY: INVENTORIES, MITIGATION AND SCENARIOS OF THE GREENHOUSE GAS EMISSIONS AND REMOVALS

Second National Communication on
the Implementation of Commitments under
the United Nations Framework Convention on Climate Change

AZ ÜVEGHÁZHATÁSÚ GÁZOK
EMISSZIÓ KATASZTERE, KIBOCSÁTÁSUK MEGELÔZÉSE ÉS JÖVÔKÉPEK
MAGYARORSZÁGON

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Tartalomjegyzék

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National circumstances

Hungary is a landlocked country in the centre of Europe, which borders Austria, Slovenia, Croatia, the Federal Republic of Yugoslavia, Romania, Slovakia, and Ukraine. The country's area amounts to 93,033 km² and its population to 10.2 million.

Progress in economic transformation

After a fall in GDP of nearly 20% between 1989 and 1993, Hungary has seen renewed growth since 1994. This has been accompanied by progress towards stabilisation of public finances, external accounts and inflation. Growth remains somewhat subdued and may be expected to remain so in the short-to-medium-term as Hungary still needs to contain public and external deficits and reduce its foreign debt. Unemployment, which had previously been concealed, rose rapidly to reach 12% of the labour force by early 1993. It has since fallen to under 10%, due to a decline in the labour force participation rate. Privatisation and restructuring have gone further in Hungary than in most other transition economies; in sectors such as telecommunications and energy supply, the scale of private involvement is greater than that in many EU member states. Apart from privatisation, the private sector in Hungary has also grown at a spectacular pace through the creation of new enterprises.

Main economic trends in Hungary

	1990	1991	1992	1993	1994	1995
Real GDP growth rate (%)	-3.3	-11.9	-3	-0.8	2.9	1.5
Unemployment rate (%)	2.1	8.5	12.3	11.3	10.2	9.3
Gross foreign debt/GDP	48.4	43.7	35.7	38.8	45.6	40.5
Exports of goods & services/GDP	33.1	32.8	31.4	26.4	28.9	34.4
Inflation rate (%)	28.9	35	23	22.5	18.8	28.2
Government budget balance/GDP	0.8	-3	-7.6	-5.5	-8.4	-6.0

Changes in the energy sector

Energy characteristics

Between 1971 and 1987, the total primary energy supply (TPES) had risen by 61%, but, as a result of Hungary's transition process and fall in economic output, it fell by 20% over the following decade. The biggest decline was in coal supply, followed by oil and natural gas. In 1995 TPES stood at 1046 PJ. Nuclear power production, which began in 1983, accounted for 15% of TPES in 1995. Energy self-sufficiency was 55% in 1995: Hungary imported 78% of its oil supply, 57% of its natural gas supply and 19% of its coal supply. Domestic resources are declining (oil and gas) or are of low quality and extracted uneconomically (solid fuels). Solid fuels production declined in the period 1983-1995 from 25 Mt to 14 Mt per year. The general energy intensity per capita shows that the Hungarian energy consumption is some 30% lower than in the average European OECD country. The energy intensity in the industry is rather low. In the residential sector the energy consumption per family is rather low due to lack of energy intensive household appliances. The consumption per heated volume is 20-30% higher than the typical value for the same climate in the member states of the European Union.

Development in the pricing policies and progress in the privatisation

There has been a fundamental change in the pricing policy of the energy sources. The direct central subsidies for energy prices have been terminated since 1991. From 1995 there is a liberalised market (and free price) for the solid fuels, oil products and district heating. The prices of natural gas,

electricity and heat do not cover the costs of supply. In 1995 average end-use gas prices were only half the level needed to cover costs. It is variously estimated that electricity prices must rise between 50% and 70% in real terms to cover the costs. The energy prices for households are still cross-subsidised by industry to a large degree. The gas prices increased by an average of 53% for the households and 9% for industry users in 1995. Electricity prices rise by an average of 65% for the households and 18% for industry users. The Hungarian Government has pursued the partial privatisation in the gas and electricity industries to meet the urgent need for increased government revenues. Earlier attempts to partial privatisation of gas distribution companies (prior to the approval of the Gas and Electricity Act) have failed, due primarily to uncertainties on regulatory arrangements for the sector. The Government formulated its new policy on privatisation of the energy sector in late of 1994 with a view to accelerating the privatisation of the National Oil and Gas Company (MOL) and the Hungarian Power Company (MVM) and gas distribution companies.

Indicators of the efficiency of energy utilisation in 1995

		Hungary	OECD Europe average
Macro-economic indicators			
TPES	(PJ)	1046	
TPES/capita	(GJ/person)	103	138.1
TPES/GDP	(GJ/1990 US$1000)	30.5	16.7
Cost of energy	(% GDP)	17%	7%
Energy intensity			
Industry	(GJ/1990 US$1000)	31.4	104.7
Households	(GJ/family)	71.2	105
Energy consumption by sectors			
Production		31%	33%
Residential		46%	34%
Transport		16%	29%

Inventories greenhouse gas emissions and removals

In Hungary, the first greenhouse gas emission inventory based on the Draft IPCC (Intergovernmental Panel on Climate Change) Guidelines was developed in 1994. In 1997, updated inventory calculation was compiled and submitted for the period of 1991-1994. Base on this publication, present analysis covers the period of 1991-1995. In the development of the inventories, the IPCC methodology and the recommended emission factors have been used in most cases. (The key assumptions, the uncertainties and other methodological aspects are described in the update mentioned above.)

Emissions from fuel use

The greatest part of CO_2 emissions (almost 97%) is generated by fuel combustion. In 1991 it was about 65 Mt/year, but it dropped to 57 Mt by 1994. There was a slight increase in 1995. This slight increase is typical for almost all greenhouse gas emission sources. As far as the sectoral structure of CO_2 emission is concerned, almost half of the total emission stems from the transformation processes in case of fuel combustion. The share of the residential sector in overall CO_2 emissions significantly decreased from 24% to 20%, mainly due to the realisation of the country-wide household gas program. The share of emissions from transport increased and reached 13% in 1994 and in 1995.

The CH_4, N_2O, CO, NO_X emissions from several stationary sources show a substantial shift in the period of 1991-1995: the emissions form the residential sources have decreased by 25-60%. Simultaneously, the emissions from commercial sources are significantly increased: for example in case of CO the commercial-origin emissions have been doubled. The total transport related non-CO_2 emissions show a certain decrease of 2-8% in the investigated period. However the different type of emissions showed some fluctuation in these years.

Distribution of fuel-related CO_2 emissions by sectors (Gg)

	1991	**1992**	**1993**	**1994**	**1995**
Energy & Transformation	28520	27476	27575	26290	26431
Industry	6380	5131	5548	6306	6352
Transport	7383	7189	7141	7212	7001
Commercial and Trade	3959	3517	3822	3970	3946
Residential	15670	12196	12271	11453	11296
Agriculture and Forestry	2120	1593	1499	1537	1519
Other	1224	1534	900	278	1022
TOTAL	**65255**	**58636**	**58754**	**57046**	**57567**

Fugitive methane emissions

In Hungary, coal is produced from both underground and open pit mines. According to the sharp decline of domestic coal mining and oil production, the methane emission from fugitive sources decreased by 30% from 1991 to 1995. The most important sources of the industrial methane emission is the fugitive losses of natural gas during its production, transport and distribution. In the middle of the 80's, the coal mining activities could be regarded as important industrial methane sources, which gave around 30% of the total methane emissions. This contribution was only 15% in 1995.

Fugitive CH_4 emissions from oil and gas activities (Gg)

	1991	1992	1993	1994	1995
oil industry	0.26	0.25	0.26	0.23	0.25
gas industry	290	257	274	273	291
coal mining	161	124	109	105	106

Emissions from the industry

Some uneconomical activities in the heavy industry stopped in the 90's in Hungary. However, in certain branches the production began to increase from 1993, and it resulted in a slight increase of emissions generated by these industries, as well. The largest source of industrial CO_2 emission is the cement production. The emission from this source increased by 14% between 1991 and 1995. However, it should be mentioned that production level of clinker cement can only be estimated at a low reliability. The CO_2 emissions from the aluminium production dropped dramatically. The CH_4 emissions form S-M steel production can be considered as negligible since 1993. The N_2O emissions dropped by 30% in the investigated time period, nevertheless, in 1994 a peak could be observed. The NMVOC industry-related emissions were almost unchanged.

Emissions from the agriculture

The most important sources of CH_4 emissions in agriculture are the manure management and enteric fermentation. CH_4 production through enteric fermentation is a part of the normal digestive activity of ruminants. According to this method, methane emission is calculated for beef cattle, dairy cattle, sheep, swine, horse and poultry. Animal waste treatment methods that provide anaerobic conditions result in CH_4 release, as well. The CH_4 emissions related to the animal husbandry decreased by 30% between 1991 and 1995, mainly due to the restructuring of the agricultural productions. The main source of N_2O emission from agriculture is the use of N-fertilisers. The N_2O emission shows a slight fluctuation around 1.5 Gg in the investigated time period. For the calculation of N_2O emissions from the fertiliser use we applied the median emission coefficient 0.0036.

Removal of carbon-dioxide

In forestry, CO_2 is sequestered by the growth of the biomass, increases in stabile humus in the soils and the accumulation of dead organic material and litter on the ground. The total area under forest management in Hungary was 1564 million hectares and 1608 million hectares in 1991 and 1995, respectively. The total carbon uptake and release were almost unchanged while the annual carbon release decreased by 20% in the investigated time period. One can see from the above results that the annual removal of CO_2 by forest management was increasing till 1994, and there was a slight decrease in 1995. The emissions from CH_4, N_2O, CO and NO_x from burning of forests decreased by 20% till 1994 in average, and they began to increase in 1995.

Carbon uptake, release and total CO_2 removal

		1991	**1992**	**1993**	**1994**	**1995**
Total Carbon Uptake	(kt C)	2940	2960	2994	3005	3041
Annual Carbon Release	(kt C)	1645	1504	1304	1294	1350
Release from Burning + Decay	(kt C)	412	413	408	396	383
Total CO_2 Removal	**($GgCO_2$)**	**3239**	**3823**	**4697**	**4820**	**4797**

Policies and measures

National Energy Saving Program

On the basis of the energy policy concept approved by the Parliament in 1993, the National Energy Saving and Energy Efficiency Improvement Program (ESAP) was developed in 1994. Based on this programme an action plan was approved by the Government in December 1995. The Energy Saving Action Plan consists of :four major set of measures: (i) penetration of renewables, (ii) energy efficiency improvement, (iii) energy efficiency labelling and (iv) education, information and encouraging technology innovation.

Measures in the energy supply sector: penetration of renewables

The energy policy concept mentioned above includes an objective to increase the share of renewable energy sources in the primary energy balance to 5-6% which is almost the double of the current figures. The estimated total utilisation of the renewables may currently put at 35 PJ which corresponds to the 3% of the total primary energy supply. Although the utilisation of wind, geothermal and solar energy is theoretically possible, the application of biomass resources are of the greatest importance in Hungary. Currently there are over 70 biomass-fired boiler plants where the total installed capacity amounts to 31 MW. The largest chopped-wood-fired heating plant on Central Europe is located at Tatabánya, where the installed boiler capacity is 12 MW. Although some progress has been made, the renewable technologies in Hungary still suffer from a significant cost disadvantage related to fossil based technologies in power and heat generation. Experience in ongoing renewable financing initiatives shows that, without funding, these investments are still not competitive with the natural gas.

Measures in demand side: energy efficiency improvement in the private and public sector

The improvement of energy management in municipalities one of the priority area of the ESAP. Support shall be provided for municipalities for the development and implementation of their energy saving concept, organisation of training and events and information supply, as well. In the residential sector certain initial step has been taken. In the production sectors a growing number of industrial companies realise the interrelation between energy wastes and profit losses. Many of them know at least what ought to be done. Recently, as more and more companies get stabilised, energy efficiency plans developed by companies are started to implement. Certain big companies have shown good progress in energy efficiency programmes on their voluntary basis.

Measures in the demand side: financing energy efficiency

The finance of energy efficiency should extend to fulfil the demands of the producers, utilities and the various end-use sectors, as well.: German Coal Aid Revolving Fund (GCARF), Energy Saving Credit Programme (ESCP), PHARE Revolving Fund (PRF), Pilot Panel Programme (PPP). In addition to the financial mechanisms mentioned above, the Ministry for Environment and Regional Policy launched an Inter-ministerial Clean Air Protection Action Program which is founded from the Central Environmental Fund. It can be also mentioned that the Hungary Energy Efficiency Cofinancing Program (HEECP) will be established soon. The lending policy of the fund will directly facilitate the establishment and maintain the stable economic conditions of the ESCOs. The establishment of the fund is under way by the World Bank/IFC.

Overview of source of funding in different energy efficiency credit facilities in Hungary

Credit facilities	**Hungarian contribution (million HUF)**		**International funding (million USD)**	
	central budget	commercial banks	source	funding
GCARF	–	–	German Government	30
ESCP	80	800	-	–
PRF	-	-	PHARE, IBRD, EIB	6.8
PPP	300	-	-	-
HEECP	-	-	GEF	4.25

Regulatory measures: energy efficiency labelling and standards

In conformity with EU's regulation, new and upgraded standards on the building energy performance were developed and published as legal regulation. The application of the technical regulation is mandatory when new buildings are designed and constructed and must be applied to the largest technically possible extent when reconstructing old buildings. There are newly upgraded efficiency regulations for building's thermal insulation and for some electric appliances. Most of the existing standards related to energy efficiency, however, obsolete and it would be necessary to review and upgrade all of them. On the basis of the EU regulation, a feasibility study has been prepared for the introduction of labelling household refrigerators and freezers. The same work is under way for dryers and washing machines. In order to introduce the building's certificate system, a feasibility study has also been prepared. The Ministry for Environment and Regional Policy established an environmentally friendly labelling scheme in 1994. Energy efficiency is one of the requirements the applicants shall comply with.

Education, information and encouraging technology innovation

By the middle of 1990s both the Hungarian Power Co. (MVM) and the distribution companies launched local PR campaigns, which included energy saving-related elements. MVM also opened an educational facility in Budapest, where information related to energy saving are provided to the general public. The gas utilities are beginning to show some interest in this activity, as well. An other promising initiative is the "Green Bridge" movement. Starting in Pécs, energy utilities established a local organisation to promote energy efficiency and environmental control. They publish and distribute flyers, organise school programmes, launch campaigns, provide advice for the consumers. The professional energy related associations under the Hungarian Alliance of Technical and Science Association (MTESZ) also keep the energy efficiency on their agenda. The most important step made by these associations is to establish a network of Regional Energy Centres. Promotional activities are also performed by the environmental NGOs. The so-called ELÉG campaign has been the most significant NGO effort so far.

Policy to enhance the sink capacities: National Forest Policy

The registered forested area of Hungary is 1,713,000 hectare, which means that 18.4% of the country is forested. Total area of forests under nature protection is 330,000 hectare, including highly protected forests of 70,000 hectare, and forest reservations of 12,000 hectare. An afforestation

programme has been initiated covering the period up to the year 2010. Its sub-period until the year 2000 has been prescribed by Government Decree. On the basis of the Act on the Protection of Forests approved by the Parliament in 1996, the Government is planning to prepare and approve a National Strategy on Forests by the end of 1997.

National strategy on forestry: afforestation programme

As a result of the ongoing national afforestation programme, the forested area of the country has been increased by 600,000 hectare within the last decade. Various studies on future agriculture in Hungary suggest that about 500,000-1,000,000 hectare of currently cultivated land has to be converted to other land use and the bulk of the non-profitable agricultural land should be afforested. Beside its apparent economical and environmental impacts, this extensive afforestation is expected to solve many problems of rural population and to help in managing unemployment to some extent, which is one of the major actual concerns in Hungary. The net specific current increment is quite high as compared to the European average. It amounts to 6.2 m^3/ha, whereas the European average is only 4.3 m^3/ha (as of 1990). This is attributable partly to the relatively favourable site and climatic conditions and partly to the relatively high proportion of tree-species of short rotation period. About 27% of the forests, i.e., 430 thousand ha, are covered with fast growing species providing 30% of the total current increment.

National strategy on forestry: forest reservation programme

Aiming at the protection of forests, promotion of the general spread of nature close forest management that secures biodiversity and ecological long-duration is planned. Maintenance and further expansion of the network of forests under nature protection, and introduction of model expert management to secure and foster the creation of a multiple genetic diversity, and to preserve the potentially endangered and ecologically valuable forest populations are needed. The foundations of a sustainable forest management are secured through planning and an independent institution system of forest supervision and nature conservation authorities, further supported by the forest maintenance contribution. Further outstanding tasks in the field of natural conservation of forests are to give preference to indigenous wood species when regeneration or afforestation are being done. Beyond all that, our intention is to increase the forested area of the country to 25%. To facilitate the implementation of this programme, an ecologically well founded, long-term strategy of afforestation needs to be elaborated.

Measures to control other greenhouse gases: the 1996 Transport Policy

In June 1996, the Hungarian Parliament passed a new framework transportation policy, which is designed to guide policy development up to the year 2000 while integrating policy objectives for after 2000.. The objectives of the policy are to contribute to the sustenance and development of society in such a way as not to endanger the potential and quality of life of future generations while serving the present one.

Characteristics of the Hungarian transport sector

The predominance of public passenger transport began to wane in the mid-1980s, as cutbacks in subsidy levels, higher tariffs and early economic restructuring. Whereas the number of vehicles has been steadily growing and will continue to do so according to forecasts, vehicle use has actually gone down, the combined effect of rising fuel prices and higher vehicle purchase and operation costs. Fuel price increases have been substantial: an average of 20 to 22 per cent more than inflation per year. Due to the high share of used, relatively old, fuel-inefficient cars, the profile of the vehicle fleet is problematic as concerns air pollution and fuel economy. Freight transport has suffered the effects of economic transformation in a number of ways. The fundamental shifting in goods trade has been accompanied by a restructuring of the trucking industry, which has further weakened the share of railway and waterway transport for freight.

The 1996 Transport Policy calls for actions and measures to develop the rail, waterway and urban transport, i.e. restructuring and renewal of railway organisation and modernisation and upgrading of lines along EU transportation corridors to a 160km/h limit; development of ports at cities of importance along the Danube; building of ports on inland waterways for combined transport and establish rail connections; fiscal measure to promote the public transport. There is considerable

potential for further development of combined transport in Hungary. Combined transport accounts at present for only around 0.5 per cent of total traffic and 7 per cent of transit traffic through Hungary.

Growth in vehicle fleet in Hungary 1970–1993 (in thousands)

	1970	1980	1990	1993
Cars	238.6	1,013.4	1,944.6	2,091.6
Buses	9.5	22.2	26.1	21.8
Truks and vans	84.5	123.8	224.0	237.5

Principal challenges to sustainability

In Hungary, traffic accounts for 45-50 % of carbon monoxide; 40 % of nitrogen oxides, one third of hydrocarbons and 90 % of lead emissions. Transport is also responsible for approximately 14 % of CO_2 emissions. Within the transport sector, 85 per cent of pollution is from road traffic; 12-13 per cent from railway; and the rest from water transport. One of the principal contributors to vehicle-related air emissions has been the two-stroke engines, which have comprised a large portion of the vehicle fleet in Hungary. Action is also being taken to phase out leaded petrol. Progress has been made in implementing some of these measures (i) import of vehicles with two-stroke engines more than four years old is now prohibited; (ii) since 1992, the number of vehicles passing mandatory yearly inspection tests has increased; (iii) to stimulate vehicle fleet renewal, a vehicle scrapping programme offering public transport tickets as an incentive to retire old two-stroke vehicles; (iv) since 1995, emissions standards for the gasoline vehicles are equivalent to EU standards.

Projections of greenhouse gas emissions and removals

In the recent years, (in the framework of the US Country Study Programme) substantial improvement has been made in development and applying a simplified methodology of emission projections. Nevertheless, it should be noted that the Government did not adopt any decision made by the projections presented either by the first or second National Communication, but it did take account of their result in shaping its energy and environment policies and position related to the AGBM process.

Methodologies used

Estimating fuel-related carbon-dioxide emissions

In our bottom-up approach, taking into account the same level of complexity, a simplified mixed econometric and energy sector model has been developed. The simplified structure of the Fuel-Related Emission Estimation (FREE) spreadsheet model allows considerable flexibility in matching the level of disaggregation to the availability of data. The FREE, based on a bottom-up approach, combines econometric, engineering and technical information in modules for fossil fuel supply in the power generation and certain categories of energy end-use. The estimation of population and economic growth and the change of the overall energy intensity of the whole economy are the main exogenous parameters of the FREE model. The off-model projections of certain power generation related parameters (i.e. energy intensity in power generation, fuel and technology mix including the penetration of the renewables and the share of combined heat and power generation) should also be considered.

Approach to scenario development

In estimating the future fuel-related CO_2 emissions four scenarios have been developed. The scenarios represent a contrasting but self-consistent views of our possible socio-economic development. The scenario setting is also determined by existing official economic, environment and energy outlook. These official policy papers allow to present greenhouse gas emissions scenarios for the period 1995-2002. According to the uncertainties in the economic growth and consumption patterns, as well as the alternatives in the accession to the European Union, the reliability of the longer terms scenarios is substantially limited. Four scenarios are characterised as follows: In the

case of estimating the non-fuel-related emission's projections, different methods and scenario development has been used for several reason: (i) lack of appropriate data and available methodology in the agriculture-related projections, (ii) about two-third of the GWP is considered by the fuel-related CO_2 emissions, therefore the projections of other emissions may have less importance. Since the preparation of our first National Communication, no updated and advanced estimation for the CH_4, N_2O, CO etc. projections is available, therefore the relevant information presented in the first National Communication are not cited or replicated here.

Main characteristics of the scenarios for the projections of fuel-related CO_2 emissions

	GDP growth (%/year)	Growth in total energy intensity (%/year)	Growth in electric energy intensity (%/year)	Energy saving by specific measures (PJ/year)
B-BAU	1.0	-	-	-
B-REF	1.0	-0.5	-	60
S-MOD	2.0	-1.0	-0.5	110
S-SEF	3.0	-1.5	-1.0	250

Emission outlook of fuel-related CO_2 emissions

The B-BAU scenario can be defined as an unrealistic "all-frozen" option for development, serving only for a basis for comparison. (It is the fact that the mid 1990s was the period of the stagnation in the Hungarian economy. Most of the indicators of the energy, environment and economic performance have shown an insignificant fluctuations around the same level. In this sense, the B-BAU is the extrapolation of the very recent tendencies, as well.) The B-REF scenario reflects the structural changes in the Hungarian economy and increase of energy prices which can lead to improvement of the energy intensity without specific energy saving measures. The S-MOD scenario can be regarded as the most probable outlook of the medium term socio-economic development in Hungary. As a result in implementing the measures prescribed in the ESAP, the increase in energy demand is substantially less than the GDP growth. In the period of 1996-2002 the GDP would rise by almost 15%, while the total final energy consumption would increase by 8% only. The S-SEF scenario supposes a positive feedback between the economic growth, the social welfare and the expenditure for energy efficiency improvement.

Baseline and aggregated policy scenarios

	1990	1992	1995	1997	2000	2002
actual	68.6	59.6	59.4			
B-BAU				62.0	63.9	65.2
B-REF				61.8	63.1	64.0
S-MOD				62.1	64.3	65.9
D-SEF				62.4	65.6	67.8

Projection of carbon sequestration

To increase the area for traditional wood production has by far the greatest potential. It is estimated that, in the next 30 years, the cultivation of some 700,000-1,000,000 hectare agricultural fields will become unprofitable, and that most of this area is suitable for afforestation. The increase of the carbon pool would involve the establishment bioenergy plantations, the increase the carbon density of stands, as well as preserving carbon in wood products. The current afforestation program was launched in 1991 with the aim to afforest 150,000 hectare by 2000. On the basis of the experiences gained by the implementation of the afforestation programme, afforestation policy scenarios has been set up. In the minimum scenario (I), some 3000 hectare is afforested annually by 2050. In the medium scenario (II) 15,000 hectare is afforested until 2010. In the achievable scenario (III), 11,000 hectare are afforested annually, and in the technical potential scenario (IV), 18,000 hectare by 2050. This last scenario is equal to afforest some 1,000,000 hectare.

Carbon sequestration by the afforestation scenarios (MtC)

	1995	2000	2005	2010	2015	2020
I	0	0.1	0.7	3.0	6.0	8.5
II.	0	0.2	0.5	0.9	1.0	2.0
III.	0	0.1	0.2	2.0	4.0	7.0
IV.	0	0.5	1.0	3.5	7.0	12

International co-operation and rising public awareness

Activities Implemented Jointly

In March 1995, the Hungarian and Dutch governments of Hungary and the Netherlands expressed their wish to jointly realise a series of AIJ projects. The aim of these projects would be to gain experiences on practical aspects of AIJ and to promote AIJ as a feasible concept. Two joint projects were therefore designated simulation projects and became subject of a monitoring study.

Energy efficiency improvement for municipalities and utilities

In this simulation study a number of energy efficiency projects that are initiated by local governments are analysed. In most cases, these projects are identified based on expert advice provided earlier through the Dutch bilateral PSO programme and through twinning arrangements with Western European cities within the EU – PHARE/ECOS/UVERTURE “urban twinning” programme. A total of 62 projects are monitored in 12 different cities. Additionally, a combination of a small-scale cogeneration (CHP) project and a Demand-Side Management (DSM) project at the Technical University of Budapest is incorporated. These projects were developed by the Dutch utility Westland and the Budapest gas utility Fögáz and are implemented by a joint venture of both companies. The implementation of the measures is financed by the local governments themselves. This is done either from own resources or by attracting external funds. These external funds can be commercial loans, but also soft-loan arrangements (e.g. the German Coal Aid Revolving Found) or third party financing (TPF) have been used by the local governments to generate the financial resources required. These varying financing mechanisms generate additional experience and input for the AIJ-simulation.

RABA/IKARUS compressed natural gas fuel engine project

This project will transfer technology, which will enable Hungarian industries to produce buses with compressed natural gas engines. The technology will be provided by Deltec, a producer of gas fuelled engines and the TNO research organisation, both of the Netherlands. Participating firms are Hungarian RABA, a producer and installer of bus engines, and IKARUS, the Hungarian bus manufacturer. It can be stated that the installation of CNG engines on all Budapest buses that currently have a D2156 Old Diesel type engine would prevent the emission of 6.4 kton CO_2 per year. Using this method, the AIJ partners estimate, by way of and example, that all full-size buses (90 passengers or more) together in Budapest cause a CO_2 emission of 120 kton per year. Note, however, that the project itself only aims to install CNG engines in a limited number of buses (about 5). The emission reduction figures are only meant as examples and do not reflect the emission reductions that can be achieved by the project. On the basis of the same methodology the total annual emission of different sorts of pollutants can also be computed.

GEF/UNEP project on the economics of greenhouse gas limitation

The primary aim of the project is to analyse to costs and benefits of several actions to mitigate the greenhouse gas emissions in twelve countries, including Hungary. The worldwide project is funded by the GEF and RISO National Laboratory (Denmark), as the regional UNEP Centre, is charged with co-ordinating the project. The Hungarian sub-project is divided into the following parts: (i) overview of present social-economic situation with special regard to the energy consumption of the public and residential sectors and the role of forest management.; (ii) compilation of a medium and a

long-term social-economic outlooks, until 2010 and until 2030; (iii) choosing the measures actually feasible, compiling (medium- and long-term) „reduction-scenarios" completed with a cost curve based on cost-efficiency analyses; (iv) presenting economic, financing instruments necessary for realising „reduction scenarios" and working out plans for ensuring social acceptance of measure. The project is implemented by the Technical University of Budapest in collaboration with several collabroative institutions and supervised by the Ministry for Environment and Regional Policy.

U.S. Country Study Programme

The U.S. Country Studies Programme is a worldwide project supported by the Government of the USA. Hungary has began to take part in the Programme in 1994. The first phase of the project aimed at the development of the first national greenhouse gas inventories of emissions and removals for Hungary calculated by the IPCC methodology. In the second phase of the Programme, we developed mid and long-term mitigation scenarios for Hungary. Several computer models became available for our experts to analyse the effects of different sectoral and cross sectoral measures. The purpose of the present phase of the project is the elaboration of a national action plan. The Hungarian National Action Plan will have been completed by March 1998. In September 1997 a second regional workshop was organised in Hungary on the use of clean energy technologies and energy efficiency project financing. The Programme is co-ordinated by the SystemExpert Consulting Ltd. involving the relevant academic and university research organisations. The Hungarian U.S. Country Studies Programme is supervised by the Hungarian Commission on Sustainable Development.

The SCORE Programme

The SCORE Programme is a joint effort of the Dutch and Hungarian Governments. The Dutch support means financial help, and, what can be even more important, first hand access to European experience in energy management. The main objective of the SCORE Programme is to assist Hungary in its efforts of improving energy efficiency. In the framework of the Hungarian SCORE Programme three major projects have been identified: (i) macro-economic assessment of energy efficiency will review and evaluate strategic concerns of energy efficiency; (ii) development of energy awareness initiates changes in behaviour of people and stimulates them on actions they can implement themselves; (iii) local energy efficiency programmes. The SCORE Programme is co-ordinated by the Energy Efficiency Centre and supervised by a Management Board, with members from Ministry of Industry, Trade and Tourism, Ministry for Environment and Regional Policy, Ministry of Finance and a representative of the non-governmental organisations. On behalf of the Dutch Government the National Energy and Environmental Agency of the Netherlands (NOVEM) will provide SCORE budget and energy efficiency expertise.

1. INTRODUCTION

The principal purpose of the compilation and submission of the national communications is to present the up-to-date information related to the status, perspectives and barriers of a Party's actions to fulfil the obligations derived from the UN Framework Convention on Climate Change (UNFCCC).

Hungary submitted its first national communication in 1994 six month after the ratification instrument deposited. The first communication was presented the position on the Convention, described the national circumstances, provided estimations on the recent and future greenhouse gas emissions, and outlined the elements of the national mitigation policies. As a supplement to that communication, the annual inventories of greenhouse gas emissions and removals for the period of 1991-1994 were published in 1997. Substantial progress has been made in the application of the default guidelines adopted by the Conference of the Parties. The availability of the appropriate data has also been improved.

The second national communication can be characterised by a "value added" feature: the new and substantial facts arising since the publication of the first communication are primarily considered. The present communication is divided into five main sections.

Firstly, the national circumstances are briefly summarised. The general policy framework, the structural socio-economic development and the recent changes in the energy sector are discussed.

The second section provides the annual inventories of greenhouse gas emissions and removals for the period of 1991-1995. In order to complement the calculations presented in the first national communication, additional sectoral emissions (e.g. CO_2 emissions from waste) have been derived, new sources (e.g. international bunkers) have been identified.

The next section describes the measures and policies which contribute to meet the emission stabilisation commitment under the convention.

The projections of future emissions are presented in the fourth section with and without the key measures which are in our case basically related to a comprehensive energy savings programme.

Finally, the assessment of impacts of anticipated climate change and our participation in the relevant international programs and projects are briefly discussed.

According to its mandate, the Hungarian Commission on Sustainable Development (HCSD) is responsible for supervising the national implementation of the Convention. The preparation of the communication was co-ordinated by the Secretariat of the Hungarian Commission on Sustainable Development with assistance of a wide range of experts. Technical analysis and computations were made by the SystemExpert Consulting Ltd.

The basic institutions and their respective tasks and responsibilities in this context are as follows: Ministry for Environment and Regional Policy (environment policy including climate change mitigation policies); Ministry of Industry, Trade and Tourism (energy policy, industry, energy efficiency policies); Hungarian Commission on Sustainable Development (overall co-ordination in implementing the UNFCCC); Hungarian Energy Office (regulatory body on energy supply and prices); Energy Information Agency (compilation of energy statistics); Energy Efficiency Centre (training, technical assistance and financing R&D projects); Institute for Environmental Management (compilation of environmental statistics).

2. NATIONAL CIRCUMSTANCES

Hungary is a landlocked country in the centre of Europe, which borders Austria, Slovenia, Croatia, the Federal Republic of Yugoslavia, Romania, Slovakia, and Ukraine. The country's area amounts to 93,033 km² and its population to 10.2 million. In the first part of this chapter the recent socio-economic transition and the general economic performance is summarised. Later, the main energy characteristics, as well as the overall policy context of energy pricing and privatisation is overviewed.

2.1. Progress in Economic Transformation

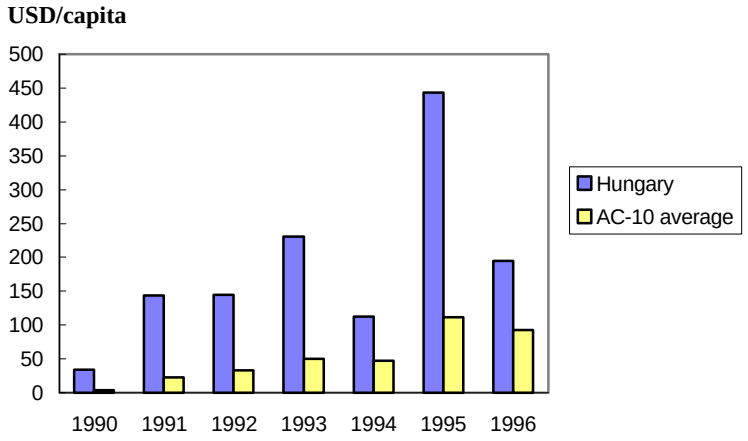
2.1.1. Stabilisation of the socio-economic situation

After a long period of the centrally planned economy, increasing social unrest and political autocracy, the new democracy that took over in Hungary in 1990 faced severe problems almost every field of the society. By the mid 1990s it has been recognised that the transition towards a new political system, including a restructuring of the economy, will not only be painful, but also slower than expected.

Building upon the gradual introduction of economic reforms from the mid-1980s, Hungary did not implement the "shock therapy" approach to economic reform applied in some other Central European countries in the present decade. The gradualist approach adopted entailed substantial further liberalisation of trade and prices and the creation of the main institutional and legal foundations of a market economy. The reforms were successfully accelerated in 1995. Set-backs in the privatisation of the banking sector were reversed, and large parts of the energy and utilities sector were sold to private investors.

Notwithstanding the early start to market reforms in Hungary, state enterprise initially remained the dominant form of economic activity: in 1989, the private sector generated about 16% of GDP. Solid progress with privatisation, and strong growth in the number of new private firms resulted in a private sector share in GDP of 60-70% by the end of 1995. Reflecting the sharp acceleration in the pace of privatisation, and Hungary's improving standing with international investors, foreign direct investment has been very significant.

Figure 2.1: The total per capita foreign investment (USD/capita) in Hungary and in the Central-East European Countries Associated to EU (AC-10)



2.1.2. Economic performance

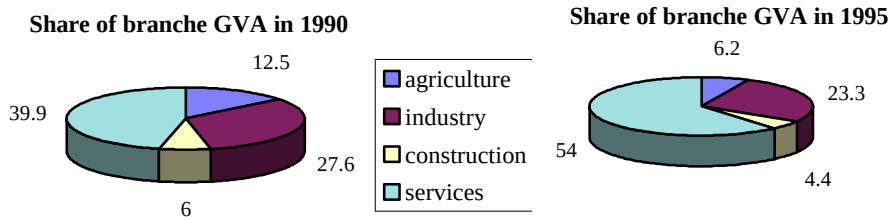
After a fall in GDP of nearly 20% between 1989 and 1993, Hungary has seen renewed growth since 1994 (1.5% in 1995, 1% in 1996). This has been accompanied by progress towards stabilisation of public finances, external accounts and inflation (19.8% in 1996). Growth remains somewhat subdued and may be expected to remain so in the short-to-medium-term as Hungary still needs to contain public and external deficits and reduce its foreign debt. Employment fell substantially during the recession, by over 1 million in a labour force of around 5 million. Unemployment, which had previously been concealed, rose rapidly to reach 12% of the labour force by early 1993. It has since fallen to under 10%, due to a decline in the labour force participation rate. Because of the moderate rate of growth Hungary has not yet seen rising employment.

Privatisation and restructuring have gone further in Hungary than in most other transition economies; indeed, in sectors such as telecommunications and energy supply, the scale of private involvement is greater than that in many EU member states. Privatisation has been a significant channel for foreign investment in the Hungarian economy. Apart from privatisation, the private sector in Hungary has also grown at a spectacular pace through the creation of new enterprises. In comparison with a "typical" market economy, it is likely that the Hungarian enterprise sector will be characterised by a relatively large proportion of very small enterprises in the years to come.

Table 2.1: Main economic trends in Hungary

	1990	1991	1992	1993	1994	1995
Real GDP growth rate (%)	-3.3	-11.9	-3	-0.8	2.9	1.5
Unemployment rate (%)	2.1	8.5	12.3	11.3	10.2	9.3
Gross foreign debt/GDP	48.4	43.7	35.7	38.8	45.6	40.5
Exports of goods & services/GDP	33.1	32.8	31.4	26.4	28.9	34.4
Inflation rate (%)	28.9	35	23	22.5	18.8	28.2
Government budget balance/GDP	0.8	-3	-7.6	-5.5	-8.4	-6.0

Figure 2.2: Structure of production: share of branch GVA (Gross Value Added)



2.2. Changes in the energy sector

2.2.1. Energy characteristics

Between 1971 and 1987, the total primary energy supply[1] (TPES) had risen by 61%, but, as a result of Hungary's transition process and fall in economic output, it fell by 20% over the following decade. The biggest decline was in coal supply (down 41% - representing 21% of the TPES), followed by oil (down 22% - representing 30% of the TPES) and natural gas (down 10% - representing 34% of the TPES). In 1995 TPES stood at 1046 PJ. Nuclear power production, which began in 1983, accounted for 15% of TPES in 1995. Energy self-sufficiency was 55% in 1995: Hungary imported 78% of its oil supply, 57% of its natural gas supply and 19% of its coal supply. Domestic resources

[1] In accordance with the IEA definition the total primary energy supply is made up of indigenous production + imports - exports - international marine bunkers μ stock changes

are declining (oil and gas) or are of low quality and extracted uneconomically (solid fuels). Solid fuels production declined in the period 1983-1995 from 25 Mt to 14 Mt per year.

The general energy intensity per capita shows that the Hungarian energy consumption is some 30% lower than in the average European OECD country. The high figure for the energy consumption per GDP reflects the relatively low output of the Hungarian economy in terms of GDP rather than an extremely high energy consumption. The energy intensity in the industry is rather low. This probably indicates that the industrial sector is running on low capacity. In the residential sector the energy consumption per family is rather low due to lack of energy intensive household appliances. The consumption per heated volume is 20-30% higher than the typical value for the same climate in the member states of the European Union.

Table 2.2: Indicators of the efficiency of energy utilisation in 1995

		Hungary	OECD Europe average
Macro-economic indicators			
TPES	(PJ)	1046	
TPES/capita	(GJ/person)	103	138.1
TPES/GDP	(GJ/1990 US$1000)	30.5	16.7
Cost of energy	(% GDP)	17%	7%
Energy intensity			
Industry	(GJ/1990 US$1000)	31.4	104.7
Households	(GJ/family)	71.2	105
Energy consumption by sectors			
Production		31%	33%
Residential		46%	34%
Transport		16%	29%

New legislative framework related to the energy and environment

1994:	Gas Act	regulates the responsibilities of the different actors of gas supply
1994:	Electricity Act	rules on the generation, transmission and supply of electric energy
1995:	Government Decree on the Energy Saving Action Plan	Implementation programme including detailed measures, timetables and financing schemes
1995:	Act on Environmental Protection	secures the conservation of environment, develops a harmonious relationship between humans and their environment
1996:	Law on Regional Development and Physical Planning	promotes the balanced and comprehensive regional development policy tasks both at national and regional levels
1997:	Parliamentary decision on the National Environmental Programme	shall be the basis for environmental planning focusing on the specific tasks, programmes and regions of high priority.

2.2.2. Pricing

There has been a fundamental change in the pricing policy of the energy sources. The direct central subsidies for energy prices have been terminated since 1991. From 1995 there is a liberalised market (and free price) for the solid fuels, oil products and district heating. The prices of natural gas,

electricity and heat do not cover the costs of supply. In 1995 average end-use gas prices were only half the level needed to cover costs. It is variously estimated that electricity prices must rise between 50% and 70% in real terms to cover the costs. The energy prices for households are still cross-subsidised by industry to a large degree. The gas prices increased by an average of 53% for the households and 9% for industry users in 1995. Electricity prices rise by an average of 65% for the households and 18% for industry users. The smaller increases for the industry are designed to reduce cross-subsidies. For household gas prices the increase will be roughly the same size, whilst the increase in household electricity prices required is about the half of the January 1995 prices in real terms. Comparison of the end-use prices for energy explains the following conclusions:

- gasoline and domestic heating oil account for smaller part of energy markets than would be typical in OECD countries due to the high relative prices in Hungary;
- the underpricing of the gas for households explains the high penetration rate and continued expansion of gas in the residential sector;
- the relatively high price of coal explains the decline in coal demand;
- international comparison of prices underlines the underpricing of gas and electricity for residential sector consumption.

Table 2.3: Energy end-user tariffs at September 1995

	Electricity (US$/kWh)	Natural Gas (US$/m^3)
General tariff		0.119
Daytime tariff (kWh/year)		
< 600	0.05	
600 - 3600	0.066	
> 3600	0.081	
Night-time tariff (kWh/year)		
< 2400	0.027	
2400 - 12000	0.031	
> 12000	0.034	

2.2.3. Privatisation

The Hungarian Government has pursued the partial privatisation in the gas and electricity industries to meet the urgent need for increased government revenues. Earlier attempts to partial privatisation of gas distribution companies (prior to the approval of the Gas and Electricity Act) have failed, due primarily to uncertainties on regulatory arrangements for the sector. The Government formulated its new policy on privatisation of the energy sector in late of 1994 with a view to accelerating the privatisation of the National Oil and Gas Company (MOL) and the Hungarian Power Company (MVM) and gas distribution companies. The ownership structure are as the follows:

- less than 50% of shares were sold in the regional gas distribution companies and regional electricity utilities. The investors are state and private companies of France, Germany, Italy and Austria. The state retained powers to control strategic decisions through a “golden share”;
- in the MOL the state will retain a 25% plus one share blocking minority share holding. 30-35% of shares were sold to a foreign investor or consortium;
- except for the Paks Nuclear Power Company and the National Grid Company which will remain subsidiaries of MVM, all the power companies were separated from MVM;
- 50% minus one share of MVM’s capital assets were made available to small domestic investors, domestic and foreign institutional investors;
- 50% plus one share of the generating companies are to be sold to strategic investors following creation of the necessary conditions for sale, such as capital increases where necessary. Remaining shares will be sold through a public offer to small domestic investors and domestic and foreign institutional investors. The privatisation of certain power generating companies is still in progress.

3. INVENTORIES OF ANTHROPOGENIC GREENHOUSE GAS EMISSIONS AND REMOVALS FOR 1991-1995

One of the principal purposes of the compilation of greenhouse gas inventories is the identification of main sources that contribute to the national level anthropogenic greenhouse gas emissions.

In Hungary, the first greenhouse gas emission inventory based on the Draft IPCC (Intergovernmental Panel on Climate Change) Guidelines was developed in 1994. In 1997, updated inventory calculation was compiled and submitted for the period of 1991-1994. Base on this publication, this chapter covers the period of 1991-1995.

In the first part of this chapter the CO_2 and non-CO_2 emissions from fuel combustion are presented. In the second part the sectoral emissions are shown, including the industry, agriculture and waste management. Finally, the CO_2 removals by forests are estimated. (The key assumptions, the uncertainties and other methodological aspects are described in the report mentioned above.)

3.1. Energy use and transformation

In the development of the inventories, the IPCC methodology and the recommended emission factors have been used in most cases. We always indicate if other values than those of the IPCC methodology are applied. If intervals are given for emission factors in the IPCC guidelines, we always use the mean values.

3.1.1. CO_2 emissions from fuel use

The greatest part of CO_2 emissions (almost 97%) is generated by fuel combustion. In 1991 it was about 65 Mt/year, but it dropped to 57 Mt by 1994. There was a slight increase in 1995. This slight increase is typical for almost all greenhouse gas emission sources. As far as the sectoral structure of CO_2 emission is concerned, almost half of the total emission stems from the transformation processes in case of fuel combustion.

The share of the residential sector in overall CO_2 emissions significantly decreased from 24% to 20%, mainly due to the realisation of the country-wide household gas program. As it can be seen in Table 3.1. the share of emissions from transport increased and reached 13% in 1994 and in 1995.

Table 3.1. Distribution of fuel-related CO_2 emissions by sectors (Gg)

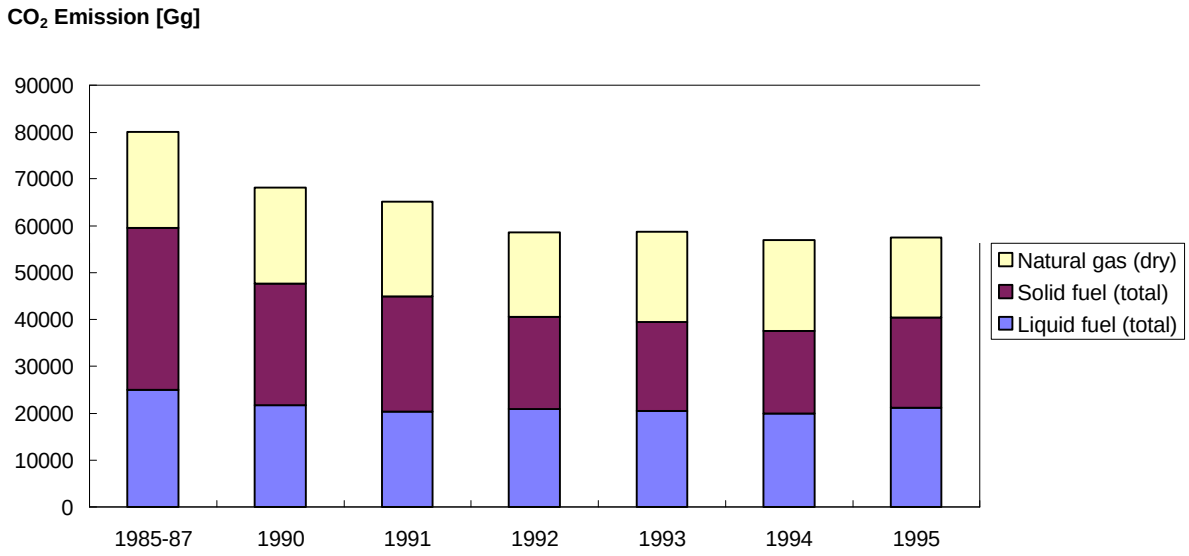
	1991	1992	1993	1994	1995
Energy & Transformation	28520	27476	27575	26290	26431
Industry	6380	5131	5548	6306	6352
Transport	7383	7189	7141	7212	7001
Commercial and Trade	3959	3517	3822	3970	3946
Residential	15670	12196	12271	11453	11296
Agriculture and Forestry	2120	1593	1499	1537	1519
Other	1224	1534	900	278	1022
TOTAL	**65255**	**58636**	**58754**	**57046**	**57567**

In 1995, more than 80% of the total carbon dioxide emissions of the transport sector was emitted by the road transport, with passenger transport accountable for the main share of these emissions. The public transport is responsible for less than 20% of the emissions from the passenger

transport. In the freight transport trucks emitted the major amount of carbon dioxide. In total, the private cars are responsible for the largest share in the emissions in 1995, followed by the trucks.

The share of emissions from solid fossil sources are significantly decreased from 37% (1991) to 30% (1995). Simultaneously, due to fuel switch at coal-fired power plants and to the implementation of the natural gas programme, the relative proportions of the oil and gas-origin emissions raised by almost 7%. (see Figure 3.1.)

Figure 3.1. Distribution of fuel-related CO_2 emissions by main fuel categories



Annex A1-A5 presents the detailed information for the fuel related CO_2 emissions by fuel types. Annex B1-B3 shows the sectoral breakdown of the CO_2 CH_4 and N_2O emissions.

3.1.2. Non-CO_2 emissions from fuel use

Stationary sources

The CH_4, N_2O, CO, NO_X emissions from several stationary sources show a substantial shift in the period of 1991-1995: the emissions form the residential sources have decreased by 25-60%. Simultaneously, the emissions from commercial sources are significantly increased: for example in case of CO the commercial-origin emissions have been doubled. Table 3.2 summarises the CH_4, N_2O, CO, NO_X from stationary sources. The non-CO_2 emissions from biomass burning is presented in Table 3.3.

Table 3.2. Non-CO_2 emissions from fuel combustion (stationary sources, tonnes)

	CH_4					N_2O				
	1991	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**
Utility Boiler	106	116	123	118	119	194	207	207	198	203
Industrial Boiler	274	214	204	182	174	52	35	31	27	25
Ovens,Dryers:Cement	11	10	11	24	21	4	4	5	8	7
Ovens,Dryers:Coking	28	5	0	0	0	40	7	0	0	0
Ovens,Dryers:Chemical	2	8	6	3	3	0	1	1	0	0
Residential Source	26356	13986	13850	10390	9297	233	182	187	175	182
Commercial and Other	293	431	479	484	442	1807	2668	2754	2943	2674
TOTAL	**27069**	**14770**	**14673**	**11201**	**10056**	**2330**	**3105**	**3184**	**3351**	**3092**

	CO					NO_x				
	1991	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**
Utility Boiler	3683	3682	3702	3650	3749	82057	83102	81362	79296	82219
Industrial Boiler	4216	2731	2704	2259	2152	15660	12073	11013	9719	9155
Ovens,Dryers:Cement	861	753	816	1864	1632	9032	7529	8009	21243	18190
Ovens,Dryers:Coking	5950	1055	0	0	0	14100	2500	0	0	0
Ovens,Dryers:Chemical	23	79	60	32	28	174	514	399	186	170
Residential Source	451043	306308	324537	291966	311043	22653	15779	15960	14203	14147
Commercial and Other	3862	6804	7575	7734	6753	10691	13089	14226	14718	13923
TOTAL	**469638**	**321412**	**339393**	**307505**	**154366**	**154366**	**134587**	**130970**	**139365**	**137805**

Table 3.3. Non CO_2 emissions from biomass burning (tonnes)

	CH_4					N_2O				
	1991	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**
Wood for direct use	7009	6976	7336	7470	8486	48	48	50	51	58
Agricultural Wastes	620	663	658	671	723	15	16	16	16	18
Charcoal Consumption	3	4	4	1	1	0	0	0	0	0
Charcoal Production	555	380	193	6	0	1	0	0	0	0
TOTAL	**8187**	**8023**	**8192**	**8148**	**9210**	**64**	**64**	**66**	**67**	**76**

	CO					NO_x				
	1991	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**
Wood for direct use	61329	61036	64193	65363	74249	1740	1732	1821	1854	2106
Agricultural Wastes	13010	13931	13823	14094	15178	554	593	588	600	646
Charcoal Consumption	214	322	322	107	107	0	0	0	0	0
Charcoal Production	926	633	322	10	0	26	18	9	0	0
TOTAL	**75479**	**75923**	**78660**	**79574**	**89535**	**2320**	**2342**	**2419**	**2454**	**2752**

Mobile sources

The total transport related non-CO_2 emissions (Table 3.4.) show a certain decrease of 2-8% in the investigated period. However the different type of emissions showed some fluctuation in these years.

Table 3.4. Non CO_2 emissions from fuel combustion (mobile sources, tonnes)

	CH_4					N_2O				
	1991	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**
Gasoline Passenger Cars	1290	1234	1268	1253	1237	61	59	60	60	59
Gasoline Light-Duty Vehicles	52	29	25	24	11	3	2	1	1	1
Gasoline Heavy-Duty Vehicles	16	13	11	10	7	1	1	1	1	0
Motorcycles	4	4	4	4	3	0	0	0	0	0
Diesel Passenger Cars	1	1	1	1	1	2	2	2	2	2
Diesel Light-Duty Vehicles	8	9	9	10	10	33	36	37	39	39
Diesel Heavy-Duty Vehicles	117	125	118	114	106	59	62	59	57	53
Road Vehicles Total	1488	1413	1436	1414	1375	158	161	161	159	154
Rail (Locomotives)	29	25	23	22	21	12	10	9	9	9
Inland Waterways	2	2	0	1	0	1	1	0	0	0
Airplanes	11	11	10	15	15	5	6	5	8	7
TOTAL	**1530**	**1451**	**1469**	**1452**	**1411**	**176**	**177**	**175**	**176**	**170**

	CO					NO_x					NMVOC				
	1991	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**
Gasoline Passenger Cars	805478	770121	791516	782313	772363	35021	33484	34414	34014	33581	74957	71667	73658	72801	71875
Gasoline Light-Duty Vehicles	24199	13411	11329	10912	4998	1917	1063	898	865	396	3167	1755	1482	1428	654
Gasoline Heavy-Duty Vehicles	8541	6861	5888	5103	3533	990	795	683	592	410	783	629	540	468	324
Motorcycles	521	521	504	504	454	2	2	2	2	2	365	365	353	353	318
Diesel Passenger Cars	92	104	115	126	143	86	96	107	117	133	23	26	29	32	36
Diesel Light-Duty Vehicles	3366	3641	3834	3981	4006	3038	3286	3460	3593	3615	903	977	1029	1068	1075
Diesel Heavy-Duty Vehicles	16396	17427	16568	15900	14875	19519	20746	19724	18928	17708	3709	3942	3748	3596	3365
Road Vehicles Total	858593	812085	829753	818839	800370	60573	59471	59286	58109	55844	83906	79360	80838	79746	77646
Rail (Locomotives)	3554	3062	2771	2672	2607	10487	9034	8176	7884	7693	757	653	591	569	556
Inland Waterways	183	174	29	47	20	584	557	93	149	62	40	38	6	10	4
Airplanes	637	654	612	902	888	1540	1581	1480	2181	2146	96	98	92	135	133
TOTAL	**862967**	**815975**	**833165**	**822459**	**803885**	**73184**	**70643**	**69034**	**68323**	**65745**	**84800**	**80149**	**81527**	**80461**	**78339**

3.1.3. Fugitive fuel emissions: oil industries and coal mining

In Hungary, coal is produced from both underground and open pit mines. According to the sharp decline of domestic coal mining and oil production, the methane emission from fugitive sources decreased by 30% from 1991 to 1995. One of the most important sources of the industrial methane emission is the fugitive losses of natural gas during its production, transport and distribution. In the middle of the 80's, the coal mining activities could be regarded as important industrial methane sources, which gave around 30% of the total methane emissions. This contribution was only 15% in 1995.

The activity data and the corresponding CH_4 emissions from fugitive sources are presented in Table 3.5. and Table 3.6. Figure 3.2. shows the trends observed in the fugitive emissions during the recent years.

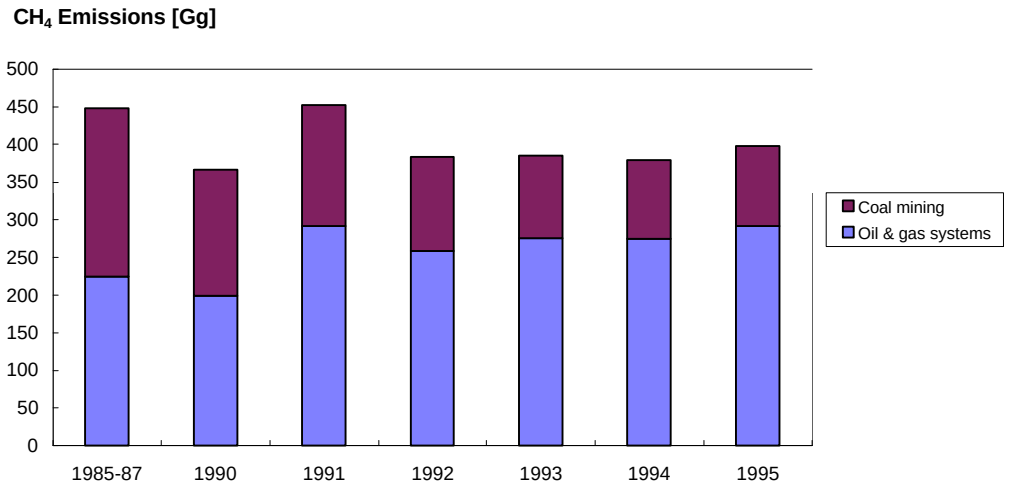
Table 3.5. Activity data of fugitive emissions

	Activity categories		**Activity data**				
	Name	**dimension**	**1991**	**1992**	**1993**	**1994**	**1995**
OIL	Production	(PJ)	76	73	68	65	68
	Transport	(PJ)	Not Est.	Not Est.	Not Est.	Not Est.	Not Est.
	Refining	(PJ)	303	306	316	289	316
	Storage	(PJ)	303	306	316	289	316
GAS	Production	(PJ)	161	151	163	157	159
	Transmission and distribution	(PJ)	370	325	350	354	384
	Non-residental leakage	(PJ)	256	220	216	206	212
	residental leakage	(PJ)	114	106	134	147	112
	venting and flaring	(PJ)	161	151	163	157	159
COAL MINING							
Undeground	mining	(Mt)	12	9	8	7	7
mines	post-mining	(Mt)	12	9	8	7	7
Surface	mining	(Mt)	6	7	7	7	7
mines	post-mining	(Mt)	6	7	7	7	7

Table 3.6. Fugitive CH_4 emissions from oil and gas activities (Gg)

		1991	1992	1993	1994	1995
OIL	Production	0.08	0.07	0.07	0.06	0.07
	Transport	Not Est.	Not Est.	Not Est.	Not Est.	Not Est.
	Refining	0.15	0.15	0.16	0.14	0.15
	Storage	0.03	0.03	0.03	0.03	0.03
	TOTAL	**0.26**	**0.25**	**0.26**	**0.23**	**0.25**
GAS	Production	48	45	49	47	48
	Transmission and distribution	148	130	140	141	154
	Non-residental leakage	77	66	65	62	64
	residental leakage	17	16	20	22	26
	TOTAL	**290**	**257**	**274**	**273**	**291**
	venting and flaring	2	2	2	2	2
OIL & GAS	**TOTAL**	**292**	**259**	**276**	**274**	**292**
COAL MINING						
Undeground	mining	136	104	91	87	87
mines	post-mining	19	15	13	12	12
Surface	mining	4	6	6	5	6
mines	post-mining	0.37	0.47	0.46	0.45	0.48
COAL	**TOTAL**	**161**	**124**	**109**	**105**	**106**
TOTAL		**453**	**383**	**385**	**379**	**315**

Figure 3.2. Trends in fugitive CH_4 emissions



3.2. Industry

It should be mentioned that the activity data of the industry are more uncertain than the data of the energy, forestry or agriculture. Simultaneously with the socio-economic changes around 1990, the Hungarian statistical system considerably changed, too. Earlier regular statistical issues of industrial activities are not published any more, therefore industrial data of the early 90's may be distorted. Table 3.7. shows the emission factors used for industrial sources in the Hungarian inventory.

Table 3.7. Parameters and emission factors used for the industry

Activity	CO_2	CH_4	N_2O	CO	NO_x	NMVOC
S-M steel prod. (kg/Mg steel)		0.010			0.005	0.060
Raw iron prod. (kg/Mg raw iron)				0.130		
Aluminium prod. (kg/Mg al.)	1850				15	
Nitrogen fertilizer prod. (kg/Mg fert.)			15			
Cement prod. (Mg/Mg product)	0.500					
Lime manufact. (kg/Mg limest.)	0.440				1.500	
Plant protecting agents (kg/Mg prod.)						0.800
Paint production (kg/Mg prod.)						1
Other chemical products (kg/Mg prod.)						
-CFCs						4
-ethylene						5
-polyethylene						10
-polypropylene						8
-polystyrene						15
-paint application						500

Table 3.8. and Table 3.9. present the activity data and the corresponding emissions, respectively. Some uneconomical activities in the heavy industry stopped in the 90's in Hungary. However, in certain branches the production began to increase from 1993, and it resulted in a slight increase of emissions generated by these industries, as well.

Table 3.8. Activity data of the industrial emissions (1000 tonnes)

Activity/Year	1991	1992	1993	1994	1995
S-M Steel Production	497	139	0	0	0
Raw Iron Production	1314	1176	1407	Not Est.	Not Est.
Aluminium Production	63	27	28	Not Est.	Not Est.
Nitrogen Fertilizer Production	250	185	167	228	178
Cement Production	2529	2236	2533	2793	2875
Lime Manufacturing	571	507	476	520	538
Plant Protecting Agent Production	38	30	31	23	19
Paint Production	68	72	67	70	63
Polyethylene Production	249	275	259	273	274
Polypropylene Production	150	148	136	137	137

Table 3.9. Emissions from the industry

	CO_2 (Gg)					CH_4 (Mg)					N_2O (Mg)				
	1991	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**
S-M Steel Production	-	-	-	-	-	5	1	0	0	0	-	-	-	-	-
Raw Iron Production	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminium Production	117	50	52	Not Est.	Not Est.	-	-	-	-	-	-	-	-	-	-
Nitrogen Fertilizer Production	-	-	-	-	-	-	-	-	-	-	3750	2771	2509	3420	2669
Cement Production	1265	1118	1267	1397	1438	-	-	-	-	-	-	-	-	-	-
Lime Manufacturing	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-
Plant Protecting Agent Production	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paint Production	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polyethylene Production	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypropylene Production	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**1382**	**1168**	**1318**	**1397**	**1438**	**5**	**1**	**0**	**0**	**0**	**3750**	**2771**	**2509**	**3420**	**2669**

	CO (Mg)					NO_x (Mg)					NMVOC (Mg)				
	1991	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**
S-M Steel Production	-	-	-	-	-	2	1	0	0	0	30	8	0	0	0
Raw Iron Production	171	153	183	Not Est.	Not Est.	-	-	-	-	-	-	-	-	-	-
Aluminium Production	-	-	-	-	-	950	403	418	Not Est.	Not Est.	-	-	-	-	-
Nitrogen Fertilizer Production	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cement Production	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lime Manufacturing	-	-	-	-	-	857	761	714	780	807	-	-	-	-	-
Plant Protecting Agent Production	-	-	-	-	-	-	-	-	-	-	30	24	25	18	16
Paint Production	-	-	-	-	-	-	-	-	-	-	68	72	67	70	63
Polyethylene Production	-	-	-	-	-	-	-	-	-	-	2486	2746	2586	2733	2738
Polypropylene Production	-	-	-	-	-	-	-	-	-	-	1200	1180	1089	1096	1096
TOTAL	**171**	**153**	**183**	**0**	**0**	**1809**	**1164**	**1132**	**780**	**807**	**3814**	**4031**	**3766**	**3917**	**3912**

3.2.1. CO_2 emissions from aluminium and cement production

The largest source of industrial CO_2 emission is the cement production. The emission from this source increased by 14% between 1991 and 1995. However, it should be mentioned that production level of clinker cement can only be estimated at a low reliability. Moreover, for lack of specific emission factors it is not possible to determine the CO_2 emission from production of other industrial materials (coke, iron, steel, etc.). The CO_2 emissions from the aluminium production dropped dramatically.

3.2.2. Non CO_2 emissions

The CH_4 emissions form S-M steel production can be considered as negligible since 1993. The N_2O emissions dropped by 30% in the investigated time period, nevertheless, in 1994 a peak could be observed. The NMVOC industry-related emissions were almost unchanged.

3.3. Agriculture

In case of the agriculture, we deviated from the IPCC Guidelines to a certain extent. According to the recommended categorisation, Hungary would be attributed by “cool climate”. The emission factor recommended for Western Europe was applied to determine methane emissions from animals and animal manure in Hungary. This figure seems to be more realistic than the default value recommended for Eastern European countries. For example, milk yields of dairy cattles in Western Europe, Eastern Europe and in Hungary are 4200 l/year, 2500 l/year and 4800 l/year, respectively. In case of rice cultivation we applied the emission factor 3.48 kg/ha-day.

Table 3.10. shows the production data for CH_4 emissions stemming from enteric fermentation, animal wastes and rice cultivation.

Table 3.10. Activity data for agriculture emissions

	1991	1992	1993	1994	1995
Dairy Cattle (1000 heads)	559	497	450	425	421
Other Cattle (1000 heads)	859	662	549	518	507
Buffalo (1000 heads)	0	0	0	0	0
Sheep (1000 heads)	1808	1752	1252	1043	977
Goats (1000 heads)	60	60	60	62	60
Camels	0	0	0	0	0
Horses & Mules (1000 heads)	75	70	71	78	80
Swine (1000 heads)	5993	5364	5001	5214	5032
Poultry (1000 heads)	55000	55000	52400	42116	35659
Rice production: harvested Area (Mha)	0	0	0	0	0
Amount of nitrogen applied in fertilizer and manure (tN)	300000	291000	261000	322000	287000
Annual Production (kt crop)	7786	5312	4272	6432	6022

3.3.1. CH_4 emissions from enteric fermentation and manure management

The most important sources of CH_4 emissions in agriculture are the manure management and enteric fermentation. CH_4 production through enteric fermentation is a part of the normal digestive activity of ruminants. According to this method, methane emission is calculated for beef cattle, dairy cattle, sheep, swine, horse and poultry. Animal waste treatment methods that provide anaerobic conditions result in CH_4 release, as well. As it can be seen in Table 3.11, the CH_4 emissions related to the animal husbandry decreased by 30% between 1991 and 1995, mainly due to the restructuring of the agricultural productions.

Table 3.11. CH_4 emissions from animals and animal manure (Gg)

	1991	1992	1993	1994	1995
Dairy Cattle	63.7	56.7	51.3	48.5	48.0
Other Cattle	46.4	35.7	29.6	28.0	27.4
Buffalo	0.0	0.0	0.0	0.0	0.0
Sheep	14.8	14.3	10.3	8.5	8.0
Goats	0.3	0.3	0.3	0.3	0.3
Camels	0.0	0.0	0.0	0.0	0.0
Horses & Mules	1.5	1.4	1.4	1.5	1.6
Swine	33.0	29.5	27.5	28.7	27.7
Poultry	4.3	4.3	4.1	3.3	2.8
TOTAL	163.9	142.2	124.5	118.8	115.7

3.3.2. CH_4 emissions from rice cultivation

Table 3.12. shows the CH_4-emissions from rice production in the different years of the examined period. Rice is produced at continuously flooded water management regime.

Table 3.12. CH_4 emissions from rice production (Gg)

	1991	1992	1993	1994	1995
Emission	3.8	2.1	2.1	2.1	1.8

3.3.3. N_2O emission from fertiliser use

The main source of N_2O emission from agriculture is the use of N-fertilisers. Table 3.13. summarises the calculation of emitted N_2O from soil caused by the use of N-fertilisers, which shows a slight fluctuation in the investigated time period. For the calculation of N_2O emissions from the

fertiliser use we applied the median emission coefficient 0,0036, given in the IPCC Reference Manual (page 4.79).

Table 3.13. N_2O emission from agricultural soils (Gg)

	1991	1992	1993	1994	1995
Emission	1.68	1.63	1.46	1.80	1.61

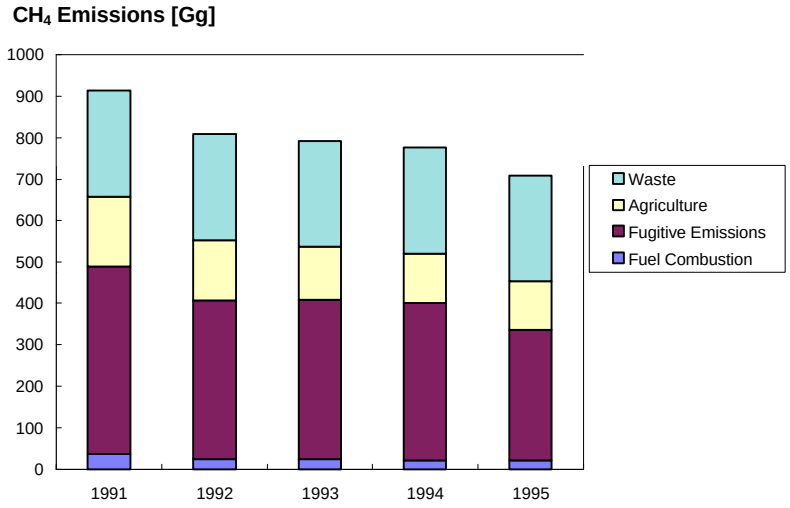
3.3.4. Non-CO_2 emissions from field burning of agricultural residues

The calculations of emitted non-CO_2 trace gases from field burning of agricultural residues are presented in Table 3.14. It should be noted that these emissions reached the lowest values around 1992-1993 and an increase can be observed afterward. Finally, the overall sources of CH_4 are presented in Figure 3.3.

Table 3.14. Non CO_2 emissions from field burning of agricultural residues (tonnes)

	1991	1992	1993	1994	1995
CH_4	4.5	3.1	2.5	3.7	3.7
N_2O	0.0	0.0	0.0	0.0	0.0
CO	95.3	65.0	52.3	78.7	78.7
NO_x	1.0	0.7	0.6	0.8	0.8

Figure 3.3. Main sources of total CH_4 emission



3.4. Forestry

As far as forest and grassland conversion is concerned, the following comments should be made:

- there is no conversion from forest to grassland. Biomass loss occurs in the form of residues from harvest (5% of this is burned on-site, 95% is left to decay);
- new afforestations, as a form of land use change, are also included in the calculations. This, however, results in no loss but gain in biomass (i.e. 'negative' loss);
- only data for decay are summed;

- long term emission from soil is estimated as negligible, because there is no change of land use from forest to anything else in Hungary, and although there is some emission after all clearcuts, it is offset by the regeneration or reforestation of the area;
- there are no abandoned lands;
- for annual growth rate and all other biomass data, only the aboveground biomass is considered. Net annual growth rate (i.e., total growth minus density-dependent and density-independent self thinning) is estimated as being 95% of total, i.e., gross growth;
- the dry matter conversion ratios are for air-dry organic matter. For carbon fraction of dry matter, the default value of 0,45 is used. This is approximately the same as was found in the literature for air-dry wood;
- it is supposed that all traditional fuelwood harvested. In Hungary, some 20% of wood is lost in thinnings and harvests. It is considered that this wood - and its carbon-content - decays.

In forestry, CO_2 is sequestered by the growth of the biomass, increases in stabile humus in the soils and the accumulation of dead organic material and litter on the ground. The total area under forest management in Hungary was 1564 million hectares and 1608 million hectares in 1991 and 1995, respectively.

Table 3.15. and Table 3.16. provides the activity data related to forestry-related emissions and removals. Table 3.17. and Table 3.18. summarise the carbon uptake, release and the emissions from on-site burning. It can be seen, that the total carbon uptake and release were almost unchanged while the annual carbon release decreased by 20% in the investigated time period. One can see from the above results that the annual removal of CO_2 by forest management was increasing till 1994, and there was a slight decrease in 1995. The emissions from CH_4, N_2O, CO and NO_x from burning of forests decreased by 20% till 1994 in average, and they began to increase in 1995.

Table 3.15. Activity data of carbon uptake: forestry and grassland conversion

		Area of Forest/Biomass Stocks (kha)					Commercial Harvest (1000 m3 roundwood)					Total Traditional Fuelwood Consumed (kt dm)				
		1991	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**
Plantations	Evergreen	216	217	218	218	216										
	Deciduous	151	150	152	151	153										
Commercial	Evergreen	29	29	30	31	30										
	Deciduous	887	876	871	890	887										
Other		281	298	318	310	322										
	Oak						384	349	332	303	370	255	232	221	258	246
	Turkey oak						408	366	318	257	284	353	317	275	276	246
	European beach						307	294	291	273	275	90	86	85	84	81
	Hornbeam						117	111	100	93	106	113	108	97	85	103
	Black locust						514	478	358	303	365	606	563	422	414	430
	Other hardwood						58	52	51	37	46	63	57	55	44	50
	Poplar						1088	933	747	777	834	106	91	73	46	81
	Other dec.softw.						202	171	145	166	161	15	13	11	24	12
	Conifers						372	362	390	539	487	21	21	22	45	28
	Other						0	0	0	0	0	0	0	0	0	0
TOTAL		**1564**	**1570**	**1589**	**1600**	**1608**	**3450**	**3116**	**2732**	**2748**	**2928**	**1622**	**1488**	**1261**	**1276**	**1277**

Table 3.16. Activity data of carbon release: forest and grassland conversion

	Area Converted Anually (kha)					Annual Loss of Biomass (kt dm)				
	1991	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**
Grassland -> Forest	6.7	7.1	3.2	2.9	4.2					
Other-Evergreen						97.3	94.9	102.2	140.5	127.7
Other-Deciduous						767.8	690.9	580.4	561.9	605.9

	Area Converted 10 year average (kha)					Loss of Biomass 10 year average (kt dm)				
	1991	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**
Grassland -> Forest	7.5	7.3	7.4	7.1	6.7					
Other-Evergreen						110.8	113.2	114.1	112.4	109.5
Other-Deciduous						810.8	815.4	808.3	780.4	750.5

Table 3.17. Carbon uptake, release and total CO_2 removal

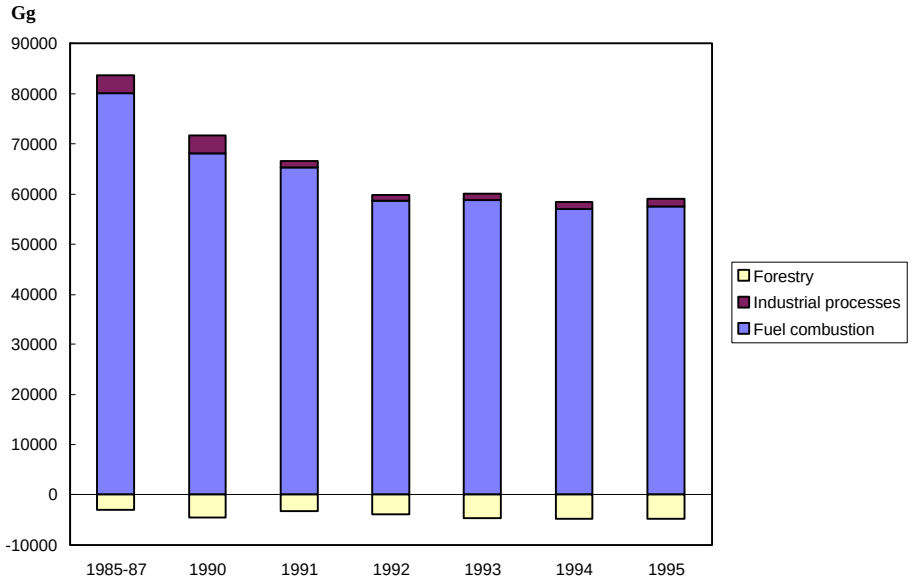
		1991	**1992**	**1993**	**1994**	**1995**
Total Carbon Uptake	(kt C)	2940	2960	2994	3005	3041
Annual Carbon Release	(kt C)	1645	1504	1304	1294	1350
Release from Burning + Decay	(kt C)	412	413	408	396	383
Total CO_2 Removal	**($GgCO_2$)**	**3239**	**3823**	**4697**	**4820**	**4797**

Table 3.18. Emissions from on-site burning of forests (Gg)

	1991	**1992**	**1993**	**1994**	**1995**
CH_4	0.280	0.255	0.221	0.228	0.238
N_2O	0.002	0.002	0.002	0.002	0.002
CO	2.453	2.228	1.935	1.991	2.080
NO_x	0.070	0.063	0.055	0.057	0.059

The tendencies in net actual carbon-dioxide emissions in Hungary are summarised in Figure 3.4. Due to the recent decline of the economy, the CO_2 emission from combustion sources has fallen by 18% between 1985 and 1994. The first year of increase was 1995 (by 1%). As a result of an economic recovery the overall net CO_2 emissions began to increase in 1995. However the net CO_2 emission level in 1995 is just 73% of that of the base period (the average of the years 1985-1987).

Figure 3.4. Total CO_2 emission and removal



3.5. Waste management

Solid wastes and flue gases

The yearly amount of wastes in Hungary is 20 million m^3/year, cca. 4 Gg/year. This was practically the same in every year of the investigated period. In Hungary there are 2682 registered land disposal sites, where 85-88% of waste is placed. There is an incineration plant in Budapest (i.e. in the capital of Hungary), whose capacity is 310 Gg/year. In Hungary there are two basic sources of air pollution caused by waste generation as follows:

- flue gases of the incineration plant in Budapest;
- gases generated at the land disposal sites.

Waste water treatment in Hungary

A great part of domestic waste waters is not treated at the moment, and this was true also for the examined period of 1985-1995. Proportion of treated waste water is as follows:

without treatment	53%
waste water cleaning	47%
mechanical cleaning	14%
mechanical and biological cleaning	31%
three steps cleaning	2%

About 20% of the residential waste water is cleaned also biologically.

The quantity of residential waste water that needed cleaning was cca 1000 million m^3/year. The amount of used water that could be regarded as industrial water without any cleaning was cca 4000 million m^3/year. The extension of the drainage system fell behind the water supply. Therefore twenty years ago 90% of flats with water supply were connected to the drainage system, while this proportion is only 45% nowadays.

Table 3.19. Emissions from waste management (Gg)

	CO_2					CH_4				
	1991	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**
Flue gases	600	600	600	600	600	-	-	-	-	-
Land disposal sites	154	154	154	154	154	68	68	68	68	68
Waste water treatment	-	-	-	-	-	188	188	188	187	186
TOTAL	**754**	**754**	**754**	**754**	**754**	**257**	**256**	**256**	**255**	**255**

	CO					NO_x				
	1991	**1992**	**1993**	**1994**	**1995**	**1991**	**1992**	**1993**	**1994**	**1995**
Flue gases	0.13	0.13	0.13	0.13	0.13	0.52	0.52	0.52	0.52	0.52
Land disposal sites	-	-	-	-	-	-	-	-	-	-
Waste water treatment	-	-	-	-	-	-	-	-	-	-
TOTAL	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.52**	**0.52**	**0.52**	**0.52**	**0.52**

4. POLICIES AND MEASURES

In this chapter the policies, concepts, strategies and detailed measures are overviewed that can lead to significant reduction of the greenhouse gas emissions or contribute to the enhancement of the carbon reservoir. As the most important tool, the National Energy Saving Program is discussed. The next section the forest policy and the new transport concept are summarised. Annex D presents an overview of the measures discussed in this chapter.

4.1. Measures to limit the carbon-dioxide emissions: National Energy Saving Program

4.1.1. Policy context

The current energy policy was adopted by the Parliament in 1993. The energy policy identifies the following strategic objectives:

- security of energy supply through diversification of energy sources;
- contribute to environmental protection;
- modernisation the supply side energy systems;
- increase the demand side energy efficiency;
- improving the public information on energy consumption ;
- attracting foreign capital for the necessary investments;
- approach to the EU and other international organisations[2].

On the basis of the energy policy concept the National Energy Saving and Energy Efficiency Improvement Program was developed in 1994. Based on this programme an action plan was approved by the Government in December 1995. The Energy Saving Action Plan consists of the following tasks:

- increasing the utilisation of renewable energies;
- improvement of energy management in municipalities;
- use of individual control and metering in newly equipped buildings with central heating;
- revision of current standards on the thermal and energy saving performance;
- introduction of a building energy performance certificate;
- qualification of energy using appliances and information for the consumers;
- rising energy and environment awareness;
- information for the energy managers;
- encourage energy saving in the R&D programmes;
- establishing the statistics and information system to support ESAP.

With respect to energy efficiency the Gas Act and the Electricity Act and their implementation resolution state that the electricity and gas shall be produced, transported, supplied and utilised with

[2] Hungary has been the regular member of the International Energy Agency since 1996

regard to the enforcement of environmental protection in accordance with the interest of the national economy related to the energy efficiency.

4.1.2. Measures in the energy supply sector: penetration of renewables

The energy policy concept mentioned above includes an objective to increase the share of renewable energy sources in the primary energy balance to 5-6% which is almost the double of the current figures. Regarding to its geographical locations and natural endowments, the renewable energy resources may play an enhanced role in the country's energy supply. The estimated total utilisation of the renewables may currently put at 35 PJ which corresponds to the 3% of the total primary energy supply.

The utilisation of wind power is limited by the low average wind speeds. The potentially utilisable annual wind power is about of 600-800 W/m^2. Minor (non commercial) wind energy utilisation is possible - for the purposes of water intake for animal feeding, inland drainage, fish-pond, sewage system ventilation etc. The utilisation of the Sun's energy is more promising in Hungary. Taking into account the climatic conditions, an average collector may supply of 400-600 kWh/m^2 heat energy in Hungary. During the recent decade almost 25,000 m^2 solar collector has been installed. Acknowledging the research and development made by the Hungarian Research Institute for Electric Industry, several thousand equipment operate by solar cells including radio relay stations, aid phones along motorways, outdoor lighting, detached houses water pumping etc. Recently significant progress has been made in the development of the solar cell industry. In co-operation with the Hungarian Development Bank, the Dunasolar Solar Cell Manufacturing Co. was established with an equity capital of HUF 825 million. According to the special geothermal endowments of Hungary, the commercial utilisation of the Earth's heat is feasible. The thermal water is directly utilised in the agriculture, providing a great share of the heat demand of the horticulture and animal husbandry. The utilisation of geothermal energy for district heating can reach the 3 PJ/year in nine towns. The utilisation of biomass resources are of the greatest importance in Hungary. Currently there are over 70 biomass-fired boiler plants where the total installed capacity amounts to 31 MW. There are in addition several thousand micro biomass facilities. The largest chopped-wood-fired heating plant on Central Europe is located at Tatabánya, where the installed boiler capacity is 12 MW.

Although some progress has been made, the renewable technologies in Hungary still suffer from a significant cost disadvantage related to fossil based technologies in power and heat generation. Experience in ongoing renewable financing initiatives shows that, without funding, these investments are still not competitive with the natural gas. The promotion of the uptake of renewable energy technologies can be undertaken in order to contribute to secure, sustainable energy supplies, to meet the environmental objectives and to provide additional benefits such as increased employment and export opportunities.

4.1.3. Measures in the demand side: energy efficiency improvement in the private and public sector

In the public sector the local governments keep energy efficiency on their agenda mainly to reduce the energy bills of their institutes (schools, hospitals, offices etc.) The improvement of energy management in municipalities one of the priority area of the ESAP. Support shall be provided for municipalities for the development and implementation of energy saving concept, organisation of training and events and information supply, as well.

In the residential sector certain initial step has been taken. In accordance with the ESAP, in case of buildings which are new and/or newly equipped with central or district heating, the application of modern individual controllers should be pursued. The possibility of substation metering-based accounting should be ensured. Cost allocators should be used to divide heating costs, wherever reasonable.

In the production sectors a growing number of industrial companies realise the interrelation between energy wastes and profit losses. Many of them know at least what ought to be done. Recently, as more and more companies get stabilised, energy efficiency plans developed by companies are started to implement. Big companies such as MOL (oil company), MÁV (National

Railways), RICHTER (pharmaceutical), CEREOL (vegetable oil), NITROKÉMIA (chemical) and others have shown good progress in energy efficiency programmes on their voluntary basis and without Governmental co-ordination or obligation.

Elements that contribute to improving energy efficiency like the ESCOs, the local energy efficiency policy plan including the adequate resources, establishing and maintaining links between national and local initiatives, mobilising all relevant actors are not really well developed in Hungary. With respect to financing energy efficiency some progress has been made (see below).

4.1.4. Measures in the demand side: financing energy efficiency

The finance of energy efficiency should extend to fulfil the demands of the producers, utilities and the various end-use sectors, as well. The different target groups involve specific funding mechanism. The main elements are as follows: German Coal Aid Revolving Fund, Energy Saving Credit Programme, PHARE Revolving Fund, Pilot Panel Programme. The appropriate co-ordination among the individual funding systems assures the effective use of the limited resources. In addition to the financial mechanisms mentioned above, the Ministry for Environment and Regional Policy launched an Inter-ministerial Clean Air Protection Action Program which is founded from the Central Environmental Fund. About HUF 200 million have been disbursed from the fund for the development of measurement systems recently. The Government provided HUF 2 billion to support the realisation of HUF 6 billion worth of investments targeted at reducing atmospheric emissions from the municipal, industrial and transport sectors.

Inter-ministerial Clean Air Protection Action Program: stationary sources of air pollution

Regulations of local air pollutants

Territorial limit values

- depending on the height of the source of emissions, and the number of point sources located on the same premises emitting identical pollutants at identical height category of emission;
- the atmospheric limit value for a given pollutant permitted for a 24 hour interval established in respect to the level of protection (zoning) required in the region where the point source is located;
- what is known as the load index (an official control value), which is related to the level of pollution in an area.

Technological limit values (introduced in 1998):

- for emissions from combustion plants of above 50 MW_{th} power. They will be issued in the near future. The regulation is fully compatible with the EU directive on large combustion plants (Council Directive No. 88/609/EEC). It established technological limit values for emissions from combustion plants fired by solid, liquid or gas fuel and from gas turbines. Limit values are differentiated according to thermal power input. The regulation also specifies the requirements for the control of emissions.
- Monitoring the efficiency of the programme of measures and improved awareness of the actual situation require the installation and operation of an appropriate measurement and control network. A conceptual plan and the related action plan for developing the national measurement network have been prepared.

German Coal Aid Revolving Fund (GCARF)

The Fund was established in 1992 as a revolving fund to finance energy efficiency investment. The principal aim of the fund is to support investments in the private and public sector which help to reduce the energy consumption and at the same time reduce environmental pollution and dependence on import. Its objectives are to replace traditional energy sources with renewables or waste related energy sources, to induce energy saving businesses and to reduce energy waste for the lowest cost possible. The GCARF is available to finance many type of projects, which provide substantial energy savings. These projects include reduction of energy end-use both by implementing low-cost, high-gain measures as well as up-to-date technology.

The GCARF has achieved considerable success since its inception by financing more than 300 projects with an estimated energy savings of about 3300 TJ/year. During the last 5 years the total investment made by the assistance of GCARF was of about HUF 6.5 billion. From the applications it can be derived that the average energy saving cost in the projects was appr. 850 HUF/GJ of annual energy saving. The initial donation to the fund has nearly doubled in size due to interest and fee income on its loans. While the original intention to provide finance to the private sector still remains the main aim of the fund, municipalities and enterprises, institutions owned by them have also been allowed to apply for loans. The GCARF is administered by the Hungarian Credit Bank and is an integrated part of the bank's lending operations.

Energy Saving Credit Programme (ESCP)

An other newly established preferential-loan facility is the Energy Saving Credit Programme. The programme has been launched by 1996 on the basis of a governmental decree. The lending policy, the target groups and the resource allocation are determined by a steering board year by year. In the first year, 1997 a total amount of HUF 800 million is provided, the interest preference of 50% is contributed by the state budget. In 1997, the main objective of the ESCP is to support the energy efficiency investments aiming at the modernisation of the energy use in municipality owned institutions (schools, hospitals, social and health care buildings etc.). The preferential loan must not exceed the amount of HUF 30 million per projects, the minimum own contribution is of 10%. An other important criteria is that at least the half of the costs saved by the investment should be reached by the reduction of the energy bill. One other criteria prescribes a minimum (specific) saving on the primary energy use, therefore the simple fuel switching projects (without efficiency improvement) are not accepted. The ESCP is technically managed by the Hungarian Energy Office, the project evaluations are made jointly by Energy Information Agency and the Raiffesen Unicbank.

PHARE Revolving Fund (PRF)

In order to support the energy efficiency and energy saving investments the PRF as a soft-loan credit facility has been established. The investments are co-financed by EBRD[3] and EIB[4], and an initial grant of ECU 7.5 million were provided by PHARE. Considering that the PHARE contribution will cover less than one third of the investment cost the total investment supported by the fund will be about HUF 5 billion. The possible applicants of the fund are the medium and micro enterprises from both the private and public sectors. The interest rate is defined by the "mixing" of the PHARE and other sources. Assuming that an investment has an own resource of 50%, applies for PHARE funding of 25% and an other 25% from EBRD or EIB the interest rate is almost the half of the general commercial rate. At least 10% own contribution is a must and the PHARE contribution must be less than 35% of the total investment cost. The grants will be offered by commercial banks and Energy Efficiency Centre[5] will be responsible for the project's evaluation and co-ordination. The facility is supervised by an interdepartmental Steering Committee. The full operation of the PRF is expected to start at early 1998.

3 European Bank on Restructuring and Development

4 Europe Investment Bank

5 Jointly re-established by Ministry for Environment and Regional Policy and the Ministry of Industry, Trade and Tourism on the basis of the EU-Hungary Energy Center.

Pilot Panel Programme (PPP)

In 1996, a pilot program was launched to improve the thermal insulation of the buildings. The first phase of the pilot program is aiming at the improvement of the thermal performance of almost 5000 block house dwellings. The Central Environmental Fund provides almost HUF 60,000 grants for each individual dwelling's insulation upgrade. In accordance with the grant the average payback time of the investments is under 10 years. The pilot program is managed by the Hungarian Foundation of Enterprise's Development. The association of the producers and sales representatives of the insulation materials and technologies are also involved into the project's implementation. After evaluation of experiences gained in 1997, the extension of the program is expected.

Table 4.1. Overview of source of funding in different (ongoing and planned) energy efficiency credit facilities in Hungary

Credit facilities	**Hungarian contribution (million HUF)**		**International funding (million USD)**	
	central budget	commercial banks	source	funding
GCARF	–	–	German Government	30
ESCP	80	800	-	–
PRF	-	-	PHARE IBRD,EIB	6.8
PPP	300	-	-	-
HEECP	-	-	GEF	4.25

GCARF: German Coal Aid Revolving Fund
ESCP: Energy Saving Credit Programme
PRF: PHARE Revolving Fund
PPP: Pilot Panel Programme
HEECP: Hungary Energy Efficiency Cofinancing Program

It can be also mentioned that an Hungary Energy Efficiency Cofinancing Program will be established soon. The fund of USD 5 million is granted by the GEF. The lending policy of the fund will directly facilitate the establishment and maintain the stable economic conditions of the ESCOs. The establishment of the fund is under way by the World Bank/IFC.

4.1.5. Regulatory measures: energy efficiency labelling and standards

Although various preparatory activities were made in the past, the most important step in upgrading the standards and introducing a labelling scheme is the issue of the Government Decree on ESAP.

Matching with the practice of the EU states the energy efficiency labelling of household appliances with high electric or gas energy consumption must be implemented. This requires that the relevant EU guidelines be included in appropriate legal regulation. Appliances which prove to be energy wasting or polluting - according to required efficiency minimum in the EU - must be banned in conformity with the GATT agreements.

In conformity with EU's regulation, new and upgraded standards on the building energy performance were developed and published as legal regulation. The application of the technical regulation is mandatory when new buildings are designed and constructed and must be applied to the largest technically possible extent when reconstructing old buildings. Further, a system of building energy certificate can be established. The certificate shall be an additional element to issue the operation licence in the long run.

There are newly upgraded efficiency regulations for building's thermal insulation and for some electric appliances. Most of the existing standards related to energy efficiency, however, obsolete and it would be necessary to review and upgrade all of them.

The Ministry of Industry, Trade and Tourism and the Hungarian Energy Office are involved into the preparatory activities to upgrade the standards. On the basis of the EU regulation, a feasibility study has been prepared for the introduction of labelling household refrigerators and freezers. The same work is under way for dryers and washing machines. In order to introduce the building's certificate system, a feasibility study has also been prepared.

The Ministry for Environment and Regional Policy established an environmentally friendly labelling scheme in 1994. The procedure in relation with the distinctive symbols is carried out by the Environmentally Friendly Product Plc. that was established for this purpose by a Government Resolution. Energy efficiency is one of the requirements the applicants shall comply with.

One of the barriers to introduce labelling, is the lack of funds to finance related research and qualification activities, and to maintain accredited labs. Although the manufacturers would be ready to pay for the labels, these payments would not be sufficient to finance the operation of the institutional background for qualification.

Regulation of the electric and gas utilities: a typical utility-level energy efficiency action plan included in their Business and Conduct Rules

- informing the consumers about efficient appliances;
- advisory service for the consumers;
- development of an incentive system to encourage savings;
- communication and reporting to the Governmental agencies;
- investigation of renewable and waste utilisation;
- improving energy efficiency of buildings;
- labelling.

4.1.6. Education, information and encouraging technology innovation

During the early 1990s the awareness activities launched by the central administration almost diminished. In this period the EU PHARE assistance became increasingly important. By the middle of 1990s many other actors recognised that rising of energy efficiency awareness is necessary. Promoting energy efficiency is concerned by the electric industry as well. Both the Hungarian Power Co. (MVM) and the distribution companies launched local PR campaigns, which included energy saving-related elements. MVM also opened an educational facility in Budapest, where information related to energy saving are provided to the general public. The gas utilities are beginning to show some interest in this activity, as well. An other promising initiative is the "Green Bridge" movement. Starting in Pécs, energy utilities established a local organisation to promote energy efficiency and environmental control. They publish and distribute flyers, organise school programmes, launch campaigns, provide advice for the consumers.

The professional energy related associations under the Hungarian Alliance of Technical and Science Association (MTESZ) also keep the energy efficiency on their agenda. The most important step made by these associations is to establish a network of Regional Energy Centres. These facilities provide an "information hub" of the producers, sales representatives and consumers interested in the energy efficiency sector. Promotional activities are also performed by the environmental NGOs. The NGOs mainly use their own papers and publications. The so-called ELÉG campaign has been the most significant NGO effort so far.

The ELÉG Campaign

Facts
- Duration: 1995-1996;
- financed by the Dutch and Hungarian Government;
- supported by International Institute of Energy Conservation;
- co-ordinated by the Energy Club.

Elements:
- media articles;
- school programmes;
- TV series on energy efficiency;
- publication of brochures;
- training of NGO activists.

In order to form energy and environmental awareness, education on energy saving must be the part of the school education. This element is incorporated in the National Curriculum of the Studies approved by the Parliament in 1995.

In the course of developing the governmental support system of research and development, the aim is to spread the well-know efficient technologies that are used abroad, as fast and as much as possible. In the course of the development of the national energy statistics and information system it must be ensured that the information necessary for the implementation of the ESAP becomes available. Preference will be given to energy saving and environmentally friendly technologies; those areas must be developed which are in compliance with the targets of ESAP.

4.2. Policy to enhance the sink capacities: National Forest Policy

4.2.1. Policy context

The registered forested area of Hungary is 1,713,000 hectare, which means that 18.4% of the country is forested. This data ranks Hungary among the countries of medium afforestation. The situation is much less favourable, however, if we consider, that only half of the present forests can be considered natural, and 25% of the tree stock is somewhat, or heavily damaged. Total area of forests under nature protection is 330,000 hectare, including highly protected forests of 70,000 hectare, and forest reservations of 12,000 hectare.

An afforestation programme has been initiated covering the period up to the year 2010. Its sub-period until the year 2000 has been prescribed by Government Decree. On the basis of the Act on the Protection of Forests approved by the Parliament in 1996, the Government is planning to prepare and approve a National Strategy on Forests by the end of 1997. Elaboration of such a strategy has been made urgent by the results of privatisation which emerged in 1991 by effecting forests, too.

4.2.2. National Strategy on Forestry: Afforestation Programme

As a result of the ongoing national afforestation programme, the forested area of the country has been increased by 600,000 hectare within the last decade. Various studies on future agriculture in Hungary suggest that about 500,000-1,000,000 hectare of currently cultivated land has to be converted to other land use, and the bulk of the non-profitable agricultural land should be afforested (see chapter 5.3.) Beside its apparent economical and environmental impacts, this extensive afforestation is expected to solve many problems of rural population and to help in managing

unemployment to some extent, which is one of the major actual concerns in Hungary. Unlike in most countries in Europe, an overwhelming majority of the forests is covered by broad-leaved species in Hungary. Conifers are considered mainly as introduced species, but a fairly high proportion of the broad-leaved forests also consists of introduced species, such as black locust and improved poplars. The most characteristic feature of the Hungarian forests is the big variety of mixed, sometimes multistored stands of broad-leaved species. Nearly all forests in Hungary could be considered as even-aged and artificially established stands. The total growing stock of the productive forests is 237 million m^3, and the majority of the current increment, 9,851 thousand m^3, is also being produced in these forests. The net specific current increment is quite high as compared to the European average. It amounts to 6.2 m^3/ha, whereas the European average is only 4.3 m^3/ha (as of 1990). This is attributable partly to the relatively favourable site and climatic conditions and partly to the relatively high proportion of tree-species of short rotation period. About 27% of the forests, i.e., 430 thousand ha, are covered with fast growing species providing 30% of the total current increment

4.2.3. National Strategy on Forestry: Forest Reservation Programme

Aiming at the protection of forests, promotion of the general spread of nature close forest management that secures biodiversity and ecological long-duration is planned. Maintenance and further expansion of the network of forests under nature protection, and introduction of model expert management to secure and foster the creation of a multiple genetic diversity, and to preserve the potentially endangered and ecologically valuable forest populations are needed. The foundations of a sustainable forest management are secured through planning and an independent institution system of forest supervision and nature conservation authorities, further supported by the forest maintenance contribution.

In the process of implementing nature close forest management, the schematic sylvicultural and wood utilisation technologies will have to be replaced by prolonged, gradual, naturally regenerating fellings, selective cutting methods, and mosaic-like regenerating cutting in the nature-like forests. Clear-fellings will have to be vigorously limited, and cutting maturity age limits will have to be raised. Further outstanding tasks in the field of natural conservation of forests are to give preference to indigenous wood species when regeneration or afforestation are being done, to stop the further decrease of the area of indigenous flood area species, to preserve the nature reserve network of forests, to maintain a stock of indigenous game and to promote the use of environmentally-friendly wood utilisation technologies. Beyond all that, our intention is to increase the forested area of the country to 25%. To facilitate the implementation of this programme, an ecologically well founded, long-term strategy of afforestation needs to be elaborated.

Ownership of Forests

More than 40% of all the forests of the country have been transferred to the private ownership, of about 350,000 owners, as a result of the privatisation and compensation processes. An expressed intention of the Hungarian Government is to keep at least 50% of all the forested areas in state ownership. Since state-owned forests are part of the property of the National Treasury, principles of sustainable property management have priority. The treasury's property management is carried out in accordance with the publicly articulated values and objectives. Private forest ownership guidelines are being developed. The authorised state administrative institution (Forestry Office of the Ministry of Agriculture) encourages the association of forest owners by making a system of subsidy available. Through this system the Office intends to influence management forms practised in private forests. State nature conservation could enforce the objectives defined above in a cost effective manner through the associations of forest owners using them as platforms, and by applying the additional system of subsidy.

Raising Awareness and Education

With special attention to the education of the future generations concerning environment protection, nature protection components of the present education system must be elaborated and continuously expanded giving an outstanding importance to forests owing to their nature conservation significance (about 45% of the flora of Hungary is to be found in forests). The ultimate aim is to create appreciation and respect for forests. Protection of the forests must be converted into a matter of

social importance. Content of specialised training provided by secondary and higher education special institutes must be reconsidered and revised.

Integration and co-operation

Our international obligations concerning forests (e.g.: Ministerial Conference for the Protection of European Forests, Helsinki) will be integrated in the elaboration of the national strategy for their protection. At the same time, the common forestry and nature protection strategy for forests will have to be incorporated into the national comprehensive development strategy.

4.3. Measures to control other greenhouse gases: the 1996 Transport Policy

In June 1996, the Hungarian Parliament passed a new framework transportation policy, which is designed to guide policy development up to the year 2000 while integrating policy objectives for after 2000. The preamble to the policy document describes the goals of the policy as aiming to create a balance between personal freedom of movement, access to the various means of transportation, and protection of the environment. The objectives of transportation are to contribute to the sustenance and development of society in such a way as not to endanger the potential and quality of life of future generations while serving the present one.

4.3.1. Characteristics of the Hungarian Transport Sector

Passenger traffic

The predominance of public passenger transport began to wane in the mid-1980s, as cutbacks in subsidy levels, higher tariffs and early economic restructuring along with rising numbers of private vehicles began to eat away at the dominant share of public transport in the modal split. Figure 4.1. shows the decline from 1988 to 1993.

Figure 4.1. Evolution of passenger transport in Hungary 1988–1993

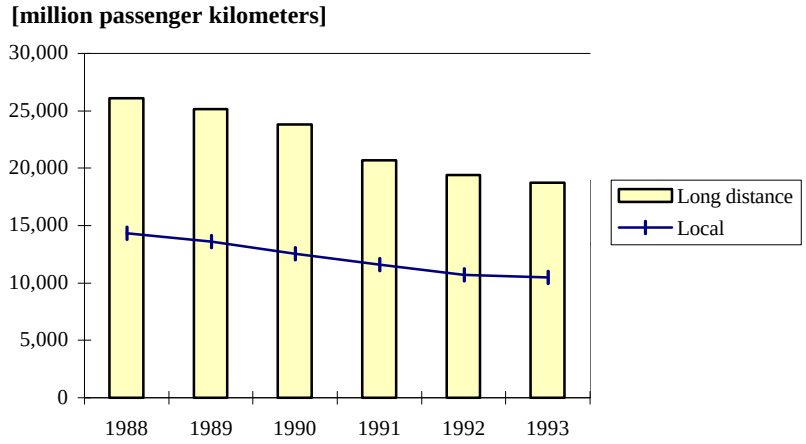


Table 4.2. Growth in vehicle fleet in Hungary 1970–1993 (in thousands)

	1970	1980	1990	1993
Cars	238.6	1,013.4	1,944.6	2,091.6
Buses	9.5	22.2	26.1	21.8
Truks and vans	84.5	123.8	224.0	237.5

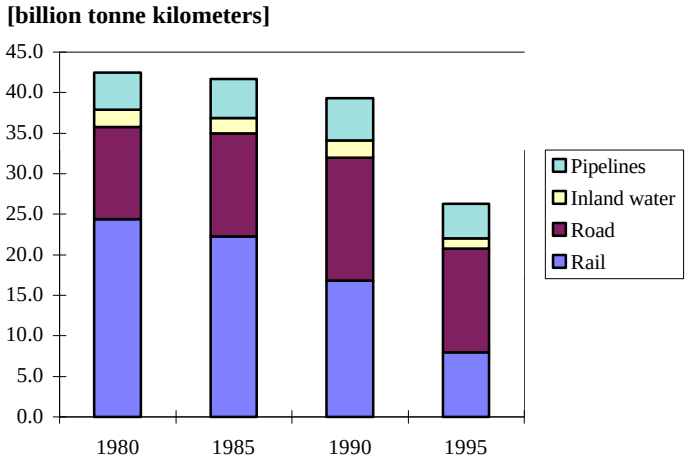
Table 4.2. shows the evolution in the vehicle fleet from 1970 to 1993. Whereas the number of vehicles has been steadily growing and will continue to do so according to forecasts, vehicle use has actually gone down, the combined effect of rising fuel prices and higher vehicle purchase and operation costs. Fuel price increases have been substantial: an average of 20 to 22 per cent more than inflation per year. These fuel price hikes seem to be sending clear signals to vehicle owners to moderate vehicle use.

Due to the high share of used, relatively old, fuel-inefficient cars, the profile of the vehicle fleet is problematic as concerns air pollution and fuel economy. The Government has taken steps to limit the inflow of old, polluting used cars by prohibiting the import of vehicles more than six years old and those with two-stroke engines. In 1996, the limit was tightened to four years old.

Freight traffic

Freight transport has suffered the effects of economic transformation in a number of ways. A reorientation in trade from the East to the West has led to a drop in volume of commercial trade. Further, the economy has shown signs of a shift in orientation from high-volume/low value goods to those with higher added values and less volume. This fundamental shifting in goods trade has been accompanied by a restructuring of the trucking industry, which has further weakened the share of railway and waterway transport for freight. Figure 4.2. below shows the decline in freight transport from 1980 to 1995.

Figure 4.2. Freight transport by mode 1980-1995



Road transport

The 1996 Transport Policy cites as one of its principal objectives the building “at the earliest possible date” of major motorways from Budapest to the country's borders. In addition, a system of connecting roads to the primary radial network is called for. As concerns Budapest, the completion of the ring road around the city is cited as a development plan. Further objectives include increasing national highway capacity; building bypasses in congested areas; and repairing and completing existing infrastructure.

Environmentally friendly MOL 2000 filling stations

MOL (Hungarian Oil Company) launched the program of "MOL 2000 filling stations" in 1992, focusing on environmental-friendly solutions, without any formal requirements of legislation. These stations meet the most rigorous environmental requirements in Europe.
No volatile gasoline vapour (i.e. NMVOCs) can be emitted during loading and unloading operations, because these vapours are collected by a closed system that feeds them back to the underground fuel tanks. These vapours are then loaded into the road tankers compartments and transported to the vapour recovery system where they again become valuable hydrocarbon products. When the cars are filled up, the nozzles equipped with vapour collection system prevent the volatile hydrocarbon vapour to be emitted into the open air.
Internal floating roof has been installed in over 70 fixed roof tanks, resulting in the recovery of 95 to 98% of the previous hydrocarbon emission which equals to many thousand tons of hydrocarbon vapour per year. This program is expected to be completed in 2006.
The performance of filling and unloading operations in a closed system and the development of related hydrocarbon recovery systems allow the prevention of hydrocarbon emission from rail, road, and barge loading bays and filling stations and the recovery of the retained vapour. Through this program MOL makes a considerable contribution to the fulfilment of the country's international commitments.

Rail transport

Objectives outlined in the 1996 Transport Policy for railway transport development from 1995–2000 include the following:

- restructuring and renewal of railway organisation, increase in safety, improvement in service quality and competitiveness, and capacity improvements;
- implementation of an investment programme for track maintenance;
- modernisation and upgrading of lines along EU transportation corridors to a 160km/h limit;
- reorganisation of MAV (Hungarian National Railways); restoration of the organisation's solvency.

This list, although not comprehensive as presented here, is ambitious given the time frame provided. Some improvements have been made; however, problems of low performance, scheduling, and lack of flexibility have reinforced a decline in demand for rail transport, especially as concerns intercity rail.

The economic and financial situation of the railway is an important aspect of the sustainability of the transport system. For rail to be able to compete with road transport, the railway system must be strong and financially viable. MAV is currently unable to service the debt it has acquired since 1989, despite a one-off grant from the Government to pay off HUF 55.25 billion in loan principal and interest payments. Subsidies to MAV is approximately 1.66 per cent of GNP.

Prospects for financial turnaround are slim. The decline in demand for rail brought about by the post-transition drop in GDP was financially disastrous for MAV. In addition, fuel price increases have hurt MAV's profitability, and the overall trend toward road traffic has exacerbated its poor economic health. For example, 150-200 km of main line track need to be replaced, and MAV has only been able to replace 45 km of main line track per year.

MAV has made strides toward improving cost recovery, laying off 40 per cent of its staff between 1989 and 1994 and increasing tariffs. However, further restructuring of the organisation and

significant improvements to track and rolling stock are needed before rail will be able to stabilise its market share.

Waterway transport

The Danube is Hungary's principal inland waterway and a major part of the transcontinental Danube-Main-Rhine system since 1992. Despite the international importance of this waterway, problems persist; for example: the stretch of the Danube just above Budapest is quite shallow, and does not meet the EU specifications for navigation. Despite the presence of other major navigable rivers, inland navigation is hindered for a number of other reasons: port density on the country's other major rivers is considerably less than that of western Europe, and cargo ports on these rivers do not meet the loading requirements of most western European countries. Adding to the unfavourable shipping conditions is the state of the Hungarian shipping fleet, which is aged and thus increasingly more costly to maintain and operate.

The 1996 Transport Policy calls for actions to support inland waterways including:

- modifications to the section of the Danube above Budapest to render it conform with EU standards;
- development of ports at cities of importance along the Danube; building of ports on inland waterways for combined transport and establish rail connections;
- modernisation of the shipping fleet for use on western European waterways.

Aviation

Air travel is on the rise in Hungary, and is projected to increased by 60 to 80 per cent by 2000. Budapest-Ferihegy is Hungary's only international airport. A large-scale modernisation and expansion programme, which includes a new terminal building, is now underway and is projected to double the capacity of the airport from its current 2 million passengers to 4-5 million passengers annually. Hungary also has several military airfields which could present opportunities for further air travel expansion.

Urban transport

The 1996 Transport Policy calls for the following measures among others:

- improvements to parking facilities at railway and bus stations, park and ride opportunities;
- more attractive fee structure to attract ridership;
- re-examination of state and local government authority over public transport;
- renovation of bridges across the Danube and increased river-crossing capacity.

In 1993, 166 urban centres in Hungary had public transport facilities; 25 per cent fewer than in 1990. Budapest has for many years had a relatively well-developed urban public transport system, with adequate accessibility and frequency of service. The quality of the rolling stock and facilities, however, has been less favourable. The system remains relatively aged – often technically obsolete – resulting in frequent operational failures, delays, fuel inefficiency and high levels of air emissions.

In 1991, the Municipality of Budapest developed a plan for development of the capital's transport system, primarily because it was necessary to halt the continual increase in subsidisation of the Budapest Transport Company (BKV). Discussions on credit opportunities were opened, and in 1995, investments from The World Bank and the EBRD were accorded for improvements in the tram, bus and metro systems. In addition, renovation of the vehicle Fleet has been undertaken, including purchases of new buses and reconstruction of bus engines. Tariffs have been significantly raised over the past five years as subsidy support has been reduced. Further increases in tariffs are envisaged over the next few years as BKV aims to attain a 50 per cent cost recovery requirement by 2000 which was imposed in the international loan conditions. Cost recovery was at 34 per cent in 1993 and around 40 per cent in 1994. BKV continues its restricting initiatives, which have included streamlining

of activities, capacity cutbacks and staff layoffs. Despite these efforts, its market share in Budapest transport seems threatened for some time to come.

Combined transport

There is considerable potential for further development of combined transport in Hungary. Combined transport accounts at present for only around 0.5 per cent of total traffic and 7 per cent of transit traffic through Hungary. According to the Transport Policy, rolling stock and infrastructure will need to be acquired for both road and water combined transport, the long-term goal being to increase the share of combined freight transport to 3-4 per cent of import/export traffic, and 15-20 per cent of transit.

Transit traffic

Hungary's geographic situation makes it inevitable that it is and will remain a 'transit" country. The main routes from South East Europe, the Middle and Far East all cross Hungary. From the nine "Crete" priority corridors no less than three pass through Hungary and in particular Budapest.

The environmental and capacity problems posed by transit are significant. With the changing trade flows the extra traffic demands have been high, though perhaps not as high as expected or as is often thought. Transit is expected to increase from about 12 billion tonnes-km in 1985 to 16 in 2000 under an "optimistic" growth scenario. Transit traffic increased substantially during the war in the former Yugoslavia and it is not clear whether this traffic will decline as normal relations resume in the Balkans.

The principle of "territoriality" - that payment is made where the journey is undertaken is now more widely accepted in theory, but in practice there are numerous exceptions. The need of countries with economies in transition to obtain payment (especially hard currency) as compensation for the wear and tear on their infrastructure and the environmental damage caused is understandable but if the charges are applied only to foreign hauliers tensions are created with trading partners.

The dilemma of "territoriality" for Central-East European countries is that it is very difficult to apply full cost pricing both to domestic and foreign vehicles. Consequently, it is impossible to cover costs by applying acceptable levels of domestic charges also to foreign vehicles.

The best solution consistent with the principles of territoriality and non-discrimination is to introduce direct road user charges or tolls. However, practical or political considerations do not always permit this.

The transit issue is a difficult one for many countries but will remain so in Hungary for the foreseeable future.

4.3.2. Principal Challenges to Sustainability

Hungary is not alone in the challenges it faces from transport-related environmental problems, particularly as concerns air pollution. Like the other countries in region, exhaust from the growing numbers of old, fuel-inefficient and polluting vehicles in the fleet are worsening the already poor air quality, especially in urban centres. In Hungary, traffic accounts for 45-50 % of carbon monoxide; 40 % of nitrogen oxides, one third of hydrocarbons and 90 % of lead emissions. Transport is also responsible for approximately 14 % of CO_2 emissions. Within the transport sector, 85 per cent of pollution is from road traffic; 12-13 per cent from railway; and the rest from water transport.

The air quality is of particular concern in Budapest, where traffic is the primary source of air pollution. Despite Budapest's lower degree of motorisation, the emissions output of vehicles in Budapest is comparable to that of cities of similar size in western Europe, where motorisation is more developed. The poor air quality in Budapest is largely a result of the structure of the private car fleet and its average age of over ten years. In addition, deficiencies in infrastructure, e.g. lack of bypass roads and traffic control equipment exacerbate congestion and air quality degradation.

One of the principal contributors to vehicle-related air emissions has been the two-stroke engines, which have comprised a large portion of the vehicle fleet in Hungary. These engines are

particularly responsible for significant levels of hydrocarbons and particulates. The Government has been pursuing policies designed to reduce the share of these vehicles in the fleet. Action is also being taken to phase out leaded petrol. Until 1992, most motor vehicles in Hungary used petrol with a lead content of 4 grams per litre (gpl), at which time, lead content was reduced to 15 gpl. Unleaded petrol is also being sold for vehicles equipped with catalytic converters.

Targeted measures related to the protection of human life and the environment

- improving co-operation between transport modes;
- slowing the rate of attrition in railway and waterway transportation;
- increasing the role of combined transport in import/export and transit traffic;
- application of more stringent, international standards for new road vehicles;
- building of bypass road to avoid residential areas;
- priority treatment for mass/public transport and railways;
- preserving protected zones and national heritage sites in transport development;
- discontinuation of leaded petrol use;
- reduction of use of chemicals for de-icing of roads;
- favouring vehicles with most non-polluting technologies.

Transportation-related noise, according to Government estimates, affects around one-third of all Hungarian households, although a decline in noise pollution has been noted since 1990. Further reduction is to be brought about by adopting 1995 EU regulations on noise pollution and by encouraging the introduction and operation of quieter vehicles.

Progress has been made in implementing some of these measures:

- import of vehicles more than four years old is now prohibited along with those with two-stroke engines;
- since 1992, according to the government, the number of vehicles passing mandatory yearly inspection tests has increased;
- to stimulate vehicle fleet renewal, a vehicle scrapping programme offering public transport tickets as an incentive to retire old two-stroke vehicles from the fleet resulted in the scrapping of 10 thousand vehicles in 1993; 100 thousand vehicles were retrofitted with subsidised catalysts;
- since 1995, emissions standards for new and used gasoline vehicles are equivalent to EU emissions standards introduced in 1993;
- also since 1995, UN-ECE emissions standards for new diesel vehicles are being applied.

It should also be noted that significant fuel price increases appear to have played a significant role in reducing vehicle use over the last five years. In addition, Hungary imposes a 4 per cent tariff on petrol to finance environmental mitigation measures, and has a tax on batteries and tires to finance their disposal costs. Revenues from these sources are estimated at HUF 7.4 billion for 1996, that contribute to the Central Environmental Fund. Though all environmental costs from road transport are not covered by these taxes, their application demonstrates real efforts on the part of Hungary to address road transport externalities.

5. PROJECTIONS OF FUTURE GREENHOUSE GAS EMISSIONS AND REMOVALS

The purpose of projections in reporting to the Convention is ambiguous, which may presume a solid analytical background on the energy/emission research and modelling. While producing our first National Communications we were lack of these analytical resources, therefore the projections of GHGs based mainly on simple trend analyses and expert judgements. In the recent years, (in the framework of the US Country Study Programme, see in Chapter 6.3.) substantial improvement has been made in development and applying a simplified methodology of emission projections. Nevertheless, it should be noted that the Government did not adopt any decision made by the projections presented either by the first or second National Communication, but it did take account of their result in shaping its energy and environment policies and position related to the AGBM process.

In this chapter the methodology used for fuel related and other greenhouse gas emissions and removals, as well as the approach to scenario development are summarised. The emission outlook of fuel related CO_2 emissions, including the baseline projections, estimating the effects of individual measures and the aggregated policy scenarios are presented. The emission outlook of the carbon sequestration are also shown. Finally, the cost of mitigation of climate change is also briefly discussed.

5.1. Methodologies used

In our bottom-up approach we used various methods in providing the projections:

- simulation models were used to calculate the future fuel-related CO_2 emissions and removals;
- expert judgements were mainly used for estimating the effects of non-combustion activities on the future greenhouse gases emissions;
- trend analyses seem to be appropriate to assess the effects of selected policies and measures which would influence the future energy balances.

5.1.1. Estimating fuel-related CO_2 emissions

The choice of method for GHG emission projection depends partly on the purpose of the projection. In our case the goal of the scenario analysis is twofold; first to provide an input for the formulation of the national negotiating position on the possible emission reduction and second to provide a reference or target trajectory of GHG emissions evaluating the actions to reduce the energy use and energy demand.

Although a variety of conceptual and computational models have been used in the energy planning in Hungary since the 1970s, the common barrier of the projections made by EMPEP or MARKAL-based model is, that, they represent adequately the supply side, but rarely simulate in a similar manner the demand side. Most such models require energy demand and other market parameters (i.e. price elasticities, technology development etc.) to be exogenously specified either by a separate economic model or using expert judgements. The more sophisticated the model, the larger the number of parameters required. This can result in greater uncertainty in the projections and less transparency in the methods used, even in the case of the non steady-sate market circumstances of the countries with economy in transition.

Model used for projections

In our bottom-up approach, taking into account the same level of complexity, a simplified mixed econometric and energy sector model has been developed. The simplified structure of the

Fuel-Related Emission Estimation (FREE) spreadsheet model allows considerable flexibility in matching the level of disaggregation to the availability of data. The FREE, based on a bottom-up approach, combines econometric, engineering and technical information in modules for fossil fuel supply in the power generation and certain categories of energy end-use. The estimation of population and economic growth and the change of the overall energy intensity of the whole economy are the main exogenous parameters of the FREE model. The off-model projections of certain power generation related parameters (i.e. energy intensity in power generation, fuel and technology mix including the penetration of the renewables and the share of combined heat and power generation) should also be considered. The FREE model establishes a link between economic growth, technology development and energy saving, corresponding to macroeconomic projections, in a same level of complexity.

Key assumption, uncertainties

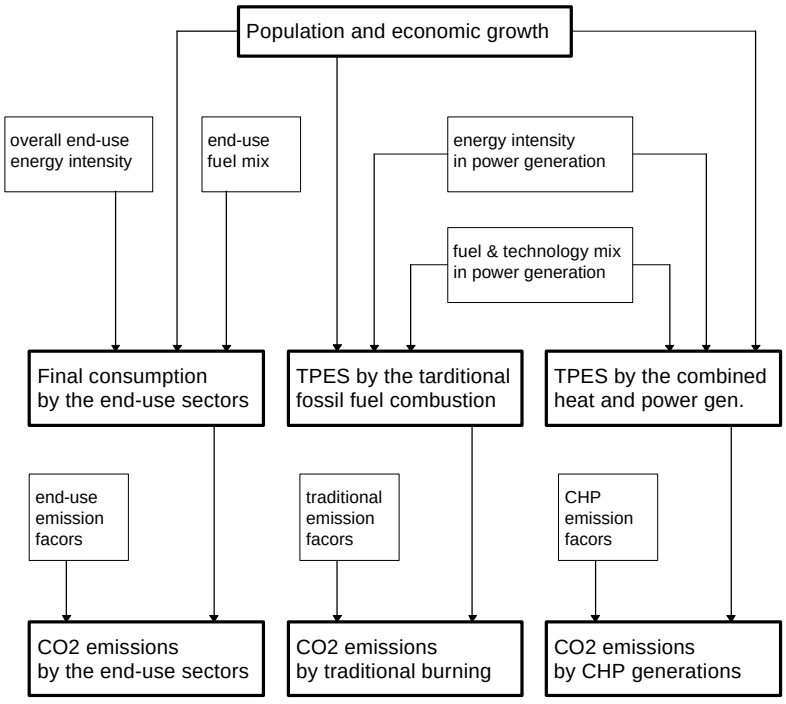
- the energy intensities of the traditional combustion and the CHP technology are supposed to be the same;
- the fuel mix of the CHP plants and the plants with traditional steam turbine is the same;
- the ratio between the CHP emission factors and the emission factors of traditional combustion does not depend on the fossil energy sources;

Sources of uncertainties:

- uncertainty in the evolution of economic and other drivers,
- systematic uncertainty in the results of the simplified approach, and
- technical uncertainty in the emission factors and other parameters.

According to the verification of the FREE model, the observed (actual) emissions almost follow the projected values for the period of 1985-1995. The differences of about 5% can partially be explained by the inability of the FREE model to capture the complex social, technological and economic dynamics, but also by the fluctuations in climate, economic growth, exchange rates etc.

Figure 5.1. Structure of the FREE model



Approach to scenario development

In estimating the future fuel-related CO_2 emissions four scenarios have been developed. The scenarios represent a contrasting but self-consistent views of our possible socio-economic development. The scenario setting is also determined by THE "MEDIUM TERM PLAN OF ECONOMIC DEVELOPMENT" prepared by the Ministry of Finance, the long term energy scenarios presented in the POWER PLANT RECONSTRUCTION PROGRAMME of the Ministry of Industry, Trade and Tourism, as well as by the NATIONAL ENVIRONMENTAL PROGRAMME approved recently by the Parliament. These official policy papers allow to present greenhouse gas emissions scenarios for the period 1995-2002. According to the uncertainties in the economic growth and consumption patterns, as well as the alternatives in the accession to the European Union, the reliability of the longer terms scenarios is substantially limited. Four scenarios are characterised as follows:

- B-BAU is a hypothetical "without measures" scenario which assumes that the future energy efficiency indicators are frozen at their current value. Moreover, it is supposed that no climate change mitigation measures have been taken. This scenario can be regarded as a hypothetical baseline;
- scenario B-REF considers that a substantial economic restructuring is and will be under way in Hungary. Although, this scenario supposes certain improvement in the energy intensity caused by the decline of the energy intensive industries, no specific climate change mitigation measures are supposed. This scenario can be regarded as a reference baseline ("without measure") scenario;
- scenario S-MOD is compiled to demonstrate the moderate penetration of the climate change-mitigation related measures. This scenario can be seen as a policy scenario with moderate progress in the energy efficiency improvement;
- the scenario S-SEF supposes a significant progress in utilisation of the theoretical energy saving potential that leads to approach a sustainable energy future. This scenario can also be regarded as a policy scenario. The main characteristics of the four scenarios are summarised in Table 5.1.

Table 5.1. Main characteristics of the scenarios for the projections of fuel-related CO_2 emissions

	GDP growth (%/year)	Growth in total energy intensity (%/year)	Growth in electric energy intensity (%/year)	Energy saving by specific measures (PJ/year)
B-BAU	1.0	-	-	-
B-REF	1.0	-0.5	-	60
S-MOD	2.0	-1.0	-0.5	110
S-SEF	3.0	-1.5	-1.0	250

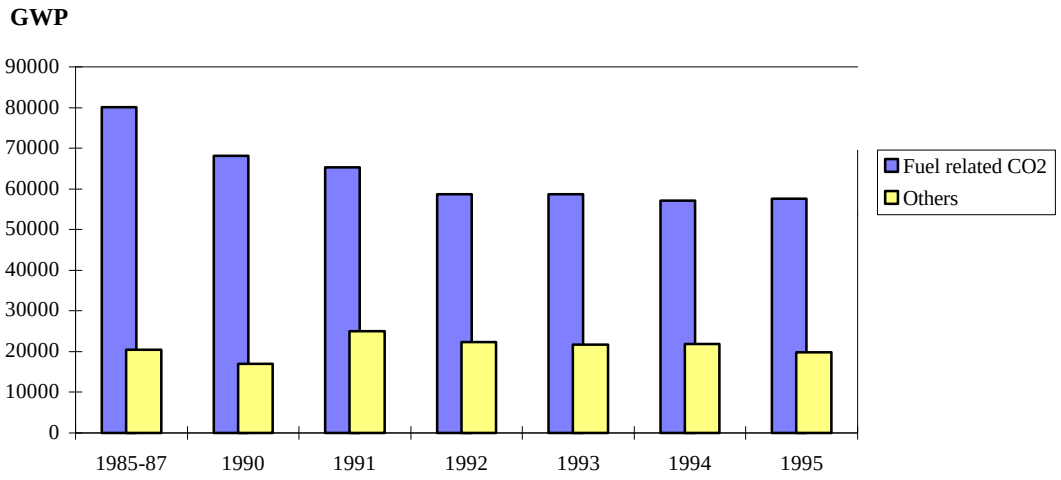
5.1.2. Estimating other GHG emissions and removals

In the case of estimating the non-fuel-related emission's projections, different methods and scenario development has been used for several reason:

- lack of appropriate data and available methodology in the agriculture-related projections,
- about two-third of the GWP is considered by the fuel-related CO_2 emissions, therefore the projections of other emissions may have less importance (see Figure 5.2.).

Since the preparation of our first National Communication, no updated and advanced estimation for the CH_4, N_2O, CO etc. projections is available, therefore the relevant information presented in the first National Communication are not cited or replicated here.

Figure 5.2. The global warming potential of the greenhouse gases in Hungary



In the case of projection of carbon sequestration by the Hungarian forests, the carbon storage from projected changes in forest cover using technical assumption of carbon sequestration has been estimated. The projection of the forest cover has been provided by the National Agriculture Programme approved by the Government in 1997. The carbon fluxes from other sources/sinks such as soils and land use change have been neglected.

Nevertheless, it should be noted that the trend-based projections are unlikely to be accurate when agricultural technologies, manure management or market conditions changing rapidly. In such cases, expert judgement is usually essential to identify possible departure from the trend. This may apply in our case of sectoral and general economic reforms under way.

5.2. Emission outlook of fuel-related CO_2 emissions

5.2.1. Baseline projections

As it is mentioned above, two baseline scenarios have been investigated: a business as usual scenario (B-BAU) and a reference scenario (B-REF), as well.

The B-BAU scenario can be defined as an unrealistic “all-frozen” option for development, serving only for a basis for comparison. (It is the fact that the mid 1990s was the period of the stagnation in the Hungarian economy. Most of the indicators of the energy, environment and economic performance have shown an insignificant fluctuations around the same level. In this sense, the B-BAU is the extrapolation of the very recent tendencies, as well.)

The B-REF scenario reflects the structural changes in the Hungarian economy and increase of energy prices which can lead to improvement of the energy intensity without specific energy saving measures.

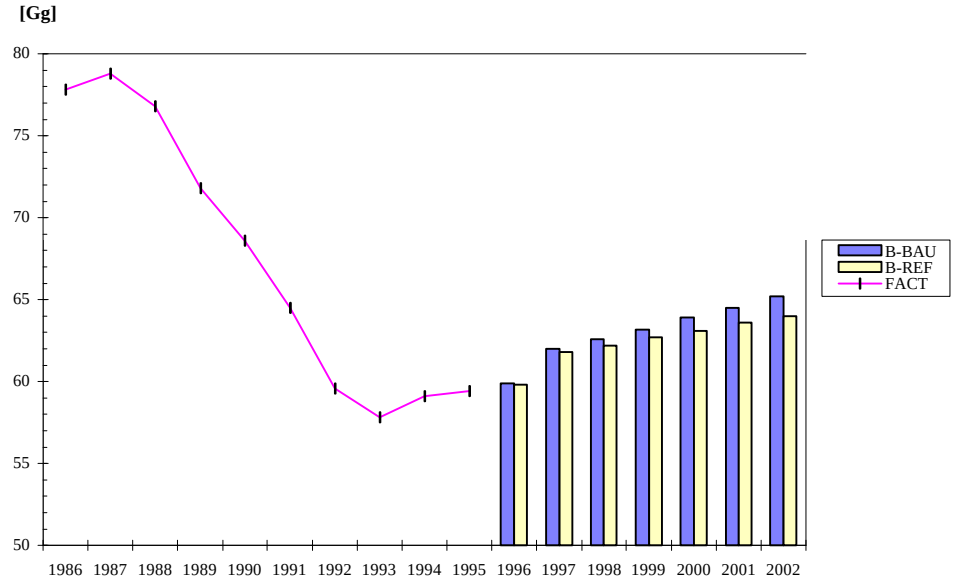
Medium-term economic outlook

Potentially growing sectors and branches
- pharmaceutics chemistry
- painting and printing industry
- food processing industry
- oil refining

Potentially declining sectors and branches
- metallurgy
- machinery industry
- mining
- fertiliser production

The actual emissions of the recent decade as well as the projected fuel-related CO_2 emissions of B-BAU and B-REF baseline scenarios are presented in Figure 5.3.

Figure 5.3. The actual fuel-related CO_2 emissions between 1986 and 1995 as well as the B-BAU and B-REF baseline scenarios



It can be seen that the improvement of the overall energy intensity by 0.5% would result in a reduce of the CO_2 emission of 1.5 Gg by the year of 2002.

5.2.2. Estimating the effects of individual measures

On the basis of the sectoral targets of the possible energy savings in the implementation of the medium term minimum programme of the National Energy Saving Program (see in Chapter 4.1.), a theoretical CO_2 reduction potential has been calculated for the individual measures.

Table 5.2. Overview of selected measures, savings and reductions in the energy sector

Sectors	mitigation options	Policy measures	energy saving (PJ)	CO_2 em. reduction (Gg)
SUPPLY SIDE	Efficiency improvement in the energy industry	• energy efficiency investment	7	0.7
	Cogeneration	• Regulatory and voluntary measures, • energy efficiency investment	26	2.6
	Use of renewable energy resources	• Regulatory and voluntary measures, • fiscal incentives for investment	21	1.6
	Updating energy technologies in industry and agriculture	• Regulatory and voluntary measures, • energy efficiency investment, • raising awareness	17	1.9
DEMAND SIDE	Efficiency improvement of consumer's equipment	• energy efficiency investment, • raising awareness	12	2.4
	Improvement of energy performance in buildings	• Regulatory and voluntary measures, • raising energy awareness	15	1.2
TRANS-PORT	Modal shift	• Regulatory and voluntary measures, raising energy awareness	12	0.9
	TOTAL		110	11.2

It should be noted, however, that this analysis can be regarded as an illustrative example and the outcomes are not applicable in the scenario development, for several reason. First, the effects of energy price increases and regulations are hard to simulate. Due to the lack of historical market data the estimation of the price elasticity is practically impossible. It is also very difficult to take into account the effects of market reform, liberalisation and privatisation under way in Hungary. Second, the standards and labelling can affect the technology, costs, performance and other characteristics which have unpredictable impacts on consumer behaviour and pattern of technology use. The effects of education, information and strategies for technological innovation are even more difficult quantify. Finally, In the case of restructuring of the national electricity industry, some of the possible outcomes (e.g. strategic rather than "optimal" investment made by the new owners) is very hard to foresee.

5.2.3. Aggregated policy scenarios

As it is presented in Chapter 5.1., two aggregated policy scenarios have been supposed: a moderate shift towards energy efficiency (S-MOD) and a sustainable energy future scenario (S-SEF), as well.

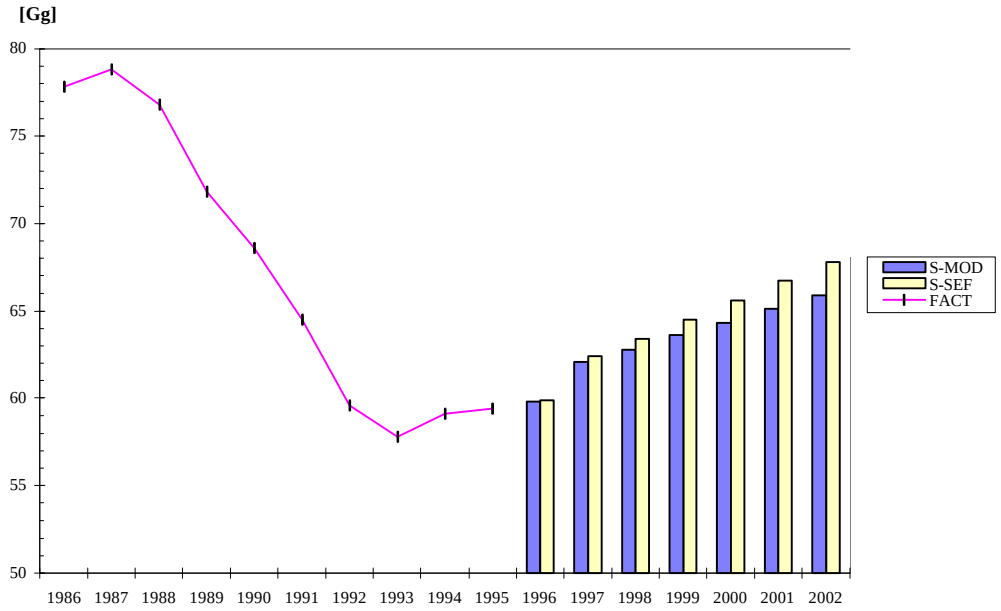
The S-MOD scenario can be regarded as the most probable outlook of the medium term socio-economic development in Hungary. Corresponding to the most recent economic and energy outlook, a moderate economic growth of 2%/year and an overall energy saving of 110 PJ/year is supposed. As a result in implementing the measures prescribed in the ESAP, the increase in energy demand is substantially less than the GDP growth. In the period of 1996-2002 the GDP would rise by almost 15%, while the total final energy consumption would increase by 8% only.

The S-SEF scenario supposes a positive feedback between the economic growth, the social welfare and the expenditure for energy efficiency improvement. In the S-SEF scenario the economic growth of the 3% and the annual energy saving of 250 PJ is considered which could lead to stabilise the total energy demand around the level of S-MOD scenario.

The actual emissions of the recent decade as well as the projected fuel-related CO2 emissions of S-MOD and S-SEF aggregated policy scenarios are presented in Figure 5.4. The main conclusions are as follows:

- the GDP growth is the major driving factor of the future emissions. Emission reductions gained by the efficiency improvement are not able to compensate the emission increase caused by growing energy demand;
- it is shown that, owing primarily to the economic decline in the recent decade, both the four scenarios the fuel-related CO_2 emission would be lower than the base year level. It seems to be important that without the successful implementation of the energy saving policies and measure the growing rate of annual CO_2 emission can reach of 1.5 Gg/year in the second half of present decade, that lead to exceed the base year level around 2005.

Figure 5.4. The actual fuel-related CO_2 emissions between 1986 and 1995 as well as the S-MOD and S-SEF scenarios

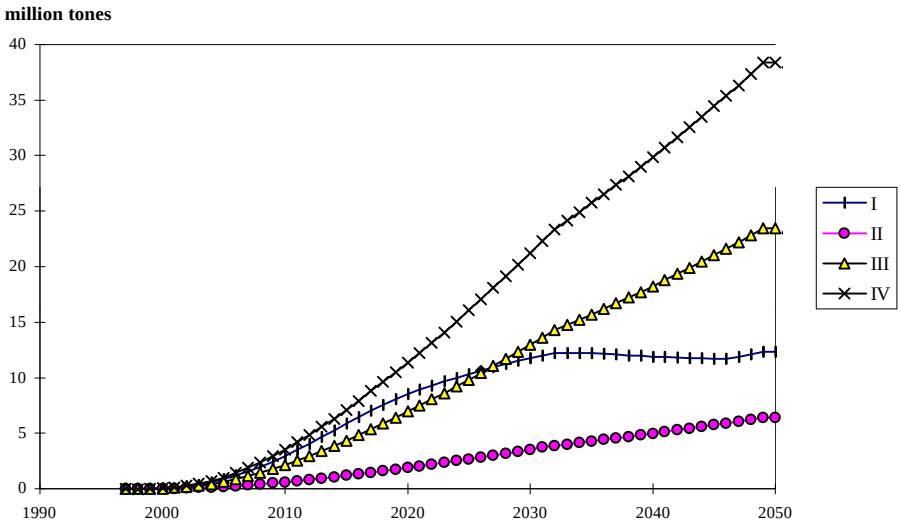


5.3. Projection of carbon sequestration

To increase the area for traditional wood production has by far the greatest potential. It is estimated that, in the next 30 years, the cultivation of some 700,000-1,000,000 ha agricultural fields will become unprofitable, and that most of this area is suitable for afforestation. The increase of the carbon pool would involve the establishment bioenergy plantations, the increase the carbon density of stands, as well as preserving carbon in wood products.

The current afforestation program was launched in 1991 with the aim to afforest 150,000 hectare by 2000. On the basis of the experiences gained by the implementation of the afforestation programme, a baseline scenario of BAU , and four afforestation policy scenarios has been set up. In the minimum scenario (I), some 3000 hectare is afforested annually by 2050. In the medium scenario (II) 15,000 hectare is afforested until 2010. In the achievable scenario (III), 11,000 hectare are afforested annually, and in the technical potential scenario (IV), 18,000 hectare by 2050. This last scenario is equal to afforest some 1,000,000 hectare.

Figure 5.5. Carbon sequestration by the afforestation scenarios.



The scenarios were analysed by running the CASMOR model of the carbon cycle of forestry.. The main conclusions are as follows:

- in all afforestation scenarios, the use of fast growing species (black locust, poplar) is assumed;
- most carbon is stored in the aboveground biomass, but large amounts are stored away in the belowground and dead biomass pools, too;
- the amount of soil carbon, accumulated in thousands of years, is very large, therefore, this pool is to be preserved by all possible means;
- if oak is planted instead of black locust, the carbon sequestered in the achievable scenario decreases by some 20%;
- the greatest costs of the program are the investment costs that incur at the launch of the program. The cost of carbons sequestration is about the same, some 7 $/tC, in each scenario.

5.4. Cost of mitigation

On the basis of the experiences gained from the successful operation of the German Coal Aid Revolving Fund (see in Chapter 4.1.1.) a detailed analysis has made to study the potential mitigation costs in Hungary. The analysis is the part of the research conducted in the framework of UNEP/GEF project entitled "THE ECONOMICS OF GREENHOUSE GAS LIMITATION" (see in Chapter 6.2.).

Table 5.3. Overview of the conservation potential and related costs

Measure	**Savings**			**Investment costs**	
	primary fuel	**CO_2**	**energy cost**	**Total investment**	**Justified by energy cost savings**
	PJ	Gg	billion HUF	billion HUF	billion HUF
Modernisation of the space heating (residential sector)	97	7.5	87	1350	540
Modernisation of the space heating (the public sector)	24	1.9	23	346	149
Efficiency improvement of home electric appliances	37	2.7	51	467	226
Electric efficiency improvement of the public sector	23	1.8	16	150	116

The main assumptions are as follows:

- primary fuel savings are calculated taking into account the losses of generation/transmission;
- CO_2 savings are calculated on the basis of the present fuel mix of the studied sectors. CO_2 savings related to electricity savings are calculated on the basis of the present fuel mix of the Hungarian power sector;
- micro level energy cost savings are calculated on the basis of the present retail prices, exclusive of VAT;
- the total investment costs represent the costs the end-users are supposed to pay. No VAT is considered. No subsidies, grants, etc. are taken into account;
- the last but one column of the following tables shows the part of investment costs justified by energy cost savings. An investment was meant to be justifiable if the net return (exclusive of inflation effects) is 9%.

The preliminary results show that state intervention into energy saving can be highly cost-efficient. Projects implemented by the help of the German Coal Aid Revolving Fund have proven that investment in energy efficiency improvement can be more cost-effective than the development of the supply-side infrastructure.

6. INTERNATIONAL CO-OPERATION AND RISING PUBLIC AWARENESS

In the first part of present chapter the ongoing AIJ projects on the on-site energy advice and technology switch from the conventional to CNG bus engine are discussed. In the next part the chapter the UNEP/GEF Project on the Economics of GHG Emissions, the Hungarian Country Study of the U.S. Country Study Programme and the Dutch-Hungarian SCORE Programme are briefly summarised.

6.1. Activities Implemented Jointly

In March 1995, the Hungarian and Dutch governments of Hungary and the Netherlands expressed their wish to jointly realise a series of AIJ projects. The aim of these projects would be to gain experiences on practical aspects of AIJ and to promote AIJ as a feasible concept. Two joint projects were therefore designated simulation projects and became subject of a monitoring study. The projects involve the conservation of energy in local municipalities and the transfer of technology know-how that will enable the production of buses that run on compressed natural gas (CNG) instead of diesel oil. It is agreed that the implementation of the two AIJ simulation studies will not change the present Netherlands' and Hungarian commitments under the Convention.

6.1.1. Energy efficiency improvement for municipalities and utilities

This project is a small scale energy efficiency project which is managed by NOVEM[6], together with EGI[7] consulting and engineering in Budapest. In this simulation study a number of energy efficiency projects that are initiated by local governments are analysed. In most cases, these projects are identified based on expert advice provided earlier through the Dutch bilateral PSO programme and through twinning arrangements with Western European cities within the EU – PHARE/ECOS/UVERTURE "urban twinning" programme. A total of 62 projects are monitored in 12 different cities. Additionally, a combination of a small-scale cogeneration (CHP) project and a Demand-Side Management (DSM) project at the Technical University of Budapest is incorporated. These projects were developed by the Dutch utility Westland and the Budapest gas utility Fögáz and are implemented by a joint venture of both companies.

This AIJ-simulation study is based on already existing projects. Additional support for investments in energy efficiency is not provided in this study. The implementation of the measures is financed by the local governments themselves. This is done either from own resources or by attracting external funds. These external funds can be commercial loans, but also soft-loan arrangements (e.g. the German Coal Aid Revolving Found) or third party financing (TPF) have been used by the local governments to generate the financial resources required. These varying financing mechanisms generate additional experience and input for the AIJ-simulation.

The cities that participate in this project provide the data on energy consumption and other relevant topics. In return they receive some additional monitoring equipment, necessary for the AIJ-simulation study. Presently, the baseline for all projections has been established. The projects primarily aim at improving energy efficiency at the end user level. Therefore, the reduction of CO_2 emissions is the relevant parameter to be monitored as far as greenhouse gases are concerned.

Local governments in Hungary have only recently become responsible for energy management and energy efficiency improvement in their city. They often do not have energy management policies related to future investments in energy efficiency improvement. Therefore, it is

6 National Energy and Environmental Agency of the Netherlands

7 Institute for Energy Management, Hungary

difficult to establish the parameters that would describe the energy situation without the projects that are considered in this simulation study. Consequently, it was decided to use 1994 as the baseline year for all of the projects. All energy consumption and CO_2 emission data available has been converted to this year, corrected for weather conditions, etc. The effect of the projections on energy consumption and CO_2 emission is compared to this baseline.

The measures to be implemented have already been identified by the municipalities. This means that "ex-ante" estimations of the necessary investment and the potential CO_2 emission reduction with respect to the baseline could also be established.

Some of the measures that have been selected are already implemented. Others will be implemented soon. This means that the 1996-1997 heating season, the main body of energy consumption and hence CO_2 emission data will be generated. This information will provide the basis for the "ex-post" assessment of the cost-effectiveness of the projects. The result of this assessment will be used to simulate crediting of CO_2 emissions. This simulation will support the development of criteria for future crediting of GHG abatement.

6.1.2. RABA/IKARUS compressed natural gas fuel engine project

This project will transfer technology, which will enable Hungarian industries to produce buses with compressed natural gas engines. The technology will be provided by Deltec, a producer of gas fuelled engines and the TNO research organisation, both of the Netherlands. Participating firms are Hungarian RABA, a producer and installer of bus engines, and IKARUS, the Hungarian bus manufacturer.

It is estimated that some three to four thousand buses provide transportation in the major Hungarian cities. Most of these buses presently run on diesel oil and cause emissions of CO_2 and other pollutants to an extent that varies with the type of engine and the size of the bus.

In this project, the baseline is computed on the basis of engine specific emissions figures. By means of a TNO conversion program, these figures can be transformed into on-the-road emission figures for any specific bus. For an example of what a baseline may look like, consider Table 6.1. The CO_2 emissions of a particular diesel type engine currently in use on several buses is compared to those of the RABA CNG engine.

Table 6.1. CO_2 emission figures from the RABA/IKARUS project

RABA D2156 Old Diesel Engine

	CO_2 emissions [kg/km]	Buses in operation in Budapest	Travelled distance per year per bus [km]	Total annual CO_2 emissions [kton/year]
Single buses*	1.092	570	65 000	40.4
Articulated buses**	1.352	220	65 000	19.3
TOTAL		790		59.7

RABA CNG Estimated numbers for Gas Engine

	CO_2 emissions [kg/km]	Number of buses simulated	Simulated distance per year per bus [km]	Simulated annual CO_2 emissions [kton/year]
Single buses*	0.941	570	65 000	34.9
Articulated buses**	1.29	220	65 000	18.4
TOTAL		790		53.3

* Buses with 90 passengers
** Buses with 120 passengers

From the table it can be inferred that the installation of CNG engines on all Budapest buses that currently have a D2156 Old Diesel type engine would prevent the emission of 6.4 kton CO_2 per year. Using this method, the AIJ partners estimate, by way of and example, that all full-size buses (90 passengers or more) together in Budapest cause a CO_2 emission of 120 kton per year. Note, however, that the project itself only aims to install CNG engines in a limited number of buses (about 5). The emission reduction figures are only meant as examples and do not reflect the emission

reductions that can be achieved by the project. On the basis of the same methodology the total annual emission of different sorts of pollutants can also be computed.

6.2. GEF/UNEP project on the economics of greenhouse gas limitation

The primary aim of the project is to analyse to costs and benefits of several actions to mitigate the greenhouse gas emissions in twelve countries, including Hungary. The worldwide project is funded by the GEF and RISO National Laboratory (Denmark), as the regional UNEP Centre, is charged with co-ordinating the project.

The Hungarian sub-project is divided into the following parts:

- overview of present social-economic situation with special regard to the energy consumption of the public and residential sectors and the role of forest management.;
- compilation of a medium and a long-term social-economic outlooks, until 2010 and until 2030;
- setting up a baseline scenario that shows how much energy consumption and GHG emission is expected (or sinking plotted against forest stock) if no measures supporting reduction come into force in the above mentioned two intervals;
- a proposal is being made for measures that may enhance GHG reduction in the given periods especially through reducing energy consumption and increasing this kind of efficiency of forest management (i.e. energy forest plantation);
- choosing the measures actually feasible, compiling (medium- and long-term) „reduction-scenarios" completed with a cost curve based on cost-efficiency analyses;
- presenting economic, financing instruments necessary for realising „reduction scenarios" and working out plans for ensuring social acceptance of measure.

The elaboration of the Hungarian sub-project started in 1996 and is expected to be finalised by 1998. The project is implemented by the Technical University of Budapest in collaboration with several collabroative institutions and supervised by the Ministry for Environment and Regional Policy.

6.3. U.S. Country Study Programme

The U.S. Country Studies Programme is a worldwide project supported by the Government of the USA. It supported the development of greenhouse gas inventories, vulnerability and mitigation analyses and elaboration of national action plans in more than 50 countries of the world.

Hungary has began to take part in the Programme in 1994. The first phase of the project aimed at the development of the first national greenhouse gas inventories of emissions and removals for Hungary calculated by the IPCC methodology. A special training course was organised for our experts to get aquatinted with the IPCC approach. In the framework of the Programme a regional workshop was organised in Budapest in May 1995 on the experiences and methodological developments of the inventories.

In the second phase of the Programme, we developed mid and long-term mitigation scenarios for Hungary. Several computer models became available for our experts to analyse the effects of different sectoral and cross sectoral measures. Our analyses focused primarily on the energy and on the forestry sector.

The purpose of the present phase of the project is the elaboration of a national action plan. The Hungarian National Action Plan will have been completed by March 1998. In September 1997 a second regional workshop was organised in Hungary on the use of clean energy technologies and energy efficiency project financing.

The Programme is co-ordinated by the SystemExpert Consulting Ltd. involving the relevant academic and university research organisations. The Hungarian U.S. Country Studies Programme is supervised by the Hungarian Commission on Sustainable Development.

The Hungarian participation in the Programme proved to be very successful. A lot of publications - books, studies, articles - have already been completed in the topics of greenhouse gas emissions and mitigation policies. The Programme is effectively supporting the preparation of the National Communications. The Hungarian experts and policy makers have access to up to date information and to special literature and to studies via the international network established by the Programme.

6.4. The SCORE Programme

The SCORE (Supporting the Co-operative Organisation of Rational Energy-use) Programme is a joint effort of the Dutch and Hungarian Governments, supported by many actors of the energy field on both sides. The Dutch support means financial help, and, what can be even more important, first hand access to European experience in energy management. The objective of the SCORE Programme is to assist Hungary in its efforts of improving energy efficiency by:

- supporting national level initiatives such as evaluating macro-economic benefits of energy efficiency and developing energy awareness,
- demonstrating potential for energy efficiency action in a selected region of the country, and concentrate efforts to demonstrate what can be done.

The SCORE Programme is co-ordinated by the Energy Efficiency Centre and supervised by a Management Board, with members from Ministry of Industry, Trade and Tourism, Ministry for Environment and Regional Policy, Ministry of Finance and a representative of the non-governmental organisations. On behalf of the Dutch Government the National Energy and Environmental Agency of the Netherlands (NOVEM) will provide SCORE budget and energy efficiency expertise.

In the framework of the Hungarian SCORE Programme three major projects have been identified:

- The study on "MACRO-ECONOMIC ASSESSMENT OF ENERGY EFFICIENCY" will review and evaluate strategic concerns of energy efficiency. The implementing working team with members from all the relevant ministries, and several academic centres, will develop models that help understand the effects of energy efficiency on the state budget, and on economic and environmental processes. The study will list and prioritise tools and instruments that the Government can apply for improving energy efficiency. The study will be conducted by the EGI Consulting Ltd. and the Institute for Economic Research that will organise the working team and co-ordinate the preparation.
- The project entitled "DEVELOPMENT OF ENERGY AWARENESS" initiates changes in behaviour of people, and stimulates them on actions they can implement themselves. The core part of the effort will be a series of short films broadcasted by the national TV. The interest generated by the films will be amplified by background activities, including publishing the material of the films in brochures, establishing a network of local advising centres which can answer questions of people, a co-ordinated campaign of other media, and active participation of utilities, manufacturers, etc. The KONKAM Ltd. is the selected partner for the implementation of this project. Connecting to this project the local energy efficiency advising centres have been also selected.
- At the regional level two organisations have been identified by the Board that could act as initiators of local energy efficiency programmes. It is expected that they will strongly stimulate energy efficiency improvement in their region by identifying and implementing the necessary measures. The nature of these measures depends on the characteristics of the region. In Miskolc, the Regional Energy Efficiency Centre established by the Hungarian Alliance of Technical and Science Association and in Debrecen the Foundation for Development of Small size Enterprises are selected to implement the regional projects.

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Annex A1: CO_2 emission from fuel combustion (1991)

FUEL TYPES	Production (TJ)	Imports (TJ)	Exports (TJ)	International Bunkers (TJ)	Stock Change (TJ)	Apparent Consumption (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)	Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Act. Carbon Emissions (Gg C)	Actual CO_2 Emissions (Gg CO_2)
Liquid Fossil														
Crude oil	75500	216644			-11029	303173	20.0	6063460	6063		6063	1.0	6003	22010
Natural Gas Liquids	25424					25424	15.2	386445	386		386	1.0	383	1403
LPG		752	1128		-94	-282	17.2	-4850	-5		-5	1.0	-5	-18
Gasoline		9946	16338		-6804	412	18.9	7787	8		8	1.0	8	28
Jet Fuel/ Kerosene			5586	5310	-1218	-9678	19.5	-188721	-189		-189	1.0	-187	-685
Gasoil/ Diesel Oil		10416	12054		504	-2142	20.2	-43268	-43	21	-65	1.0	-64	-234
Residual Fuel Oil		9108	1531		-5038	12615	21.1	266177	266		266	1.0	264	966
Naphta						0	20.0	0	0	357	-357	1.0	-353	-1294
Bitumen			2520		-240	-2280	22.0	-50160	-50	140	-190	1.0	-188	-689
Other Oil Products		847	7560			-6713	20.0	-134260	-134	49	-183	1.0	-181	-663
TOTAL LIQUID FOSSIL	**100924**	**247713**	**46717**	**5310**	**-23919**	**320529**		**6302608**	**6303**	**566**	**5737**		**5679**	**20824**
Solid Fossil														
Coking Coal	2450	25711			-329	28490	25.8	735042	735		735	1.0	720	2641
Other Bit. Coal	23872	35714			6616	52970	25.8	1366626	1367		1367	1.0	1339	4911
Sub-bit.(Brown) Coal	116415	16083			7015	125483	26.2	3287655	3288		3288	1.0	3222	11814
Lignite	36029	129			-468	36626	27.6	1010878	1011		1011	1.0	991	3632
BKB/Patent Fuel		3478	86		14	3378	25.8	87152	87		87	1.0	85	313
Coke		9509			-988	10497	29.5	309662	310		310	1.0	303	1113
TOTAL SOLID FOSSIL	**178766**	**90624**	**86**	**0**	**11860**	**257444**		**6797014**	**6797**	**0**	**6797**		**6661**	**24424**
Gas Fossil														
Natural Gas(Dry)	161160	208148	282		-1016	370042	15.3	5661643	5662	75	5587	1.0	5559	20384
TOTAL GAS FOSSIL	**161160**	**208148**	**282**	**0**	**-1016**	**370042**	**15.3**	**5661643**	**5662**	**75**	**5587**	**1.0**	**5559**	**20384**
SUM TOTAL FOSSIL	**440850**	**546485**	**47085**	**5310**	**-13075**	**948015**		**18761265**	**18761**	**641**	**18121**		**17899**	**65631**
Biomass(Solid)	13422					13422	29.9	401318	401		401	1.0	397	1457
International bunker				5310		-5310	19.5	-103545	-104		-104	1.0	-103	-376

Annex A2: CO_2 emission from fuel combustion (1992)

FUEL TYPES	Production (TJ)	Imports (TJ)	Exports (TJ)	International Bunkers (TJ)	Stock Change (TJ)	Apparent Consumption (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)	Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Act. Carbon Emissions (Gg C)	Actual CO_2 Emissions (Gg CO_2)
Liquid Fossil														
Crude oil	72543	233782			41	306284	20.0	6125680	6126		6126	1.0	6064	22236
Natural Gas Liquids	33816					33816	15.2	514003	514		514	1.0	509	1866
LPG		1034	1489		799	-1254	17.2	-21569	-22		-22	1.0	-21	-78
Gasoline		13612	18594		756	-5738	18.9	-108448	-108		-108	1.0	-107	-394
Jet Fuel/ Kerosene		1616	4291	5451	210	-8336	19.5	-162552	-163		-163	1.0	-161	-590
Gasoil/ Diesel Oil		17422	18606		294	-1478	20.2	-29856	-30	53	-83	1.0	-82	-302
Residual Fuel Oil		13685	4178		-8002	17509	21.1	369440	369		369	1.0	366	1341
Naphta						0	20.0	0	0	408	-408	1.0	-403	-1479
Bitumen			3120			-3120	22.0	-68640	-69	138	-207	1.0	-205	-752
Other Oil Products		785	6174			-5389	20.0	-107780	-108	30	-138	1.0	-136	-500
TOTAL LIQUID FOSSIL	**106359**	**281936**	**56452**	**5451**	**-5902**	**332294**		**6510279**	**6510**	**629**	**5881**		**5822**	**21348**
Solid Fossil														
Coking Coal	2402	2746			-20	5168	25.8	133334	133		133	1.0	131	479
Other Bit. Coal	15830	13646			-4872	34348	25.8	886178	886		886	1.0	868	3184
Sub-bit.(Brown) Coal	86398	10159	2035		-2974	97496	26.2	2554395	2554		2554	1.0	2503	9179
Lignite	46952				1523	45429	27.6	1253840	1254		1254	1.0	1229	4505
BKB/Patent Fuel		1789	89		-420	2120	25.8	54696	55		55	1.0	54	197
Coke		19987	87		-437	20337	29.5	599942	600		600	1.0	588	2156
TOTAL SOLID FOSSIL	**151582**	**48327**	**2211**	**0**	**-7200**	**204898**		**5482386**	**5482**	**0**	**5482**		**5373**	**19700**
Gas Fossil														
Natural Gas(Dry)	151314	172210			-1774	325298	15.3	4977059	4977	51	4926	1.0	4902	17973
TOTAL GAS FOSSIL	**151314**	**172210**	**0**	**0**	**-1774**	**325298**	**15.3**	**4977059**	**4977**	**51**	**4926**	**1.0**	**4902**	**17973**
SUM TOTAL FOSSIL	**409255**	**502473**	**58663**	**5451**	**-14876**	**862490**		**16969724**	**16970**	**680**	**16290**		**16097**	**59021**
Biomass(Solid)	13270				-37	13307	29.9	397879	398		398	1.0	394	1444
International bunker				5451		-5451	19.5	-106295	-106		-106	1.0	-105	-386

Annex A3: CO_2 emission from fuel combustion (1993)

FUEL TYPES	Production (TJ)	Imports (TJ)	Exports (TJ)	International Bunkers (TJ)	Stock Change (TJ)	Apparent Consumption (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)	Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Act. Carbon Emissions (Gg C)	Actual CO_2 Emissions (Gg CO_2)
Liquid Fossil														
Crude oil	67814	247066			-1722	316602	20.0	6332040	6332		6332	1.0	6269	22985
Natural Gas Liquids	35941					35941	15.2	546303	546		546	1.0	541	1983
LPG		1833	3478		-517	-1128	17.2	-19402	-19		-19	1.0	-19	-70
Gasoline		17934	13650		3910	374	18.9	7069	7		7	1.0	7	26
Jet Fuel/ Kerosene		2394	4032	5102	-168	-6572	19.5	-128154	-128		-128	1.0	-127	-465
Gasoil/ Diesel Oil		26208	39018		9605	-22415	20.2	-452783	-453	23	-476	1.0	-471	-1726
Residual Fuel Oil		26331	683		7127	18521	21.1	390793	391		391	1.0	387	1419
Naphta						0	20.0	0	0	470	-470	1.0	-465	-1706
Bitumen			2120			-2120	22.0	-46640	-47	155	-202	1.0	-200	-732
Other Oil Products			9492			-9492	20.0	-189840	-190	30	-220	1.0	-218	-798
TOTAL LIQUID FOSSIL	**103755**	**321766**	**72473**	**5102**	**18235**	**329711**		**6439386**	**6439**	**678**	**5761**		**5704**	**20914**
Solid Fossil														
Coking Coal						0	25.8	0	0		0	1.0	0	0
Other Bit. Coal	13379	7870	60		-3287	24476	25.8	631481	631		631	1.0	619	2269
Sub-bit.(Brown) Coal	74359	17334	1308		-4601	94986	26.2	2488633	2489		2489	1.0	2439	8942
Lignite	45127				-3508	48635	27.6	1342326	1342		1342	1.0	1315	4823
BKB/Patent Fuel		1533	209		-513	1837	25.8	47395	47		47	1.0	46	170
Coke		24995	29		-371	25337	29.5	747442	747		747	1.0	732	2686
TOTAL SOLID FOSSIL	**132865**	**51732**	**1606**	**0**	**-12280**	**195271**		**5257276**	**5257**	**0**	**5257**		**5152**	**18891**
Gas Fossil														
Natural Gas(Dry)	162892	199648			12496	350044	15.3	5355673	5356	63	5293	1.0	5266	19310
TOTAL GAS FOSSIL	**162892**	**199648**	**0**	**0**	**12496**	**350044**	**15.3**	**5355673**	**5356**	**63**	**5293**	**1.0**	**5266**	**19310**
SUM TOTAL FOSSIL	**399512**	**573146**	**74079**	**5102**	**18451**	**875026**		**17052336**	**17052**	**741**	**16312**		**16122**	**59116**
Biomass(Solid)	13688				-175	13863	29.9	414504	415		415	1.0	410	1505
International bunker				5102		-5102	19.5	-99489	-99		-99	1.0	-98	-361

Annex A4: CO_2 emission from fuel combustion (1994)

FUEL TYPES	Production (TJ)	Imports (TJ)	Exports (TJ)	International Bunkers (TJ)	Stock Change (TJ)	Apparent Consumption (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)	Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Act. Carbon Emissions (Gg C)	Actual CO_2 Emissions (Gg CO_2)
Liquid Fossil														
Crude oil	64575	226484			2173	288886	20.0	5777720	5778		5778	1.0	5720	20973
Natural Gas Liquids	37507					37507	15.2	570106	570		570	1.0	564	2069
LPG		329	1786		-282	-1175	17.2	-20210	-20		-20	1.0	-20	-73
Gasoline		27300	24570		4746	-2016	18.9	-38102	-38		-38	1.0	-38	-138
Jet Fuel/ Kerosene		1596	4368	7519		-10291	19.5	-200675	-201		-201	1.0	-199	-728
Gasoil/ Diesel Oil		30954	46032		-4326	-10752	20.2	-217190	-217	53	-270	1.0	-268	-981
Residual Fuel Oil		29708	80		-3979	33607	21.1	709108	709		709	1.0	702	2574
Naphta						0	20.0	0	0	398	-398	1.0	-394	-1445
Bitumen			3120			-3120	22.0	-68640	-69	203	-272	1.0	-269	-986
Other Oil Products			8652			-8652	20.0	-173040	-173	34	-207	1.0	-205	-751
TOTAL LIQUID FOSSIL	**102082**	**316371**	**88608**	**7519**	**-1668**	**323994**		**6339077**	**6339**	**688**	**5651**		**5595**	**20513**
Solid Fossil														
Coking Coal						0	25.8	0	0		0	1.0	0	0
Other Bit. Coal	16644	8381	1690		1168	22167	25.8	571909	572		572	1.0	560	2055
Sub-bit.(Brown) Coal	66437	13417	1064		-3830	82620	26.2	2164644	2165		2165	1.0	2121	7778
Lignite	45064				-656	45720	27.6	1261872	1262		1262	1.0	1237	4534
BKB/Patent Fuel		1110			-268	1378	25.8	35552	36		36	1.0	35	128
Coke		29277			-29	29306	29.5	864527	865		865	1.0	847	3107
TOTAL SOLID FOSSIL	**128145**	**52185**	**2754**	**0**	**-3615**	**181191**		**4898504**	**4899**	**0**	**4899**		**4801**	**17602**
Gas Fossil														
Natural Gas(Dry)	157236	189108			-7169	353513	15.3	5408749	5409	74	5335	1.0	5308	19463
TOTAL GAS FOSSIL	**157236**	**189108**	**0**	**0**	**-7169**	**353513**	**15.3**	**5408749**	**5409**	**74**	**5335**	**1.0**	**5308**	**19463**
SUM TOTAL FOSSIL	**387463**	**557664**	**91362**	**7519**	**-12452**	**858698**		**16646330**	**16646**	**762**	**15884**		**15703**	**57578**
Biomass(Solid)	14000					14000	29.9	418600	419		419	1.0	414	1520
International bunker				7519		-7519	19.5	-146621	-147		-147	1.0	-145	-532

Annex A5: CO_2 emission from fuel combustion (1995)

FUEL TYPES	Production (TJ)	Imports (TJ)	Exports (TJ)	International Bunkers (TJ)	Stock Change (TJ)	Apparent Consumption (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)	Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Actual Carbon Emissions (Gg C)	Actual CO_2 Emissions (Gg CO_2)
Liquid Fossil														
Crude oil	68388	240629			1148	307869	20.0	6157380	6157		6157	1.0	6096	22351
Natural Gas Liquids	39046					39046	15.2	593499	593		593	1.0	588	2154
LPG		517	1692		94	-1269	17.2	-21827	-22		-22	1.0	-22	-79
Gasoline		19866	27720		3066	-10920	18.9	-206388	-206		-206	1.0	-204	-749
Jet Fuel/ Kerosene		1848	1554	7401	336	-7443	19.5	-145139	-145		-145	1.0	-144	-527
Gasoil/ Diesel Oil		17850	44520		4620	-31290	20.2	-632058	-632	55	-687	1.0	-680	-2493
Residual Fuel Oil		27376			-4036	31412	21.1	662793	663		663	1.0	656	2406
Naphta						0	20.0	0	0	368	-368	1.0	-364	-1336
Bitumen		2120	3600		40	-1520	22.0	-33440	-33	228	-262	1.0	-259	-950
Other Oil Products			8496			-8496	20.0	-169920	-170	108	-278	1.0	-275	-1009
TOTAL LIQUID FOSSIL	**107434**	**310206**	**87582**	**7401**	**5268**	**317389**		**6204901**	**6205**	**759**	**5446**		**5391**	**19768**
Solid Fossil														
Coking Coal						0	25.8	0	0		0	1.0	0	0
Other Bit. Coal	10888	8245			-1694	20827	25.8	537337	537		537	1.0	527	1931
Sub-bit.(Brown) Coal	70958	7102			-436	78496	26.2	2056595	2057		2057	1.0	2015	7390
Lignite	48303				-155	48458	27.6	1337441	1337		1337	1.0	1311	4806
BKB/Patent Fuel		576			-78	654	25.8	16873	17		17	1.0	17	61
Coke		27625			-315	27940	29.5	824230	824		824	1.0	808	2962
TOTAL SOLID FOSSIL	**130149**	**43548**	**0**	**0**	**-2678**	**176375**		**4772476**	**4772**	**0**	**4772**		**4677**	**17149**
Gas Fossil														
Natural Gas(Dry)	158583	231608			6063	384128	15.3	5877158	5877	74	5804	1.0	5775	21174
TOTAL GAS FOSSIL	**158583**	**231608**	**0**	**0**	**6063**	**384128**	**15.3**	**5877158**	**5877**	**74**	**5804**	**1.0**	**5775**	**21174**
SUM TOTAL FOSSIL	**396166**	**585362**	**87582**	**7401**	**8653**	**877892**		**16854535**	**16855**	**833**	**16022**		**15843**	**58091**

Annex B1: CO_2 emissions by source and removal by sink categories

Source and sink categories	1991	1992	1993	1994	1995
1A. Fuel Combustion	**65255**	**58636**	**58754**	**57046**	**57567**
1A1. Energy & Transformation	28520	27476	27575	26290	26431
1A2. Industry	6380	5131	5548	6306	6352
1A3. Transport	7383	7189	7141	7212	7001
1A4. Commercial and Trade	3959	3517	3822	3970	3946
1A5. Residential	15670	12196	12271	11453	11296
1A6. Agriculture and Forestry	2120	1593	1499	1537	1519
1A7. Other	1224	1534	900	278	1022
1B. Fugitive Emissions					
1B1. Coal Mining	-	-	-	-	-
1B2. Oil and Natural Gas	NEF	NEF	NEF	NEF	NEF
2. Industrial Processes	**1382**	**1168**	**1318**	**1397**	**1438**
2A. Iron and Steel	-				
2B. Non-ferrous Metals	117	50	52	Not Est.	Not Est.
2C. Inorganic Chemicals	-	-	-	-	-
2D. Organic Chemicals	-	-	-	-	-
2E. Non-metallic Products	1265	1118	1267	1397	1438
2F. Other	-	-	-	-	-
3. Solvent Use	Not Est.	Not Est.	Not Est.	Not Est.	Not Est.
4. Agriculture					
4A. Enteric Fermentation	-	-	-	-	-
4B. Manure Management	-	-	-	-	-
4C. Rice Cultivation	-	-	-	-	-
4D. Agricultural Soils	-	-	-	-	-
4E. Savannah Burning	-	-	-	-	-
4F. Field Burning of Agricult. Resid.	-	-	-	-	-
5. Forestry	**-3239**	**-3823**	**-4697**	**-4820**	**-4797**
5A. Changes in Stocks	-4747	-5336	-6194	-6271	-6200
5B. Forest/Grassland Conv.	1509	1514	1497	1452	1403
5C. Abandonment of Managed Lands	-	-	-	-	-
5D. Other	-	-	-	-	-
6. Waste	**754**	**754**	**754**	**754**	**754**
6A. Solid Waste Disposal on Land	154	154	154	154	154
6B. Wastewater Treatment	-	-	-	-	-
6C. Waste Incineration	600	600	600	600	600
TOTAL	**67391**	**60557**	**60826**	**59196**	**59758**
International Bunkers	376	386	361	532	524

NEF=No Emission Factor is available

Annex B2: CH_4 emissions by source categories

Source and sink categories	1991	1992	1993	1994	1995
1A. Fuel Combustion		**24**	**24**		**21**
1A1. Energy & Transformation	Not Est.	Not Est.		Not Est.	Not Est.
	Not Est.	Not Est.		Not Est.	Not Est.
	Not Est.	Not Est.		Not Est.	Not Est.
	Not Est.	Not Est.		Not Est.	Not Est.
	Not Est.	Not Est.		Not Est.	Not Est.
	Not Est.	Not Est.		Not Est.	Not Est.
	Not Est.	Not Est.		Not Est.	Not Est.
	Not Est.	Not Est.		Not Est.	Not Est.
	453	**383**		**379**	**315**
	161	124		105	106
	292	259		274	292
	0.005	**0.001**		**0.000**	0.000
	0.005	0.001		0.000	0.000
	-	-		-	-
	-	-		-	-
	-	-		-	-
	-	-		-	-
	-	-		-	-
	Not Est.	**Not Est.**		**Not Est.**	**Not Est.**
	168	**144**		**121**	**117**
4A. Enteric Fermentation	122		90	85	
4B. Manure Management	42		34	34	
4C. Rice Cultivation	4		2	2	
4D. Agricultural Soils	-		-	-	
4E. Savannah Burning	-		-	-	
4F. Field Burning of Agricult. Resid.	0.005		0.002	0.004	
5. Forestry	**0.280**		**0.221**	**0.228**	
5A. Changes in Stocks	-		-	-	
5B. Forest/Grassland Conv.	-		-	-	
5C. Abandonment of Managed Lands	0		0	0	
5D. Other	-		-	-	
6. Waste	**257**		**256**	**255**	
6A. Solid Waste Disposal on Land	68		68	68	
6B. Wastewater Treatment	188		188	187	
6C. Waste Incineration	-		-	-	
TOTAL	**914**		**792**	**776**	
International Bunkers	0		0	0	0

Annex B3: N_2O emissions by source categories

Source and sink categories	1991	1992	1993	1994	1995
1A. Fuel Combustion	**2.6**	**3.3**	**3.4**	**3.6**	**3.3**
1A1. Energy & Transformation	Not Est.	Not Est.	Not Est.	Not Est.	Not Est.
1A2. Industry	Not Est.	Not Est.	Not Est.	Not Est.	Not Est.
1A3. Transport	Not Est.	Not Est.	Not Est.	Not Est.	Not Est.
1A4. Commercial and Trade	Not Est.	Not Est.	Not Est.	Not Est.	Not Est.
1A5. Residential	Not Est.	Not Est.	Not Est.	Not Est.	Not Est.
1A6. Agriculture and Forestry	Not Est.	Not Est.	Not Est.	Not Est.	Not Est.
1A7. Other	Not Est.	Not Est.	Not Est.	Not Est.	Not Est.
1B. Fugitive Emissions	**-**	**-**	**-**	**-**	-
1B1. Coal Mining	-	-	-	-	-
1B2. Oil and Natural Gas	-	-	-	-	-
2, Industrial Processes	**3.7**	**2.8**	**2.5**	**3.4**	**2.7**
2A. Iron and Steel	-	-	-	-	-
2B. Non-ferrous Metals	-	-	-	-	-
2C. Inorganic Chemicals	3.7	2.8	2.5	3.4	2.7
2D. Organic Chemicals	-	-	-	-	-
2E. Non-metallic Products	-	-	-	-	-
2F. Other	-	-	-	-	-
3. Solvent Use	Not Est.	Not Est.	Not Est.	Not Est.	Not Est.
4. Agriculture	**1.68**	**1.63**	**1.46**	**1.80**	**1.61**
4A. Enteric Fermentation	-	-	-	-	-
4B. Manure Management	-	-	-	-	-
4C. Rice Cultivation	-	-	-	-	-
4D. Agricultural Soils	1.68	1.63	1.46	1.80	1.61
4E. Savannah Burning	-	-	-	-	-
4F. Field Burning of Agricult. Resid.	0.000	0.000	0.000	0.000	0.000
5. Forestry	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**
5A. Changes in Stocks	-	-	-	-	-
5B. Forest/Grassland Conv.	-	-	-	-	-
5C. Abandonment of Managed Lands	0.002	0.002	0.002	0.002	0.002
5D. Other	-	-	-	-	-
6. Waste	**-**	**-**	**-**	**-**	-
6A. Solid Waste Disposal on Land	-	-	-	-	-
6B. Wastewater Treatment	-	-	-	-	-
6C. Waste Incineration	-	-	-	-	-
TOTAL	**8**	**8**	**7**	**9**	**8**
International Bunkers	0.005	0.005	0.005	0.008	0.007

Annex C: Summary tables of greenhouse gas emissions

Greenhouse gas emissions in 1991 (Gg)

Source/Gas	CO_2	CH_4	N_2O	CO	NO_x	NMVOC
Energy	65255	490	3	1393	228	85
Agriculture	-	168	2	95	0	-
Industry	1382	0	4	0.2	2	4
Waste Management	754	257	-	0.1	0.5	-
Forestry	-3239	0	0	2	0.1	-
Total Emission	**67391**	**914**	**8**	**1491**	**231**	**89**
International Bunkers	376	0	0	0.6	1.5	0.1

Greenhouse gas emissions in 1992 (Gg)

Source/Gas	CO_2	CH_4	N_2O	CO	NO_x	NMVOC
Energy	58636	408	3	1213	206	80
Agriculture	-	144	2	0.1	0	-
Industry	1168	0	3	0.2	1	4
Waste Management	754	256	-	0.1	0.5	-
Forestry	-3823	0.3	0	2	0.1	-
Total Emission	**60557**	**808**	**8**	**1215**	**208**	**84**
International Bunkers	386	0	0	0.7	2	0.1

Greenhouse gas emissions in 1993 (Gg)

Source/Gas	CO_2	CH_4	N_2O	CO	NO_x	NMVOC
Energy	58754	409	3	1251	201	81
Agriculture	-	127	1	0.1	0	-
Industry	1318	0	3	0.2	1	4
Waste Management	754	256	-	0.1	0.5	-
Forestry	-4697	0.2	0	2	0.1	-
Total Net Emission	**60826**	**792**	**7**	**1253**	**203**	**85**
International Bunkers	361	0	0	0.6	1	0.1

Greenhouse gas emissions in 1994 (Gg)

Source/Gas	CO_2	CH_4	N_2O	CO	NO_x	NMVOC
Energy	57046	400	4	1209	208	80
Agriculture	-	121	2	0.1	0	-
Industry	1397	0	3	0.0	0.8	4
Waste Management	754	255	-	0.1	0.5	-
Forestry	-4820	0.2	0	2	0.1	-
Total Net Emission	**59196**	**776**	**9**	**1211**	**209**	**84**
International Bunkers	532	0	0	0.9	2	0.1

Greenhouse gas emissions in 1995 (Gg)

Source/Gas	CO_2	CH_4	N_2O	CO	NO_x	NMVOC
Energy	57567	336	3.33	1047	204	78
Agriculture	-	117	1.61	0.1	0	-
Industry	1438	0	2.67	0.0	0.8	1
Waste Management	754	255	-	0.1	0.5	-
Forestry	-4797	0.2	0.00	2	0.1	-
Total Net Emission	**59758**	**708**	**7.61**	**1049**	**206**	**79**
International Bunkers	524	0	0.01	0.9	2	0.1

Annex D: Summary of policies and measures

Name	Type of instrument	Objective and implementation objective	enforcement	Sector	Status and elements of implementation phase	legal cond.
penetration of renewables	regulatory	remove the indirect subsidies on the natural gas	HEO[1]	energy (supply side)	planned	ESAP[2]
energy efficiency improvement	voluntary	prepare and implement energy efficiency plans	-	energy (business sector)	ongoing	-
financing energy efficiency	fiscal	provide support to save energy	various interminis-terial boards	energy (comm. and resid. sector)	ongoing	ESAP, Govt. decrees
energy efficiency labelling	regulatory	labelling household electric appliances	HEO	energy (residential sector)	planned	ESAP
rising energy awareness	information	awareness campaigns, PR activities	Energy Centre, utilities	energy (comm. and resid. sector)	ongoing	ESAP, NEP[3]
afforestation program	investment	afforestation min. 200,000 hectares	Forest Service	forestry	planned	National Forest Policy
forest reservation programme	regulatory	protection of the forests	regional forest inspections	forestry	ongoing	National Forest Policy
rail transport development	investment	modernisation of the railways	MAV[4]	transport	ongoing	Transport Policy
waterway transport development	investment	improve the shipping conditions	MTTWM[5]	transport	planned	Transport Policy
urban transport development	fiscal	attractive fee structure for the public transport	municipalities	transport	ongoing	Transport Policy

1 Hungarian Energy Office

2 National Energy Saving Action Programme

3 National Environmental Programme

4 Hungarian Railways

5 Ministry for Transport, Telecommunication and Water Management