HUNGARY: STABILISATION OF THE GREENHOUSE GAS EMISSIONS

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

AZ ÜVEGHÁZHATÁSÚ GÁZOK
KIBOCSÁTÁSÁNAK KORLÁTOZÁSA
MAGYARORSZÁGON

Nemzeti beszámoló
az ENSZ Éghajlatváltozási Keretegyezményben
foglalt kötelezettségek végrehajtásáról

1994

TARTALOMJEGYZÉK

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ELÔSZÓ

Az ENSZ Éghajlatváltozási Keretegyezményt - többéves egyeztetést és elôkészítést követôen - az 1992-ben megrendezett Környezet és Fejlôdés ENSZ Konferencián nyitották meg aláírásra. Magyarország bekapcsolódott az elôkészítô tárgyalásokba és egyike volt azon országoknak, amelyek Rio de Janeiróban aláírták e fontos egyezményt. Kezdettôl fogva azt a véleményt képviseltük, hogy az éghajlatváltozás globális környezeti kockázatának leküzdése csak nemzetközi megállapodás keretében lehetséges. A magyar álláspont a hazai tudományos kutatók - az elmúlt két évtizedben folytatott - tevékenységére és eredményeire támaszkodott, illetve a szakértôk és a politikai döntéshozók közötti párbeszéden alapult.

Az üvegházhatású gázok légköri mennyiségének gyors növekedésének, valamint a lehetséges következmények terén - kapcsolódva a nemzetközi kutatási eredményekhez és együttmûködésekhez - hazai elemzések láttak napvilágot. Az emberi tevékenység éghajlatra gyakorolt hatásának vizsgálata nyomán Magyarország elismerte korlátozott, de tényszerû felelôsségét e globális környezeti kockázat kialakulásában. E folyamatok felismerésével kapcsolatos nemzetközi egyetértés kialakulása sajátos módon egybeesett a kelet-közép-európai térségben megkezdôdött alapvetô társadalmi-gazdasági változások idôszakával. Az átalakulási folyamat egyebek mellett különleges helyzetet teremtett az üvegház-hatású gázok kibocsátása, a kibocsátás-korlátozást megalapozó technológiák, a környezetvédelmi célokra fordítható pénzügyi erôforrások, a környezeti tudatosság, illetve az Egyezmény végrehajtására rendelkezésre álló hazai kapacitások tekintetében.

A Magyar Köztársaság az Egyezmény hivatalos megerôsítésével újólag kinyilvánította az üvegház-hatású gázok kibocsátás-korlátozásával kapcsolatos alapvetô kötelezettség vállalását. A ratifikációs határozatot az Országgyûlés 1993. december 22-én egyhangú határozattal elfogadta. A megerôsítésre vonatkozó okmány 1994 februári benyújtása meghatározta a hazai üvegház-gáz forrásokkal és nyelôkkel, a kibocsátás-korlátozást támogató intézkedésekkel, illetve a kibocsátási jövôképekkel foglalkozó nemzeti beszámoló elkészítésének határidejét. A nemzeti beszámoló kidolgozása érdekében ágazatközi együttmûködést kezdeményeztünk, különös tekintettel az energetikai eredetû kibocsátások, az energiatakarékossággal és az energiahatékonysággal kapcsolatos törekvések, illetve egyéb - az üvegház-gázok kibocsátását szabályozó - stratégiák és intézkedések témakörében. További jelentôs segítséget jelentenek azok a két- és többoldalú nemzetközi együttmûködések, amelyek e környezeti probléma értékelésére és a szükséges hazai intézkedések kidolgozására irányulnak.

Minden erôfeszítésünk ellenére e nemzeti beszámoló szükségszerûen magán viseli a gazdasági-társadalmi átalakulás jegyeit, például a statisztikai adatok bizonytalansága vagy az egyezmény végrehajtására fordítható szûkös erôforrások tekintetében. Ebben az értelemben a jelen elemzés inkább egy folyamat kezdetét, semmint végét jelöli ki. Erôsítenünk kell az egyes résztémák tudományos megalapozását, illetve javítanunk kell a környezeti és más ágazati szempontokat integráló stratégiai döntéselôkészítô tervezést. A kidolgozott nemzetközi és a nemzeti szintû intézkedési terveket végre kell hajtani - elsôsorban a megelôzés, az elôvigyázatossági elv figyelembe vételével. E szempontok alapján kell folytatni az Egyezményhez kapcsolódó hazai tevékenységeket e beszámoló elkészülte után is.

Budapest, 1994 október

PREFACE

After many years of discussion and preparation the UN Framework Convention on Climate Change was opened for signature in 1992 during the United Nations Conference on Environment and Development. Hungary took part in the negotiations and was one of the countries who signed this important convention in Rio de Janeiro. Our constructive approach in finding international agreement to combat this global environmental hazard was based on the activities and results from the Hungarian scientific community for the past two decades in this field and on the dialogue between the experts of various disciplines and the policy-makers.

Based on the extensive international research activities and co-operation, the hazard from the rapid accumulation of greenhouse gases in the atmosphere and its potential consequences have been investigated and reported in our country and the realistic view on our limited, but factual, contribution to this hazard has also been acknowledged. This period of emerging international consensus on the need to pay due attention to possible anthropogenic interference with the climate system occasionally coincided with substantial socio-economic changes in our region. Such transition means rather special circumstances in our country, inter alia, in terms of anthropogenic sources of the greenhouse gases, the technologies which essentially influence their emissions, the availability of financial resources to respond to the economic and environmental challenges, the public awareness on the environmental problems or the capacities for adequate investigation of these issues, elaboration and implementation of the relevant measures.

The principal commitment to stabilise the greenhouse gas emissions was approved by Hungary which was clearly expressed by ratifying the Convention. Such resolution was unanimously passed by the Parliament on December 22, 1993 and submission of the ratification instrument in February 1994 determined the deadline for the first national communication on sources and sinks of the greenhouse gases and the required measures. This endeavour was facilitated by a cross-sectoral co-operation especially for such areas as the energy-related emissions, the efforts for improved energy savings and efficiency, the aforestation potentials, the various prevention and mitigation options. The importance of those bilateral and multilateral international collaborations should also be noted which assist the solution of our tasks in assessing this environmental problem and planning the response policies.

It should be clearly stated that despite our determination and all efforts by this stage, the first communication is also a reflection of the special conditions of transition, the multitude of uncertainty problems regarding the data and the projections or the present scarce resources to meet the requirements under this Convention. In this sense, the presented analysis is a starting point rather than a final statement. The scientific foundation will be strengthened, the integrated policy planning should be improved and the proper measures will have to be implemented both at international and national levels putting the main emphasis on the prevention in accordance with the precautionary principle. With these basic aspects in mind, our national efforts will be continued after and beyond this first communication.

Budapest, October 1994

Special conditions in terms of the Convention

Though the greenhouse gas contribution of Hungary to the overall emissions in absolute values is insignificant, yet it is quite high in proportion to its population or its gross domestic product. Considering the historical and contemporary emissions in Hungary, the proportionate responsibility for the global environmental problem of the increasing greenhouse gas concentrations was recognised. In 1991, the Government declared that the annual specific carbon dioxide emissions deriving from the domestic economic activities will not exceed the averaged annual emission level of the base period accepted for comparison by 2000. In the light of characteristic features of process of economic transition, the period of 1985-1987 which precedes the current economic recession is considered as the base period for comparison of the carbon dioxide emissions.

Understanding of the flexibility term

The Parliament decision on the ratification in December 1993 took note of this opportunity and considered reasonable and unavoidable to apply the provision of Article 4.6 of the Convention. Accordingly, the statement submitted with the deposition of the ratification instrument reiterated this claim at least in relation to the carbon-dioxide emissions. As it is seen from the assessments, the deep recession which started in the second half of the 1980s reached most of the sectors which are generally the basic sources of the greenhouse gases. For this reason and also for practical purposes we will use the unique base period of 1985-87 for the base level calculations in the future for all these gases (by deriving mean annual base levels from this period), whilst providing estimates for 1990 for the international comparisons and synthesis.

Our understanding of the flexibility term of the Convention in context of the first national communication is summarised as follows:

- The flexibility term is necessary to set realistic base levels for greenhouse gas emissions, corresponding to a period prior to the beginning of the transition processes. Hungary has chosen the three year period of 1985-1987 to develop an average base year emissions level.
- Due to the lack of research experiences in the subject of greenhouse gas emissions and according to the lack of information and data, the recommended methodology was used for the inventories of carbon-dioxide and methane only. The combustion sources and the emission from cement productions are considered in the case of CO_2. The calculation of CH_4 emission refers to the fugitive sources, emission from enteric fermentation and rice cultivation.
- At present, the economic activities can only be projected for short-term because of the deep uncertainties related to the transition period. Regarding our commitments under the Convention to stabilise the CO_2 emissions at a level of 1985-1987 by the year of 2000, projections of future greenhouse gas emissions presented in this communication are not extended beyond 2000.
- Although, the chapter on policies and measures includes description of several programmes that could lead to reduction of greenhouse gas emissions, the quantitative projections of future emissions are only presented for the energy savings programme as “with measure” and “without measure” scenarios.

National circumstances

Hungary is located in the Carpathian Basin in the heart of Europe, its territory amounts to 93030 km^2. Hungary is a typical low-lying country: 73 % of its territory is flatland which is less than 200 meters above the sea level. The country belongs to the catchment area of Danube and Tisza and their affluents. The country is located at the shifting frontier between the temperate continental (with hot summer and relatively cold winter) and the Mediterranean (with hot, dry summer and rainy winter) climate zones with complementary effects of the temperate oceanic climate. Southeast part of Hungary

belongs entirely to the semiarid and dry subhumid climatic belts. The significance of the insufficient precipitation has increased for the last 15 years which might be a dangerous indicator of the increasing drought frequencies for this area.

Transition to market economy

The country is in process of substantial socio-economic transition and it became evident that the lasting grave crisis symptoms in the Hungarian economy are basically of a structural origin. These structural changes substantially affect the contemporary and the future emissions of the greenhouse gases and offer a peculiar opportunity to take into account the environmental considerations to a better extent during the transition and in the future. The considerable fall in the production has not left the industrial structure untouched: half to two thirds of the capacity of industry of several years ago has become superfluous and has been written off for the recent years. In a sectoral analysis, the changes are more obvious. A considerable proportion of the metallurgy, mining and agriculture co-operatives, as well as the electronic and telecommunications industry, and of the artificial fertiliser industry has disappeared. Undoubtedly, new activities have also appeared (e.g. passenger car production).

Recent transition in the energy sector

The trend of energy use in Hungary changed in the 1980's after a long period of growth. Rate of growth slowed down in the first half of this decade, and after some years of fluctuation the trend became decreasing from 1987. The decreasing trend of energy demand stopped in 1992. Total energy consumption was by 1.5 % higher in 1993 than in the previous year, within that electricity consumption increased by 0.5 %. Both the total energy consumption and electricity consumption were again lower in the first half of 1994 in comparison with the identical period of 1993. Domestic primary energy production has been decreasing since 1989 and in 1993 it fell back underneath the level of 1970 with 568.3 PJ. Net energy import - not including the electricity produced by the single nuclear power plant which used imported nuclear fuel - is maintained at about 45-49 %. Dependency on primary energy import decreased slightly from 53.1 % to 51.6 % calculated on the ratio of import within total sources. The total energy consumption of the industry was by 40 % lower in 1993 than in 1987. Electricity demand of 34.9 TWh for 1993 was mostly covered by domestic power plants - with the share of 13.79 TWh generated by the Paks Nuclear Power Plant and, 17.97 TWh provided by fossil fuelled plants. The share of hydro-carbons in the total energy import amounting to 576.4 PJ in 1993 and consisting of 4.8 Mt (318 PJ) of crude oil and 5.8 billion m^3 (200 PJ) of natural gas, which is a slight reduction compared to 1990. The largest reduction took place in the electricity import: net import of 11.1 TWh in 1990 fell back to 2.5 TWh in 1993.

International co-operation

The Netherlands-Hungary bilateral co-operation in the field of environment is based on a Memorandum of Understanding between our two environment ministries. The objectives of the project were to elaborate on a possible Hungarian position on climate change, including its consequences for energy production, energy efficiency and related issues. The last six months (and the remainder of 1994) the co-operation mainly focused on the preparation of National Communication for the Convention.

An other project was initiated by the Norwegian institute CICERO from the Norwegian Government which focuses on some long-term response policies options for the Hungarian climate-energy strategy. This project started in the first half of 1994 in the framework of Norwegian-Hungarian bilateral environmental co-operation and its emphasis is on determining some (cost-effective) measures for reducing GHG emissions.

Under the U.S. Country Study Programme, a research project was launched in September, 1994. The main objectives are the improvement and refinement of an inventory of sources and sinks with prime focus on the sectoral assessments and the development of scenarios and concrete long-term sector-based response policies to assist the national policy planning with particular attention on the energy savings/efficiency aspects.

Inventories of greenhouse gas emissions and removals

One of the principal purposes of greenhouse gas inventories is the identification of main sectors, subsectors and technologies that contribute to the national level anthropogenic greenhouse gas balance either by emission or by removal. A comprehensive and reliable inventory can be a starting point for projection of mitigation policies and measures and their effects. Although certain first-guess preliminary assessments of greenhouse gas emissions were derived to form the preliminary position regarding to the Convention, Hungary has not elaborated an emission inventory either by IPCC/OECD or CORINAIR methodology yet. In lack of appropriate data, the recommended methodology was successively followed in the case of inventories of carbon-dioxide and methane emission only. Nevertheless, certain simplified estimation for emissions of N_2O, NO_x and NMVOC are also included in present inventory.

Energy data have already been collected in Hungary for more than fifty years and national energy balances have been compiled since the beginning of the 1950's. The energy statistical system changed considerably during the past decades. Two simultaneous energy statistical systems were maintained for a considerable period in Hungary. The first system functioned in the Central Statistical Office, the other one was under the auspices of the Ministry of Industry and Trade (MIT). As a consequence of the above mentioned parallelism data of different years supplied for international organisations were sometimes presented by different Hungarian institutions and were differing to some extent so that some of them have to be adjusted later. The determination of greenhouse gas emissions is based on the official Hungarian national energy balance produced and published in particular for the IEA review process.

CO_2 emissions

The greatest part of CO_2 emissions is generated by fuel combustion. In the base period it was about 80 Mt/year, but it dropped to 68 Mt by 1990. The result is in accordance with previous estimations although these estimations showed the actual CO_2 emission a little bit higher. The difference can be explained by the fact that the IPCC default emission factors were used for the development of the present inventory. The actual factors may be slightly higher. Regarding the sectoral structure of CO_2 emission concerns, in case of fuel combustion, almost half of the total emission stems from the transformation processes. Share of the residential sector reaches almost 25 % of the total CO_2 emission.

Uncertainty of CO_2 emission depends not only on reliability of energy consumption data but it is also influenced by the uncertainties in the emission factors. As different emissions have to be taken into account for different types of energy consumption it is important to determine the emission factors for the particular technologies and equipment as precise as possible. At present the uncertainties of these factors are greater than those of energy consumption or of other energy data.

Greenhouse gas emissions calculated by the recommended IPCC/OECD methodology

	1985-1987 (base period)		**1990 (reference year)**	
Emission Sources	CO_2 [1]	CH_4 [1]	CO_2 [1]	CH_4 [1]
Fuel combustion	80089	7.7	68105	5.6
Fugitive fuel		448.3		366.0
Industrial processes	3587		3568	
Solvent use				
Agriculture		208.4		173.0
Wastes				
Total Emission	**83676**	**664.4**	**71673**	**544.6**
Land use and forestry (removal)	3097		4467	

Greenhouse gas emissions calculated by simplified methods (ktonnes or Gg/year)

	1985-1987 (base period)				1990 (reference year)			
Emission Sources	**N_2O[2]**	**NO_x[2]**	**CO[2]**	**VOC[3]**	**N_2O[2]**	**NO_x[2]**	**CO[2]**	**VOC[3]**
Fuel combustion[4]	8.36	231.4	743.1	91.5	7.25	199.6	733.6	73.5
Fugitive fuel				35.0				25.0
Industrial processes								
Solvent use				78.5				44.5
Agriculture	4.56				4.10			
Wastes								
Total Emission	**12.92**	**231.4**	**743.1**	**205.0**	**11.35**	**199.6**	**733.6**	**143.0**

[1] Calculated by IPCC/OECD methodology
[2] Estimation methodology based on Tajthy (1993) except for N_2O from agricultural soils which has been calculated by the recommended methodology
[3] The base year and reference year for VOC emission calculations is 1988 and 1991, respectively. The estimation methodology was developed by the Institute of Environmental Protection, Hungary
[4] Including transport related energy use

Removal of CO_2

In Hungary the amount of burning aboveground biomass is negligible. The decrease of forest area (caused by occasional burning, road construction etc.) is fully compensated by the reproduction and afforestation. The annual carbon release was 2419 Gg and 3276 Gg in the base period and in 1990, respectively. The carbon uptake was estimated of 845 Gg and 1218 Gg in the same years. In Hungary the net carbon uptake of forests is typically positive. This uptake was also calculated according to the IPCC methodology. The annual value of CO_2 removal was 3097 Gg in the base period and 4467 Gg in 1990.

CH_4 emissions

In the present inventory the fugitive fuel emissions, enteric fermentation and rice cultivation as sources of CH_4 emission are taken into account. Such important sources like landfills, wastewater treatment and incineration are omitted in lack of appropriate data. The fugitive fuel emission from coal mining is considered which gives around 75 % of the total methane emissions. This contribution decreased by 20 % from the reference year to 1990. In Hungary, coal is produced from both underground and surface mines. It should be mentioned that in Hungary a considerable decrease of coal mining activity is expected in the next decades. Methane emissions from enteric fermentation and rice cultivation are also taken into account. The decrease in methane emission from enteric fermentation is mainly caused by the fall of livestock of beef and sheep. The emission from rice cultivation is regarded as insignificant compared with other sources.

Description of policies and measures

National Energy Efficiency Improvement and Energy Conservation Programme

The basic idea of the Programme (NEEIECP) is to set up an operational capability for the energy conservation. The main goals of the energy saving programme can be summarised as follows:

- Environment protection,
- Reducing the dependency on imports,

- Saving domestic energy resources,
- Postpone the construction and installation of a new basic electric power plants,
- Increasing the competitiveness of the economy,
- Adjustment to the energy policy of EU, OECD/IEA recommendations.

Targets and key assumptions

Two targets for medium-range (5 to 10 years) and an other two for long-term (15-20 years) have been set up. The minimum target supposes that the annual growth rate is expected to decrease up to 1995. Beyond 1995 the annual growth rate would increase by 1-2 %/years. It is also assumed that the price system of energy carriers shall reflect the realistic expenditure in the years of 1995 and 1996 and the cross-financing to be ceased. The total potential energy saving capacity is estimated of 200-300 PJ relative to the projected amount for the respective medium and long term period provided the full utilisation of several energy conservation possibilities.

Target	**Saved energy**	**Saved energy cost**	**Total investment**	**Relative investment**
	PJ	M USD	M USD	M USD/PJ
medium term minimum	63.7	373.0	422.0	6.6
medium term maximum	124.4	708.0	1250.0	10.0
long term minimum	193.4	1120.0	2148.0	11.1
long term maximum	309.3	1739.0	4036.0	13.0

Projections of energy conservation for various sectors

As mentioned before, the sectoral savings below are also relative to the respective business-as-usual projections.

The total fuel-related consumption in the energy sector might be reduced by 2.3 %. The most significant contribution is projected from the efficiency improvement of energy transportation (2.5 PJ) and from the co-generation (2.7 PJ).The improvement of energy awareness in the production side might lead to an energy conservation of 1 PJ.

The industrial energy demand might be reduced by 13 PJ. About half of those might be reached by improving the energy awareness. An other important sources of the energy conservation would be the updating the energy technologies in industrial production and the improvement of thermal insulation by 2 PJ and 1.5 PJ, respectively.

The agriculture sector has significant potential in the energy conservation of 12 % related to the overall sectoral consumption (30 PJ). The primary source of savings would also be the improvement of energy awareness.

The energy conservation in the transport sector is estimated to be about 13 PJ. This amount consists of the improvement of energy awareness, optimising the public transport co-operation and reduction of energy consumption of vehicles. The savings in the transport sector might amount to about the 25 % of the total energy conservation.

The overall energy savings in the communal sector (trade, services, governmental institutions and municipalities) are expected to be 9.2 PJ. The main contribution of the conservation is also the improvement of energy awareness by 7 PJ.

The energy savings in the residential sector (17 PJ) is the most significant part of total conservation. The primary sources of the efficient use of energy in the households might be the improvement of energy awareness (81 %) and the efficiency improvement of consumer's appliances (11 %).

Raising public awareness aimed at efficient use of energy

In the past ten years there have been three major - nation-wide - energy saving campaigns in Hungary. The objectives of the last series supported by PHARE were to spread awareness of the fact that:

- there is a direct connection between the consumption of energy and environmental impact (environmental damage),
- it is possible to save energy and at the same time maintain or increase standards of living,
- saving energy is a sign of efficiency and is a positive and straightforward concept,
- it is possible for each individual to do something and that the actions of each individual matter.

Content and goal of the programme

The media campaign made use of television, cinema and press advertising. This was the central element in the campaign. Television was given an extremely strong weight in order to maximise the reach and the frequency of giving the message to the target audience.

The slogan of the campaign was "you pay twice", that is, once for the wasted energy and once for the environmental damage. Press advertising in four national newspapers was used to put over information on energy use and environmental damage. In support of the media campaign, a leaflet was prepared and printed in many copies. A public relations campaign was used to support the media campaign. The campaign was launched and closed with a press conference. A weekly press release was issued each on a different theme - energy saving at home, how to save energy in cooking water use etc.

A schools campaign aimed at children aged 10-14 years was also developed and implemented. In this programme, a leaflet was prepared and disseminated in large number in all elementary schools in Budapest. It gave information on energy use, the environment and energy saving in a simple question and answer format. An integral part of the schools programme was a competition for the children which asked questions about energy use and energy saving.

Conclusions of the campaign

There are both positive and negative lessons which can be learned from the project and which should be noted for future energy conservation campaigns:

- Publicity campaigns can succeed in changing attitudes to energy use and the environment in Hungary and such campaigns can even succeed in changing deeply held attitudes.
- The campaign was successful because of the accurate targeting of the message and because the advertisement was creative and had a strong impact.
- The most effective way to influence attitudes in Hungary is through TV advertising. This was by far the most important media in the campaign and was responsible for the results achieved.
- Press advertising is useful as a support to TV advertising. Cinema advertising appeared to be ineffective.

VOC emission reduction programme

Hungary has signed the ECE Protocol for the reduction of VOC emissions in Geneva in November 1991. The participating countries have undertaken to reduce emission levels at least by approximately 30 % up to 1999. In several countries including Hungary the “standstill principle“ applies. The base year for Hungary is 1988. According to this international agreement, a National VOC Emission Reduction Programme will be implemented in Hungary which is based on the obligations and recommendations of the ECE Protocol.

The Hungarian VOC-emissions (Gg)

Source category	1988	1991
Energy production	1.0	1.0
Oil industry (mining, storage, refineries, primary distribution)	35.0	25.0
Transport (incl. refuelling)	90.5	72.5
Solvent use	78.5	44.5
Total	**205.0**	**143.0**

The main target of the VOC Programme is to prepare a strategy consisting of a reduction plan and an implementation plan for the VOC emissions in Hungary. Phase 1 of the project completed in 1993. The result is a survey of the emission of the selected industries in Hungary. Phase 2 of the project should result in a reduction plan for the selected industries such as the graphic industry, metal surface industry, textile printing industry, painting processes, storage of chemical and oil products and rubber and plastic industry.

The following list gives a general outline of measures available which are evaluated for implementation individually or in combination:

- Substitution of VOCs e.g. the use of water-based degreasing baths and paints inks, glues or adhesives which contain low or no amount of VOCs.
- Reduction by best management practices such as good housekeeping, preventive maintenance programmes or by changes in processes such as closed system during utilisation, storage and distribution of low-boiling organic liquids.
- Recycling and/or recovery of efficiently collected VOCs by control techniques such as absorption condensation and membrane processes ideally organic compounds can be reused on-site.
- Destruction of efficiently collected VOCs by control techniques such as thermal recatalytic incineration or biological treatment.

The estimation of the future VOC emission is calculated on the basis of GDP change scenarios. The projected VOC emission outlook for 1995 supposing the successful implementation of the reduction programme ("with measures scenario") is 125 kt while the “business as usual scenario” gives 145 kt with an uncertainty level of 15 %. Some percent of the annual growth of GDP is assumed in the period 1995-2000. Therefore, after having ratified the VOC Protocol, several reduction measures will have to be in force already for that period. So VOC emission outlook for 2000 in the case of "with measure" scenario is 110 kt while in the case of “business as usual” is 170 kt. The estimated uncertainty is 20 %.

Enhancement of sink capacities: the forest policy

As a result of large scale, still ongoing national afforestation programme, the forested area of the country has been increased by 600,000 hectare and reached the present rate of 18.2 %, or 1.7 million hectare. Various studies on future agriculture in Hungary suggest that about 500,000-1,000,000 ha of currently agricultural 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. 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.

The Forestry Law currently in force was enacted in 1961. The main objective of this law is to increase forest resources, to maintain and intensify special forest functions and to develop harmonised wildlife management. The Forestry Law regulates stocked forests, clearings, roads, alleys, nurseries, open lands embraced by forests, i.e., all lands under forest management, but it ignores ownership.

The increasing public concern over the health of forests, air pollution effects, and the threat of possible climate change focused the public attention on forestry issues. The main emphasis is shifting towards the non-wood benefits of forests, while wood production is controlled by market conditions rather than central decisions. These, as well as the changing ownership structure call for adjustment in forestry policy, which finally should result in a new Forestry Law.

The key issues of the new forest policy to be implemented in the new Forestry Law, of which certain elements are already in effect in lower level regulations, are as follows:

- to define forest in a complex way with the priority of long term interest for human health, nature conservation and the maintenance of forest resources;
- to define the role of forest in nature conservation, protection, welfare-oriented use and recreation;
- to define the role of forest in wood supply, and the necessary economic and institutional background;
- to define the prerequisites of sustainable management under changing ownership structure, and to develop the system of guaranties of maintaining forest heritage;
- to define the desired ownership structure (the share of state forest is expected to exceed 50-55 % on the long run);
- to define the co-ordinating and controlling role of the state in ensuring sustainable management;
- to define the role of foresters, their education and training, and the conditions of their employment;
- to define the role of public relations; finally,
- to define the role of international relationships.

The degree of conformity with international agreements is intended to be as high as possible. Some coincidental contradiction might exist, and imperfect implementation may occur. If any, they will be revised and corrected during the legislation procedure ahead.

Country programme for ODS reduction

The use of CFCs in Hungary has reduced dramatically since 1986 due to a great extent to the decline in domestic and local foreign markets. Some manufactures have already ceased to use ozone depletion substances (ODS) as dictated by export markets where destination countries have banned import of equipment containing ODS in line with the Montreal Protocol. This factor continues to be a major influence for companies using CFCs along with the phaseout policy which is now legislated.

Use of ODS by the end-users in Hungary (metric tonnes)

SUBSTANCES	1986	1989	1991	1992	1993	1994 plan
All CFCs	5360	4750	2660	1880	1668	1120
All Halons	455	440	275	170	65	
CTC (carbon-tetrachloride)	700	630	320	200	124	70
MCF (methyl-chloroform)	570	780	580	447	290	250

Hungary is not a producer of regulated substances. There are no ODS production facilities for the substances regulated under the Montreal Protocol nor for the transitional HCFC substances and HFC substitutes. ODS are imported mainly from the European Union and the Russian Federation by Hungarian distributors.

Content and goals of the programme

The objectives of the Country Programme for the phaseout of ozone depleting substances are as follows:

- Summarise the usage of ODS including CFCs, halons, 111-trichloroethane or MCF, carbon-tetrachloride and HCFCs in Hungary;
- Present a breakdown of ODS usage by substances for the refrigeration, aerosols, solvents, foams and fire extinguishing sectors and detail the regional distribution of usage;
- Assess the factors that effect ODS demand;
- Identify possible alternative substances and technologies for ODS phaseout;
- Quantify phaseout time scales, incremental costs and environmental benefits;
- Describe the institutional and policy framework of the Country Programme.

The foreign trade of ODS (regulated materials) is obliged to license in Hungary. The product charges on refrigerators, used oil and refrigerants are in phase of elaboration. The authoritative regulation is set in laws. In order to realise the obligations accepted by the signing of the international agreements, the modification of the customs regulation is a viable tool. The limitation in foreign trade of environmentally harmful materials by the modification of customs regulations is acceptable for the authorities of GATT and of EU with proper reasons. It is important to emphasise that because of the treaty between Hungary and the EU the modifications in the customs regulation are obliged to reconcile with the EU. The use of contingents is the most common tool of trade preferences. There is a possibility for suspending the customs for a given period or given goods. In the cases of important economic policy targets through the so-called licensing procedure, the customs of imported goods are to be suspended or reduced. These regulators serve as a tool of import limitations but they can promote the preferential import of materials substituting the ODS and machines for processing the substitutes.

Results

According to the experiences of the countries acting initiative role in phasing out ODS it is the most simple to phase out using aerosols as propellants: this sector gave 50 percent of the whole national ODS consumption in Hungary in 1986 and the consumption dropped to one tenth by 1993. It can be said that the firms aware of the regulations of the Montreal Protocol. They get acquainted with the different technical forms of phasing out and substitution and they use the experiences of other countries but they can not perform similar measures or introduce new ODS technologies because of the declining economic situation. According to the regulation, only 25 % of CFCs can be used in 1994 and 1995 comparing to the base year and 15 % of CTC and 50 % of MCF is allowed to use in 1995.

Projection of future greenhouse gas emissions

The implementation of the National Energy Efficiency Improvement and Energy Conservation Programme is analysed. Due to the prolonged recession of Hungarian economy, the original scenarios made in 1991 during the preparation of NEEIECP are lost their reliability and therefore could not serve as a useful variants for the analysis of future greenhouse gas emission projections. Two updated scenarios are investigated: a business as usual (BAU) - scenario and an energy saving scenario (S), as well. The energy saving scenario (S) based on the medium-term targets of NEEIECP. It is supposed that in the year 2000 the effective implementation of NEEIECP would lead to an energy saving of about 60 PJ compared with the BAU-scenario (As it is mentioned the energy conservation target is about 50-100 PJ up to 2000). The calculations of emission values both for the reference year (1990) and the scenarios are completed by using of simple method different from IPCC/OECD methodology.

Projection of CO_2 emission

Taking into consideration the scenarios for the energy consumption the future fossil fuel demand should be determined. In the case of the BAU-scenario the fossil fuel consumption increases in the year 2000 about 950 PJ while with significant energy savings and conservation it might increase 890 PJ only. Both in the 2000BaU and 2000S scenarios the annual fuel-related CO_2 emission does not exceed the base period level. Nevertheless the BAU scenario is higher by 7 % compared to the scenario (S).

Projection of fuel-related CO_2 emission (Gg) by sectors

SECTORS	**1995**	**2000BAU**	**2000S**
household	15768	17960	16493
service	3858	4144	3 947
transportation	7906	9949	9361
public power plants	19893	22715	21095
district heating	2895	3154	2983
industry	13818	13608	13181
agriculture	1737	1921	1681
total	**65875**	**73451**	**68741**

Projection of CH_4 emission

In determining the methane emissions connected with the domesticated and undomesticated animals the default emission factors presented in the IPCC/OECD methodology have been used. The domesticated animal population decreased dramatically in the recent years mainly because of the collapse of the eastern markets. The increase of the export is very uncertain but it might recover in medium-term. There are no generally accepted scenarios for animal livestock, therefore a stock is estimated on expert judgement basis.

Methane emission (Gg) from enteric fermentation and animal wastes

	1990	**1992**	**1995**	**2000**
cattle	115.6	84.6	77.0	99.6
swine	40.8	26.5	25.8	34.0
horse	1.1	1.1	1.1	1.1
sheep	9.4	8.4	8.4	9.4
poultry	3.5	3	2.9	3.4
total	**170.4**	**123.6**	**115.2**	**147.5**

It is supposed that in year 2000 the domesticated animal population will be approximately the mean value of the present and the earlier peak stocks. The ratio of cultivated land and forest areas is not supposed to modify significantly the “first guess approximation“ of the methane emissions and the emissions produced by the different type of lands might be regarded as constant.

The future emissions of N_2O, NO_x and CO are also analysed in the Communication.

Fulfilment of the CO_2 stabilisation target

The Government of Hungary has declared that - in the light of characteristic features of processes of its economic transition - the period of 1985-1987 which precedes the current economic recession is considered as the base period for comparison of the greenhouse gas emissions. It is also stated that the carbon-dioxide emission should be returned to the base period level by the year 2000. It should be emphasised that the greenhouse gas emission reduction target therefore refers to stabilisation of carbon-dioxide emission at a level of 1985-1987.

The fulfilment of CO_2 reduction target

	CO_2[1] (Gg/year)	**CH_4[2] (Gg/year)**
base period (1985-1987)	81534	604.9
reference year (1990)	69116	491.6
1995	65875	310.1
2000BAU	73451	232.2
2000S	68741	

[1] The recent fuel-related CO_2 emission calculated by the recommended methodology and the future projection of fuel-related CO_2 emissions estimated by simplified method are compared. The projection is presented as “with measures” (2000S) and “without measures” (2000BAU) scenarios regarding the implementation of the National Energy Efficiency and Energy Improvement Programme. (The net emissions including the non-combustion sources and removals are not calculated in the projections. The difference between the net CO_2 emission and fuel-related ones is less than 5 %)

[2] Accordingly, the methane emissions from fugitive sources and enteric fermentation for the base period and the reference year are derived from the IPCC/OECD methodology. The future projection of methane emission from same sources is based on the referred simplified method. (The net emissions including the fuel related methane sources are not calculated in the projections. The difference between the net CH_4 emission and emission from fugitive and enteric fermentation is less than 2 %)

Chapter 1
INTRODUCTION

The fundamental commitment under the Framework Convention on Climate Change (FCCC) is the stabilisation of the greenhouse gas emissions at their 1990 level (not controlled by the Montreal Protocol) by the Annex I Parties by the end of the present decade. Obviously, this commitment is the first step to reach the objective of the Convention that reads (FCCC, Article 2, 1992):

> "*The ultimate objective (...) is to achieve (...) stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system*."

Although contribution of Hungary to the overall emission levels is insignificant (*HCSD, 1994)*, it is quite high in proportion to its population and gross domestic product. In this context, the very long residence time of the greenhouse gases should be also taken into account so that the historical levels of emissions are also important factors in the enhancement of the atmospheric concentrations of these gases.

Considering the historical and contemporary emissions in Hungary, the proportionate responsibility for the resulted global environmental problem was clearly acknowledged. Expressing this position, the President of the Republic of Hungary signed the Convention in 1992 at the United Nations Conference on Environment and Development in Rio de Janeiro.

The Convention was ratified by the Parliament on December 22, 1993 and deposited on 24 February, 1994.

According to the Article 4.2.b and Article 12 of the Convention, Hungary should submit the first National Communication of Information six month after the ratification instrument has been deposited. The Communication provides an overview on actual and future greenhouse gas emissions, as well as mitigation measures currently being taken and/or projected.

The National Communication is divided into four main chapters. Chapter 2 summarises Hungary's special conditions in context of the commitments under the Convention. The national greenhouse gas reduction target and the understanding of the flexibility term are also discussed.

Chapter 3 summarises the various elements of the national circumstances which are important in context of the Convention. The basic features of the transition period are described.

The next main chapter provides the inventories of greenhouse gas emissions from various sources and removals by sinks subdivided for groups of combustion and non-combustion activities.

Chapter 5 describes the measures and policies which contribute to meet the Convention's commitments. Finally, the projections of future emission are presented with and without the key measures which are in our case basically related to a comprehensive energy savings programme.

The Hungarian Commission on Sustainable Development was established in April 1994 and this interdepartmental body was appointed to deal with the multisectoral and multidisciplinary issues of the sustainable development, the implementation at national level of the decisions of the United Nations Conference on Environment and Development and those emerged within its international follow-up activities. The tasks related to the Framework Convention on Climate Change is just one of these important tasks. The ratification process of this convention has also been prepared under the auspices of this interdepartmental commission.

The preparation of the Hungary's National Communication was co-ordinated by the Secretariat of the Hungarian Commission on Sustainable Development with assistance from a wide range of experts.

COLLABORATIVE PARTNERS
IN PREPARATION OF THE NATIONAL COMMUNICATION

Hungarian Ministry of Agriculture

Hungarian Ministry for Environment and Regional Policy

Hungarian Ministry of Industry and Trade

Hungarian Power Co.

Hungary -EC Energy Centre

Institute for Environmental Management

State Authority for Energy Management and Energy Safety

Systemexpert Consulting Ltd.

Technical University, Budapest

The draft version of the report was made available to the non-governmental organisations for review and comment. The official approval was made by the Hungarian Commission on Sustainable Development at its meeting on 11 November, 1994.

Chapter 2
SPECIAL CONDITIONS IN TERMS OF THE CONVENTION

2.1. General position on the Convention and specifics of the transition period

The special situation of a number of countries in the Central-, East-European region was repeatedly expressed during the intergovernmental negotiations on the Convention. The two key and common elements of such interventions were as follows:

- the relatively low per capita greenhouse gas emission rates as compared to those of the most of the industrialised countries, and
- the significant economic constraints being attributable to the profound socio-economic changes and process of transition to market economy.

In particular, the Hungarian position was officially submitted to the Intergovernmental Negotiating Committee in November 1991 *(HNC, 1991)*:

> "(*...) our task is as follows: (...) closely study the possibility of setting limits to the atmospheric emissions at national level (...). The convention should clarify, among others the legal, financial and technology transfer aspects of the tasks of common environmental interests. From the point of the given environmental problem, the convention should make allowances, with proper differentiation, for the situation and potential of various countries. At present, reduction of the environmental effects in Hungary can be realised by further restructuring the energy infrastructure and energy savings through technical developments that require excessive capital investments and expenditures. Because of our limited financial resources we should like to utilise the present international support system in the future, too. Fore the sake of effective solutions we attach prominent importance to our co-operation with the interested international organisations and countries.*"

These aspects were repeatedly underlined in the Government declaration issued in April 1992 just before the final round of the international negotiations *(HNC, 1992b)*:

> *“The Government of the Republic of Hungary (...)*
>
> *expresses its intent to co-operate with international organisations and institutions concerned in the interest of protection of the earth' environment and the climate and the seek, at the same time for economic and technical co-operation with the developed countries in order to, among others, be able to fulfil the requirements of environmental protection, in general, and to keep also protecting the earth' atmosphere and the climate, in particular, in the course of the country's economic transition and stabilisation (...) and*
>
> *declares that Hungary joins the position of the European Community and the European Free Trade Association, however, - in the light of characteristic features of process of its economic transition - the period of 1985-1987 which precedes the current economic recession is considered as the reference period for comparison of the carbon dioxide emissions (...)*
>
> *pronounces the commitment that the annual specific carbon dioxide emissions deriving from the domestic economic activities will not exceed the averaged annual emission level of the basic period accepted for comparison by 2000 and thereafter; and*
>
> *emphasises moreover, that the effective implementation of this plan and also the possible further reduction of these emissions considerably depends on that at what rate*

the country can stabilise, renew its economy and, in this context, how the energy efficiency develops and, furthermore, it depends on the progression of economic and technological co-operation with developed countries (...)

expresses its interest in that an effective agreement be prepared for the protection of earth' climate ... and this agreement should take into account the responsibility and situation of all specific groups of countries and

declares its readiness to join the convention if its final version properly reflects the enlisted interests."

HISTORY OF FCCC-RELATED NATIONAL ACTIVITIES	
March, 1989	The Hungarian delegation led by the President of the Republic of Hungary endorsed the Hague Statement on risk of greenhouse gas induced climate change
1989-1992	Research projects on climate change supported by the Ministry of Environment and Regional Policy and the Hungarian Academy of Sciences
November, 1990	At the Second World Climate Conference the Government delegation join the declaration that urged to start the negotiation on an international convention of greenhouse gas limitation
1991-1992	Participation in the international negotiations on formulation of the Convention
April, 1991.	National Committee is established to co-ordinate the preparatory tasks for UNCED
November, 1991	The statement by the Hungarian Academy of Sciences' committee on the climate change
April, 1992	The Government declaration on the greenhouse gas emissions, the climate change and on the stabilisation of CO_2 emissions
May, 1992	The government adopted a resolution on signing the FCCC
June, 1992	The President signed the FCCC in Rio de Janeiro at UNCED
April, 1993	The Government passed a resolution on the national UNCED follow-up tasks including the ratification and implementation of the FCCC
December, 1993	The Parliament voted unanimously to ratify the FCCC.
February, 1994	The ratification instrument was deposited with the Secretary General of the United Nations

2.2. Understanding of the flexibility provision of the Convention for countries in transition

During the international negotiations on the FCCC, the countries with economy in transition have emphasised the importance of special circumstances in which they currently find themselves. The beginning of this decade was a milestone in the history for these countries: the period of centrally planned economies was terminated and the comprehensive transition to a market economy had begun. The flexibility term was introduced during the last stage of negotiations (May 1992) in order to take into account the special situation of these countries. Various proposals had been submitted. Hungary supported strongly such a position that focused on following elements of compromise: (i) setting up an open list which enlists the parties committing themselves to stabilise the greenhouse gas emissions and the transition countries - depending on their individual decision - might be included in this list; (ii) the concrete terms of emission stabilisation might differ for these "transition" countries to

some extent; (iii) these countries will not be excluded at least from the mechanism of assisting the technology transfer which is necessary for modernising their obsolete, inefficient, highly polluting energy and other systems; (iv) at the same time, these countries at this stage will not commit themselves to offer contributions to the financial mechanism of the Convention. Eventually, the accepted package solution included the possibility to use some flexibility by these countries in the context of emission stabilisation requirements (FCCC, Article 4.6; 1992):

> "*In implementation of their commitments under paragraph 2 above, a certain degree of flexibility shall be allowed (...) to the Parties included in Annex I undergoing the process of transition to a market economy ...*"

National greenhouse gas reduction target

The Parliament decision on the ratification in December 1993 took note of the opportunity mentioned above, and considered it reasonable and unavoidable to apply for this provision of the Convention. Accordingly, the statement submitted with the deposition of the ratification instrument reiterated this claim at least in relation to the carbon-dioxide emissions:

> "*The Government of the Republic of Hungary attributes great significance to the United Nations Framework Convention on Climate Change and it reiterates its position in accordance with the provision of Article 4.6 of the Convention on certain degree of flexibility that the average level of anthropogenic carbon-dioxide emissions for the period of 1985-1987 will be considered as reference level in context of the commitments under Article 4.2 of the Convention. This understanding is closely related to the "process of transition" as it is given in Article 4.6 of the Convention. The Government of the Republic of Hungary declares that it will do all efforts to contribute to the objective of the Convention. (...)*

This target leaves open such commitments for other greenhouse gases. As it will be seen from the assessments given below, the deep recession which started in the second half of the 1980s reached most of the sectors which are generally the basic sources of the greenhouse gases. For this reason and also for practical purposes we will use the unique base period of 1985-87 for the base level calculations for all these gases (by deriving mean annual base levels from this period), whilst providing estimates for 1990 for the international comparisons and synthesis.

EMISSION LIMITATION TARGETS IN HUNGARY
(based on international agreements)

SO_2	the emission reduced by 30 % up to 1993 (compared to the 1980 level)
NO_x	the emission stabilised up to 1994 at the level of 1987
VOC	the emission should be stabilised at level of 1988 by the year of 2000
CFC	the emissions should be reduced by 50 % by 1995
CO_2	the emission should be returned to the average level of 1985-1987 by 2000

Source: MERP (1994a)

Selection of the base level for the emissions

The year 1990 would not be a particularly appropriate base year for Hungary as a Party with economy in transition and due to special circumstances characterised in Chapter 3.

As a result of the transition process, the current and future economic uncertainties, Article 4.6 of the Convention, which provides that the economies in transition may seek a certain degree of flexi-

bility in fulfilling the commitments of the Convention which is very important in our terms. The reasonable base period, or other requested flexibility conditions, may vary from country to country in accordance to their historical level of anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol or other significant transition circumstances. Hungary has declared an official position setting the three year period of 1985-1987 as an average base emission level for several reasons:

- The economic crisis led to the collapse of the centrally planned economies. From the second half of the 1980s, economic activity fell back considerably, therefore the anthropogenic emission values of 1990 were also significantly lower than those in previous years.
- Another main reason of not choosing 1990 as a base year is that the statistical system has changed considerably around 1990 as a consequence of the substantial socio-economic changes, the fundamental shifts in whole economic sectors, and the large-scale privatisation process. In particular, no detailed and reliable statistics are available at the moment on the of industrial activities.
- It should also be mentioned that it is more correct under the above-mentioned conditions of uncertainty to choose base emission values for a certain period than for a particular year because emissions may fluctuate to a considerable extent from year to year.

OVERVIEW OF UNDERSTANDING OF THE FLEXIBILITY TERM IN CONTEXT OF HUNGARY'S NATIONAL COMMUNICATION

- **Base level.** The flexibility term is necessary to set realistic base levels for greenhouse gas emissions, corresponding to a period prior to the beginning of the transition processes. Hungary has chosen the three year period of 1985-1987 to develop an average base year emissions level.
- **Emission calculations.** Due to the lack of research experience on greenhouse gas emission evaluations, and according to the lack of information and data, the recommended methodology was used for the inventories of carbon-dioxide and methane only. The combustion sources and the emission from cement productions are considered in the case of CO_2. The calculation of CH_4 emission refers to the fugitive sources and emission from enteric fermentation and rice cultivation.
- **Horizon of projections.** At present, the economic activities can only be projected for short-term because of deep uncertainties related to the transition period. With regard to our commitments under the Convention is to stabilise the CO_2 emissions at a level of 1985-1987 by the year of 2000, projections of future greenhouse gas emissions presented in this communication are not extended beyond 2000.
- **Emission projections.** Although the chapter on policies and measures includes the description of several programmes that could lead to the reduction of greenhouse gas emissions, the quantitative projections of future emissions are only presented for the energy savings programme using "with measure" and "without measure" scenarios.

Chapter 3
NATIONAL CIRCUMSTANCES

3.1. Transition to market economy

3.1.1. Structural changes in the economy

Hungary is in the process of a substantial socio-economic transition and it has become evident that the lasting grave crisis symptoms of the Hungarian economy are basically structural in nature. The structural changes substantially affect the contemporary and future emissions of the greenhouse gases and offer a peculiar opportunity to take into account the environmental considerations to a better extent during and after the transition. The mass production capabilities that were built up to satisfy the protected domestic and COMECON markets during the preceding decades are obsolete. The efficiency of economic activities based on cheap Eastern European raw materials and energy imports, considerably lags behind advanced international market competitors in most cases. For a number of products, the Eastern European market has disappeared. In the case of some important product groups, the previous Hungarian market share has been taken over by world companies, who are able to, in many cases produce products with higher technical standards at lower prices. The considerable fall in the production has not left the industrial structure untouched: half to two thirds of the previous industrial capacity has become superfluous and has been written in for recent years. In a sectoral analysis, the changes are more obvious. A considerable proportion of the metallurgy, mining and agriculture co-operatives, the electronic and telecommunications industry, and of the artificial fertiliser industry has disappeared. Undoubtedly, new activities have also appeared (e.g. passenger car production). Nevertheless, they are unable to compensate for the deterioration in other areas in terms of the overall economic outcome. The extremely strong centralisation related to state ownership in the Hungarian economy decreased considerably in recent years. This process should be continued and strengthened by direct methods of transformation and privatisation of state companies; indirect methods of strengthening and supporting the small and medium-size enterprise sphere; and through consistent actions against monopolies.

ECONOMIC PROFILE
Main economic indicators in Hungary

	1988	1992
per capita GDP (USD)	2736	2364
sources of GDP		
- industry	43 %	38 %
- agriculture	18 %	17 %
- services	39 %	45 %
use of GDP		
- consumption	74 %	78 %
- investments and savings	26 %	22 %
unemployment rate	-	8 %
foreign trade balance (M USD)	786	361
foreign direct investment (M USD)	215	3424
gross foreign debt (M USD)	19600	21400
exchange rate (Ft/USD)	55	79

Source: Central Statistical Office (CSO, 1993)

One of the most important methods of ownership restructuring is the privatisation of state companies. The basic goal of ownership reform is the improvement of economic productivity and the establish a company ownership that is directly interested in the successful utilisation of assets. At the same time, privatisation process aims to serve the following:

- the elimination of market, organisation and ownership monopolies;
- the structural decentralisation of companies which consist of a number of individual units;
- the strengthening of co-operative supply relationship between economic organisations and the establishment of new types of integration;
- the promotion of property acquisition by domestic entrepreneurs and employees, efficiently turning these parties into co-operating company owners.

The new environmental standards, drawn both from national and international requirements are also being introduced during this restructuring process. According to current government strategy, domestic privatisation means fundamentally the sale of property. Experiences so far indicate, however, that demand and supply conditions are inadequate for the quick privatisation process that had been initially envisioned by the government. The supply side has been weakened by worsening economic conditions and the increasing number of bankruptcy and liquidation experienced by companies. On the demand side, limited domestic purchasing power, moderate foreign investor interest, and the high nominal interest rate caused by high inflation are among the many influences that have impacted the pace of privatisation.

3.1.2. Recent transition in the energy sector

Energy demand

The trend of energy use in Hungary changed in the 1980's after a long period of growth. Growth rate slowed down in the first half of 1980's and after some years of fluctuation the trend had than started to decline since 1987. This trend for energy demand reversed again in 1992. Total energy consumption was up by 1.5 % in 1993 over the previous year figure, with electricity consumption increasing by 0.5 %. Both the total energy consumption and electricity consumption were again lower in the first half of 1994 in comparison with the identical period of 1993.

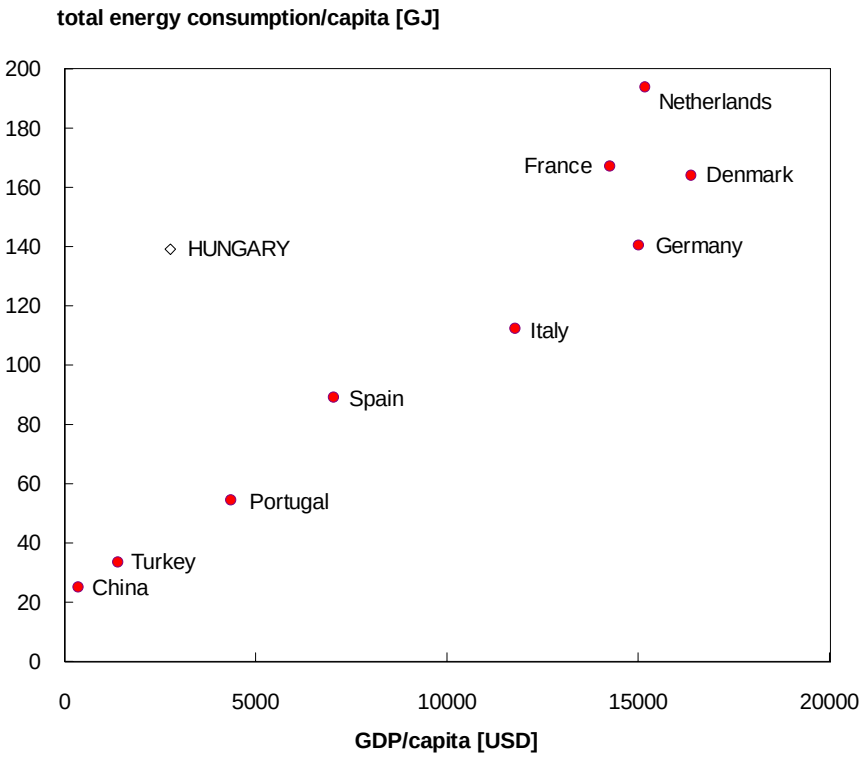
Since 1980, there has been a simultaneous shift in the total energy consumption figures with its residential-communal share on the increase, and reduction of the proportion used in manufacturing branches. After 1987, these changes accelerated, since a number of organisations in the productive sector, mostly industrial consumers, were forced to liquidate unprofitable economic activities and thus also energy use linked to these activities ceased. As a result, the total energy consumption of the productive sector decreased by about 35 % between 1987 and 1992 and first of all the energy consumption of the most energy intensive basic material industries went back. Increase of the energy consumption in the residential-commercial sector was due to the restructuring of the economic pattern: the rapid emerging of new small enterprises was to be observed in this sector.

Changes in the consumption of electricity by different sectors were similar but not identical. Consumption in the production sector, including industry, decreased due to a drop in production. The former increases seen in residential-household electricity consumption patterns were maintained partly due to the increased number and use of electrical appliances (and grade of mechanisation of households and partly to growth of production-aimed energy consumption in the households). Important changes which took place at the main energy consumers of the country are as follows (*MIT, 1994a*):

- total energy consumption for the industry was 40 % lower in 1993 than in 1987. This change can be explained by the economic setback and structural process: during these years the production fell in metallurgy by 51 %, in building materials industry by 33 %, in chemical industry by 40 %, in textile, shoes, etc. by 35 %, in food industry by 23 %;
- energy consumption in the transport sector had an average annual increase of 1.9 % between 1985-1990, but during the past three years the annual decrease amounted to 5-10 %. Despite the rapid increase in the number of personal road vehicles, the change in this trend is due to the significant rise in gasoline prices;

- although the total consumption level for agriculture, forestry, commerce, residential-communal sector was less by 13 % than that in 1987, their proportion within the total consumption of the country increased from 48.2 % to 55.5 %. In this sector, the largest consumer group is households, which requires presently 37 % of the final energy consumption (while its proportion was 29.5 % in 1987).

Figure 3.1. Energy intensity in Hungary and selected developing and OECD countries



Source: ECN, 1992

Energy production and supply

Domestic primary energy production has been decreasing since 1989. In 1993, it fell below the 1970 level to 568.3 PJ. Net energy import - not including the electricity produced by the single nuclear power plant which used imported nuclear fuel - is maintained at about 45-49 %, which cannot be regarded as exaggerated in international comparison. Domestic production of the main energy carriers has seen the following trends for the last three years (*Szergényi, 1993*):

- Coal mining was reduced to 14.6 Mt in 1993 from the 17.5 Mt in 1990. Within this volume the reduction took place at the deep mines, whilst the open pit lignite production increased by 30 %.
- In spite of Hungarian Oil Co. (MOL Rt) efforts the domestic crude oil production could not be maintained at the 1.96 Mt level of 1990, it reached only 1.71 Mt in 1993. Further decreases are expected due to depleting reserves.
- Although the production of natural gas had a modest increase in comparison to 1990 and it was slightly over 5 billion m^3 in 1993, the extraction will decrease due to depletion of reserves.
- Electricity demand of 34.9 TWh for 1993 was mostly covered by domestic power plants - with the share of 13.79 TWh generated by the Paks Nuclear Power Plant and 17.97 TWh provided by fossil fuelled plants. It means unchanged share in case of nuclear plant and an essential increase of the production of fossil fuelled power plants.

- The share of hydro-carbons in the total energy import amounting to 576.4 PJ in 1993 and consisting of 4.8 Mt (318 PJ) of crude oil and 5.8 billion m^3 (200 PJ) of natural gas, which is a slight reduction compared to 1990. The largest reduction took place in the electricity import: net import of 11.1 TWh in 1990 fell back to 2.5 TWh in 1993.

Dependency on primary energy import decreased slightly from 53.1 % to 51.6 %, basing calculations on the ratio of imports within the total of all sources. In the future a significant increase in natural gas imports will likely to be necessary due to the development of electricity generation based on gas turbines, coupled with other trends in residential gas supply. Given this potential increase, the augmentation of gas import possibilities is to be regarded as main target of the energy supply strategy.

Pricing and end-use taxation

In the centrally planned economy period, the price and costs of the different types of energy were artificially low in Hungary. The prices had been regulated by the State Office of Prices and were fairly constant for a long period, remaining independent of the variations experienced in the world market prices. Given this situation, there were no incentives to conserve energy or motivation to install effective technologies or equipment. Due to these factors, the overall energy intensity of the different consumers and productive sectors had been very disadvantageous.

Oil product prices (excluding those for the PB-gas) were liberalised since January 1, 1991. The prices for coal, coal products and PB-gas were also liberalised beginning March 1, 1992. Determination of the fees for district heating and provision of hot water supply was up to the authorities of local municipalities. For all energy carriers supplied by Hungarian Power Co. (MVM Rt), the operated power plants belong to the pricing authority of the Minister of Industry and Trade. Presently, the price of the electricity is established according to three so-called consumption blocks with different consumption limits and unit prices for daytime or night consumption. Prices for the separately metered night consumption are lower and the block limits larger. At present, the natural gas supply has three price categories: supply fee category, general consumption category and household consumption category. A special category for the chemical industry was abolished from December 31, 1993.

The consumer prices for energy carriers include 10 % VAT (with the exception of gasoline and diesel oil, which both include 25 % VAT, consumption tax, environment fee and contribution to a special fund for road network development.) On July 25, 1994 the XLI/1994 Law on Gas Supply entered into force and in accordance with it, the Hungarian Energy Office was established. This office is responsible for energy pricing policy planning and regulation for energy carriers who fall under general regulation. Establishment of regulated prices and conditions of application are regulated under the LXXXVII/1990 Law on Establishment of Prices until December 31, 1996. By this time, the cross financing contained within the individual price categories will be abolished according to the above aforementioned laws.

ENERGY PROFILE

Main energy sector indicators in Hungary

	1988	1992
Energy supply (PJ)	1440	1118
- domestic production	48 %	50 %
- import	51 %	48 %
- stock decreasing	<1 %	2 %
Energy sources by fuels		
- coal and other solid	24 %	20 %
- liquid hydrocarbons	31 %	34 %
- gaseous hydrocarbons	28 %	30 %
- electricity	17 %	16 %

Source: State Authority for Energy Management and Energy Safety (ÁEEF)

3.1.3. Economic outlook into the future

Regarding the dynamics of national production, the period up to year 2000 can be divided into two distinct sections. In the first period of 1994-1995, the estimated annual growth rate of industrial GDP will be 0-3 %. Successful crisis management and stabilisation practices may be established in the second half of the period (1996-2000). For this period, the estimated annual growth rate is 4-5 % for industry and 5-7 % in the building industry (Table 3.1).

Table 3.1. The estimated annual growth rate of GDP between 1994 and 2000 in the industrial and building industrial sectors

	1994 - 1995 %/year	**1996 - 2000 %/year**
Industry	0 - 3	4 - 5
Building industry	0 - 3	5 - 7
Economy general	-1 - 0	0 - 2

Source: Ministry of Finance

The uncertainties in these projections are rather high which is just one feature of the present transition period. As a consequence, the medium and even more the longer term energy scenarios reflect these uncertainties which make difficult the energy supply planning or formulation of the energy strategy for the horizons necessary for the Convention related projections. Nevertheless, some of the sectors seems to follow well predictable trends - like the increasing transport sector - which have a considerable share in the overall energy balance and responsible for essential amounts of pollutants emissions.

EXPECTED GROWING SECTORS

1995
- supply of equipment to small enterprises in food industry
- passenger-car production
- industry branches associated with environmental protection
- pharmaceutical industry
- plastics processing
- printing industry
- building material industry
- textile-garment industry

2000
- supply of equipment to small enterprises in food and agricultural industries
- power-industry engines
- supplying passenger-car industry
- non-consumer electr. appliances
- branches related to environmental protection
- pharmaceutical industry
- fine-chemical industry
- printing industry
- textile-garment industry
- building-material industry

In the first period between 1994 and 1995, industry's share of employment and GDP figures will continue to decrease. The reasons are as follows:

- the removal of superfluous capacity which had relied on COMECON co-operation, with modernisation of remaining capacity expected to be in progress for the entire period;
- the reduction of traditional activities (mining, metallurgy, textiles, garment and shoe industry, timber processing, etc.) continues, and although the pace will be somewhat accelerated by import competition, it will be curbed by employment considerations;
- the rate of expansion in the service sector is exceeding that of industry. At present the volume of industrial investment is not sufficient to replace obsolete capacity, factory buildings are scarce and the modernisation of existing ones is a rare phenomenon.

The number of those employed in industry is expected to total 650,000 to 700,000 by the turn of the century. However, the decrease of industry's share of the national economy does not necessarily imply a continuous decline in production of individual sectors. The main factors reflecting economic development are as follows:

- the adaptability of domestic companies and entrepreneurs;
- the appropriate level of state participation in economic life;
- an improved external orientation (especially regarding integration into the EU);
- the effectiveness of foreign capital investments in easing debt service burdens and improving the economy.

3.2. Geography and climate

Geography

Hungary is located in the Carpathian Basin in the heart of Europe. The area of the country is less than 1 % of Europe: the extent in north-south direction is 268 km; in west-east direction is 528 km; the total length of border is around 2300 km (*CSO, 1985*). Hungary is a typical low-lying country: 73 % of its territory is flatland which is less than 200 meters above the sea level.

Six major terrains can be identified: the Great Plain and Little Plain are filled lowlands, while the Transdanubian Hills, the Transdanubian Mountains, the Subalpine Region and the Northern Mountains are denuded formations.

GEOGRAPHICAL PROFILE

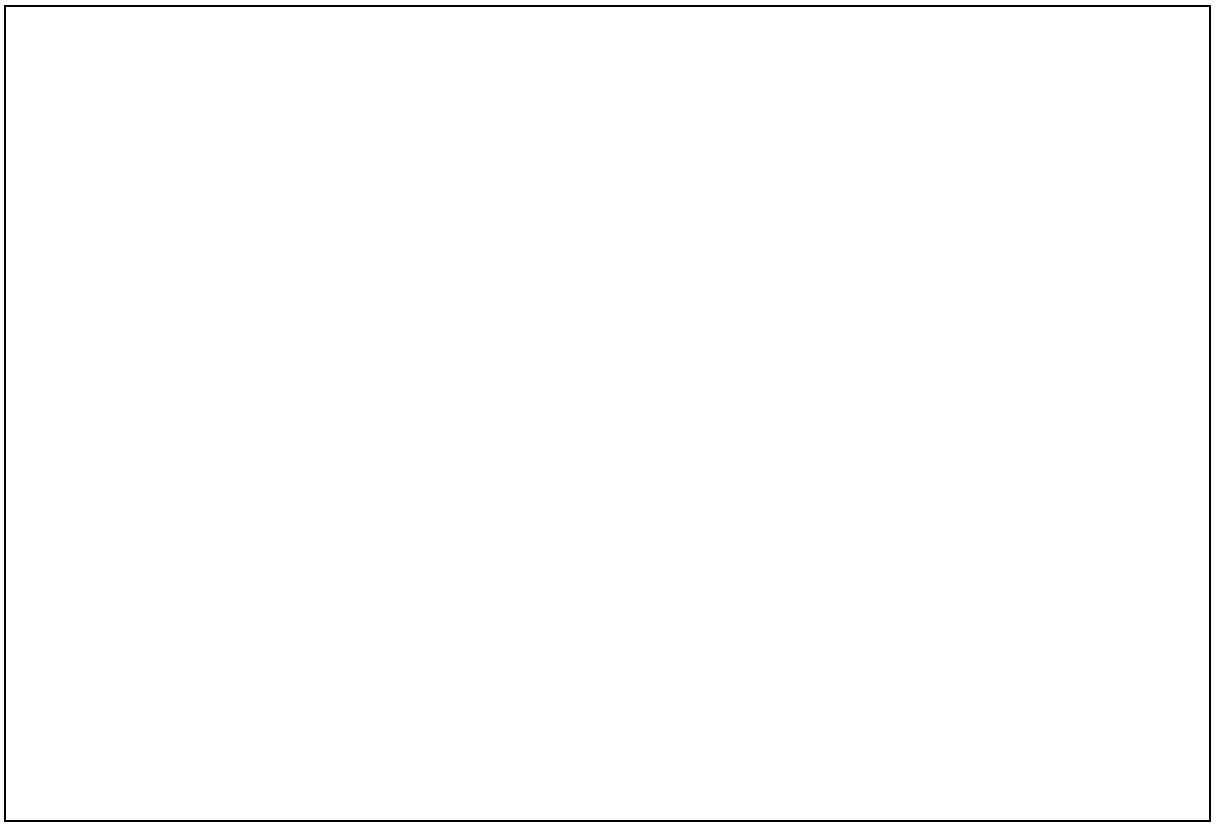
- its territory amounts to 93 030 km^2
- 93 % of its surface is covered with loose sedimentary rock
- the country's territory represents the lowest part of the Carpathian Basin covering an overall area of about 300,000 km^2
- 94 % of surface water comes from abroad
- 58 % of the surface is covered with loose rocks and another 4.4 % of it is covered with karstic rocks
- as a results of its geological structure, the country is relatively poor in mineral resources
- in the Carpathian Basin surrounded with high mountains ranges the prevailing winds are the western and northern ones

Source: HNC, 1991

The country belongs to the catchment area of Danube and Tisza and these effluents. The Lake Balaton with its area of 600 km^2 is one of the largest lakes in Europe. Bauxite, brown coal, lignite and hydrocarbons are the most significant mineral resources found in Hungary, while, as a result of past volcanic activity, the country is also rich with thermal springs.

The number of inhabitants is 10.6 millions (1993) with a medium range population density of 115 capita/km^2.

Figure 3.2. Geographical map of Hungary

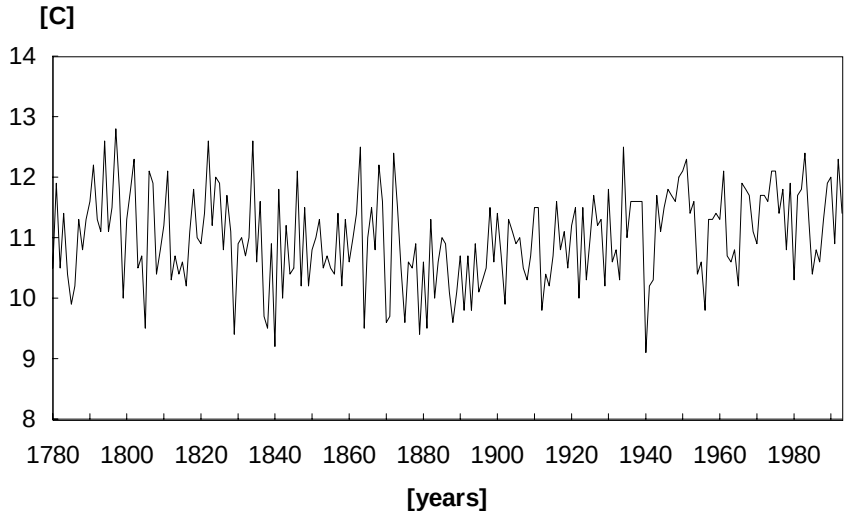


Climate

Hungary is located at the shifting frontier between the temperate continental (with hot summer and relatively cold winter) and the Mediterranean (with hot, dry summer and rainy winter) climate zones with complementary effects of the temperate oceanic climate.

In general, the mean annual precipitation varies between 400-800 mm throughout the country with large interannual variability. The driest part is the Great Plain, and the rainiest part is area along the western border of the country. One of the main climatic features of the climate is the insufficient precipitation with a tendency for dryness and frequent droughts especially in the above mentioned Great Plain area. This part of Hungary belongs entirely to the semiarid and dry subhumid climatic belts. The significance of the insufficient precipitation has increased in the last 15 years which might be a dangerous indicator of the increasing drought frequency for this area.

Figure 3.3. Annual average temperature in Budapest



Source: Hungarian Meteorological Service

CLIMATE PROFILE

	winter	summer	annual
temperature (C)	0.0	20.1	10.2
absolute max. temperature :			41.3
absolute min. temperature :			-35.0
precipitation (mm)	100	200	580
absolute max. annual precipitation amount :			1510
absolute minimum annual precipitation amount :			235
absolute maximum daily precipitation:			260
evapotranspiration (mm)	50	220	550
prevailing wind	W-NW	NW, N-NE	
absolute maximum measured wind gust (m/s):			44.5
absolute maximum estimated wind gust (m/s):			87-103
cloud amount (%)	45	70	57
absolute maximum sunshine duration (hours):			2496
absolute minimum sunshine duration (hours):			1398
snow covered days	35		
absolute maximum snow depth (cm):	151		

Source: Hungarian Meteorological Service

The annual mean temperature is about 9-11 C. The hottest month is typically July with monthly mean of 20-22 C while the coldest month is January with monthly mean of 1-4 C. The mean temperature of January shows the highest interannual variation. The average temperature difference between the coldest and the warmest January exceed 15-17 C over the past hundred years. This difference is only 6-9 C in July. The last day with frost in the spring time usually takes place at the middle of April and the first frost in autumn usually occurs in the last week of October. The mean length of the period without frost is about 180-220 days. The mean numbers of "hot days" with maximum daily temperature being equal or higher than 30 C, varies between 15-30 days with increasing tendency during the last ten years. The mean values of the "winter days" with highest daily temperature being equal or lower than 0 C varies between 25-40 days.

3.3. Monitoring and research of the climate system

Monitoring

The observation of climate has a great past in Hungary: for instance the air temperature has been measured since the mid-17s at the town of Buda. At present, the detailed climatic parameters are observed at about one hundred meteorological stations supervised by the Hungarian Meteorological Service and which provide data for climatological information services and research activities. This climatological surface observation network is supplemented by more than eight hundred rain gauges.

In a rural area in vicinity city of Kecskemét a regional background air pollution monitoring station and laboratory is maintained. This station is part of the UNEP's Global Environment Monitoring System (GEMS) and several international monitoring networks (BAPMON, EMEP) and research programmes (EUREKA). At this station, among others, the following air pollutants are measured, which are important in studies of greenhouse effect of the atmosphere: atmospheric concentrations of carbon-dioxide, nitrous-oxide, sulphur-dioxide, ammonium, tropospheric ozone and composition of aerosols. In the most polluted cities some components of air quality (sulphur dioxide, nitrogen oxides, carbon monoxide, dust, etc.) are continuously measured providing data for air quality planning and measures, public information, research and - in the case of Budapest - for smog alert. This system is maintained by the Institute for Public Health. In the recent years important in-field observing experiments were conducted which provided information on cycle of the greenhouse gases or on the impacts of climatic variability on the carbon uptake by forests, the vertical fluxes of methane, carbon dioxide and sulphur dioxide, some agroclimatic observations.)

Research

The first comprehensive studies on the anticipated climate change and its possible global and regional implications were published in late 1970s. In Hungary experts, politicians and the general public are increasingly concerned about the hazardous processes in the ambient environment and their possible significant ecological and socio-economic effects. In the past decade the main research directions were as follows (*HNC, 1992a*):

- monitoring of atmospheric environment, climate and ecosystems, with special emphasis on the detection of possible long-term changes in their states;
- estimation of recent trends and setting of future scenarios for the anthropogenic greenhouse gas emissions;
- investigation of regional climate change scenarios and assessment of the associated environmental, social and economic impacts.

In recent years, the Hungarian Ministry for Environment and Regional Policy has commissioned various research institutes, governmental and expert bodies to undertake a series of studies on greenhouse gas emission analysis, climate change monitoring, impact assessment and appropriate response strategies.

Research programmes of regional climate modelling and preliminary estimations of greenhouse gas emissions have also been carried out with the support of the Hungarian Academy of Sciences since mid 1980's.

In order to summarise the state-of-art of the climate change research and to draw the attention of the general public and the decision makers to this hazard, a scientific overview was prepared by the Climate Subcommittee of Hungarian Academy of Sciences (*HAS, 1991*) on this issue and the relevant tasks.

3.4. International co-operation

Given the global nature of the subject, internationally co-ordinated efforts are required in the following areas: elaboration of aims and tasks in environmental policy; observation of the Earth's atmosphere and observational data exchange; co-ordination of researches; development for and application of technologies necessary to reduce environmental effects of industry and other sectors; monetary, legal, institutional and international trade problems in connection with the protection of atmospheric environment and reduction of climate change risk, respectively. In the implementation of the Convention, special attention should be paid to the specific environmental, economic conditions of certain regions and their potentials, with due regard to our particular region.

Climate change is such a grave problem threatening the development of mankind that the Hungarian government, keeping national interests in mind, considers it highly important. Accordingly, we feel that our tasks are as follows:

- to participate to the greatest possible extent in the elaboration and enforcement of the convention on climate change;
- to closely study the possibility of setting limits for atmospheric emissions at the national level;
- elaborate the adequate mitigation options regarding to our special economic and social circumstances;
- continue observations and analysis of the atmospheric environment and related changes of the environmental components in accordance with the requirements of international co-operation;
- survey of our afforestation potentialities and grass plantation being also relevant to this subject.

The following climate-related co-operation has been established in the recent years:

Netherlands-Hungary co-operation

The Netherlands' - Hungary bilateral co-operation in the field of environment is based on a Memorandum of Understanding between our two environment ministries. The subject of climate change has been adopted in the annual programmes. Co-operation between our two countries has been fruitful at the highest policy-maker's level as well as at the expert level. Stimulated by the negotiating process for a climate convention. Hungarian experts carried out tentative assessments of national greenhouse gas emissions and their scenarios. At the time, the Netherlands' Government suggested to start bilateral co-operation leading to the formulation of the official Hungarian position in the negotiations. This co-operation intended to identify areas of common interests between Hungarian economic development and global climate protection. Since the reaction was positive the project formulation for this comparative study started, with the assistance of Dutch climate and energy experts.

The objectives of the project were to elaborate on a possible Hungarian position on climate change, including its consequences for energy production, energy efficiency and related issues. A possible Hungarian action programme to stabilise CO_2 emissions was to be prepared and discussed. Finally, the global environmental implications of greenhouse gas emissions, particularly of CO_2, and the implications for the international position of Hungary in its relation with other European countries were to be presented to all relevant Hungarian organisations.

It was also used during several meetings held subsequently with Ministry officials, members of the Parliament, and the Subcommittee in which European Communities and Netherlands positions on climate change were explained, and the case was made for a preliminary Hungarian position to stabilise emission of CO_2. This project between Hungary and Netherlands resulted in a joint publication, with a preface signed by both ministers, published in early 1994 (*HCSD, 1994)*. Both the Netherlands and Hungary have expressed a desire to continue the bilateral co-operation. The last six months (and the remainder of 1994) the co-operation mainly focused on the preparation of National Communication for the FCCC.

Norwegian-Hungarian co-operation

A project was initiated by the Norwegian institute CICERO from the Norwegian Government which focuses on some long-term response policy options for the Hungarian climate-energy strategy. This climate-related project started at the beginning of 1994 under the auspices of Norwegian-Hungarian bilateral environmental co-operation and its emphasis is based on the advanced Norwegian experience in field of energy and environment related policy, financial and technology measures.

U.S. Country Study Programme

In March of 1993 a project proposal for a comprehensive study programme was submitted under the framework of the U.S. Country Study Initiative. The principal objective of the original project was to provide substantial contribution to the implementation of reporting (first national communication) commitments in accordance with the Convention. This proposal addressed the development of an inventory of sources and sinks of greenhouse gas emissions, an assessment of vulnerability to climate change, the evaluation of several options to mitigate greenhouse gas emissions. After repeated consultations with the U.S. co-ordinators and modifications of the proposal, the final version includes the following principal objectives:

- improvement and development of an inventory of sources and sinks with primary focus on the sectoral assessments;
- development of scenarios and concrete long-term sector-based response policies to assist the national policy planning with particular attention on the energy savings/efficiency aspects;

Actually, such studies will also assist in the formulation of key elements of the national action programme in compliance with the commitments of the Convention. The project proposal was officially approved on 15 September, 1994.

Other international collaborations

It should be also mentioned that Hungary joined the OECD project on development of the methodology for the content, review and evaluation of the first national communications. In the initial phase of this project, a country visit was made to Hungary by the expert team of OECD and the International Energy Agency (IEA) to audit the national capacities and resources in order to fulfil the Convention's commitments. Hungary also took high priority of the consultations among the four Central European countries (the Visegrád group consisting of Czech Republic, Hungary, Poland and Slovak Republic) in the context of the implementation of the Convention.

Chapter 4
INVENTORIES OF GREENHOUSE GAS EMISSIONS AND REMOVALS

4.1. Introduction

One of the principal purposes of the derivation of greenhouse gas inventories is the identification of main sectors, subsectors and technologies that contribute on national level to the anthropogenic greenhouse gas balance either by emission or by removal. A comprehensive and reliable inventory can be a starting point for formulation of mitigation policies and measures and their effects on emissions. The Intergovernmental Panel on Climate Change in co-operation with an OECD team has elaborated guidelines in order to develop comparable national inventories. According to the decision by the Intergovernmental Negotiating Committee (Decision 9/2 accepted by the ninth session) these "Draft Guidelines for National Greenhouse Gas Inventories" should be used in estimating, reporting and verifying inventory data. Consequently, these guidelines and the recommended methodology were taken into consideration, when the Hungarian inventory was compiled. According to these guidelines, at least emission data of CO_2, CH_4 and N_2O are to be reported in the national inventories, while the provision of information on other greenhouse gases (NO_x, CO, NMVOC etc.) is encouraged. The estimated level of uncertainty should also be included in the inventories.

PRELIMINARY ESTIMATIONS FOR DOMESTIC GREENHOUSE GAS EMISSIONS

	year	CO_2 **(Gg)**	CH_4 **(Gg)**	N_2O **(Gg)**
Jászay (1989)	1985	90000		
MERP (1990)	1985	88800	440-800	
Szepesi (1992)	1985	99000	398	> 28.0
Tajthy (1993)	1985		466	$^{+}$8.6
HCSD (1994)	1985	89100		
MERP (1990)	1986	87000		
Mészáros& Molnár (1992)	1986		427-900	> 59.0
Lévai &Mészáros (1989)	1987	87633		
MERP (1990)	1987	87400		
MERP (1990)	1988	84600		
HCSD (1994)	1988	84500		
HCSD (1994)	1989	81400		
HCSD (1994)	1990	74000		
Tajthy (1993)	1990		421	$^{+}$7.2
MERP (1992)	1990		581	

$^{+}$: only for fossil fuel sources

Although the recommended methodology and reporting format used in the compilation of the Hungarian inventory, it was necessary to deviate from it in certain cases. These deviations are always made clear and explained. The emission calculations are separated for combustion and non-combustion sources, and refers to the period of 1985-1987. Hereinafter the period of 1985-1987 is defined as a base period for the greenhouse gas emission reduction. The greenhouse gas emission inventories for 1990 (in the sequel called as reference year) are provided only as supplementary information. Although certain first-guess assessments of greenhouse gas emissions were derived to

form the preliminary position regarding to the Convention, Hungary has not elaborated an emission inventory either by IPCC/OECD or CORINAIR methodology yet. Due to the lack of relevant research, the default emission factors recommended by the IPCC/OECD methodology were subsequently used. Considering the incomplete list of default emission factors for N_2O, NO_x and NMVOCs, the recommended methodology was used for CO_2 and CH_4 only. The VOC emission calculation for 1988 and 1991 (that is also calculated by a non-IPCC/OECD methodology) is shown in Section 5.4. It should be mentioned that the methane and NMVOC sources are not separated in this calculation, therefore, the total VOC emissions including methane have been presented.

It should also be noted that the preliminary estimations for methane and nitrous oxide emission are more uncertain than the CO_2 ones mainly due to the lack of available production data and the unknown emission factors. Despite the significant uncertainty in these estimates, the decreasing tendency in the emissions during the late 1980s (*Tajthy, 1993*) is an obvious consequence of the same factors which characterised the CO_2 emissions (decline of the relevant sectors). Therefore, the year 1990 seems not to be a realistic base year for the longer term emission stabilisation targets for these gases as well.

The activity/production data base is shown in Annex A. The detailed inventories of CO_2 and CH_4 emissions and removals are presented in Annex B and Annex C. Preliminary assessments for emissions of N_2O, NO_x and VOC are also enclosed in Annex D.

4.2. Key assumptions and lack of information

With the lack of appropriate data the present inventories can not contain all the types of greenhouse gas emissions that are recommended by the IPCC/OECD methodology. Most of the problems are based on the existence and adequacy of emission factors and on the lack of certain activity/production data. Moreover, some methodological problems were also recognised as a result of discrepancies found in the distributed software version and in the Workbook & Reference Manual of the IPCC/OECD methodology. With the lack of data and research needs, present analysis follows the Polish in-depth review (*FEWE, 1993, Radwanski, 1993*). The non-available data and the divergence from the methodology used can be summarised as follows:

1A - Energy Fuel Combustion Activities: No emission factors are available for non-CO_2 emissions except for biofuel combustion and electricity generation. Due to the statistical classification of the Hungarian energy sector, the category of “1.A.1 Energy production Industries” includes the transformation industries, as well. Similarly, the “1.A.4. Commercial and institutional activities” includes the trade sector as a whole. In general definitions and categorisation of fuels in the Hungarian nomenclature correspond to the definitions of the IEA. However, in case of certain groups of products there are slight differences. The relevant differences are as follows:

- In the Hungarian energy statistical system “Kerosene” and “Jet fuel” are still not separated within the group of oil products. Separation could only be made by estimation. “Jet fuel” data is therefore included in the category “Kerosene”. The category “Gasoline” covers both the gasoline used in olefin production and motor gasoline. The emission from international bunkers is included, but it can not be regarded as a separated source of emissions.
- Breakdown of oil products in the Hungarian statistics is not more detailed than that of the IEA. Therefore the category “Other Oil Products” includes all products which belong to categories “Lubricants” “Petroleum Coke” “Refinery Feedstocks” and “Other Oil Products” in the IEA statistics. Separation of these materials would be very uncertain in the Hungarian statistical system.
- Separation of different sorts of coal is based on different calorific value limits compared to those used in the IEA system. It does not cause any considerable differences in calculation of either energy consumption or emissions.
- The domestic registration system of renewable energy carriers covers only a certain part of their use. Production and consumption of fuelwood and charcoal are registered completely. However, the quantity of industrial wastes and agricultural residues used for energy production is probably higher in reality than the corresponding data reveals.

CLASSIFICATION OF COAL (unit: MJ/kg)

	lignite	brown coal	hard coal
Hungarian energy statistics	3.5-10.0	10.0-17.0	17.0-33.0
IEA/EUROSTAT statistics	<17.4	17.4-23.9	>23.9

Source: State Authority for Energy Management and Energy Safety (ÁEEF)

1B - Fugitive Fuel Emissions: No emission factors are available for CO_2 and NMVOC fugitive fuel emissions.

2 - Industrial Processes: No emission factors are available for CO_2, CH_4 and N_2O emissions, except for CO_2 emission from cement production. The "2.E. Non-metallic products" classification includes only the cement and lime productions.

3 - Solvent use: The Hungarian statistical data system does not provide the sectoral distribution required by the methodology. The NMVOC emission - as it is mentioned above - is calculated using a procedure developed by the Institute for Environmental Protection, Hungary, and the emission factors can be regarded as country specific.

4 - Agriculture:" The burning of agricultural waste is almost negligible in Hungary, therefore, it is considered to be zero.

5 - Land use and forestry: No data are available for the extension of forest clearing and grassland conversion.

6.- Wastes: No reliable data is available for the wastes due to the lack of information on waste structure including ingredients, moisture, fragmentation and density.

4.3. Emissions from combustion activities

4.3.1. Energy data

The energy sector is one of the main sources of the greenhouse gases. Emission of the whole scale of greenhouse gas emissions (CO_2, CH_4, N_2O, NO_x, CO and NMVOC) is connected with the energy production, transformation, transmission and consumption processes.

Determination of emissions connected with the use of energy carriers should be based on a reliable energy statistical system. Energy data have already been collected in Hungary for more than fifty years, and national energy balances have been compiled since the beginning of the 1950's. The energy statistical system has changed considerably during the past decades. Two simultaneous energy statistical systems were maintained for a considerable period in Hungary. The first system functioned in the Central Statistical Office, while the other one was under the auspices of the Ministry of Industry and Trade (MIT). The latter was operationally managed from the beginning by the State Authority for Energy Management and Energy Safety (ÁEEF). Liquidation of parallel activities of these two systems was reached in 1986 by shifting the entire responsibility for this information system to the State Authority for Energy Management and Energy Safety.

As a consequence of the above mentioned parallelism, data of different years supplied for international organisations were sometimes presented by different Hungarian institutions which consequently differed to some extent, therefore some of the data had to be adjusted later.

The structure of the energy balances in Hungary differs in some instances from that used in developed countries and various international organisations. The methodology created by energy statistics organisations of the OECD-IEA and United Nations was used in Hungary first in the mid 1980s.

The determination of greenhouse gas emissions is based on the official Hungarian national energy balance produced and published in particular for the IEA review process. Therefore structure of this information provision system corresponds to the methodology applied by the IEA and the definitions and categories are also in accordance with the IEA-system.

Source of the basic data is the regular data collection activity of the State Authority for Energy Management and Energy Safety. These data are supplied by energy producing firms, by firms dealing with foreign and domestic trade of energy carriers, by energy suppliers (utilities) and by certain energy consumers. The legal basis for this statistical system is provided by the Statistical Law XLVI/1993 and the Governmental Resolution No. 170/1993

4.3.2. Greenhouse gas emissions for the base period and for 1990

CO_2 emissions

The greatest part of CO_2 emissions is generated by fuel combustion. In the base period it was about 80 Mt, but it dropped to 68 Mt by 1990. The result is in accordance with previous estimations (see *MERP, 1990; HCSD, 1994; Jászay, 1989; Szepesi, 1992; Lévai and Mészáros, 1989*), although these estimations showed the actual CO_2 emission a little bit higher. The difference can be explained by the fact that the IPCC default emission factors were used for the development of the present inventory. Regarding the sectoral structure of CO_2 emission concerns, in case of fuel combustion, almost half of the total emission stems from the transformation processes.

Share of the residential sector reaches almost 25 % of the total CO_2 emission. The most recent assessments for the CO_2 (and other gases) by *Molnár and Mészáros (1994)* are in close correspondence with the presented ones within the limits of indicated uncertainties.

Table 4.1. Distribution of fuel-related CO_2 emissions by main fuel categories

	Energy consumption (PJ/year)		**CO_2 emissions (Gg/year)**	
Fuel type	**base period (1985-1987)**	**reference year (1990)**	**base period (1985-1987)**	**reference year (1990)**
Natural Gas (dry)	379.4	373.2	20552	20404
Liquid Fuel (total)	397.7	343.8	25054	21759
Solid Fuel (total)	353.8	267.5	34483	25942
Total	**1130.9**	**984.5**	**80089**	**68105**
Biomass[1] (solid)	13.3	9.4	1445	1011

[1] in accordance with the recommended methodology, the biomass related data are given separately

Figure 4.1. Total CO_2 emission and removal by sectors

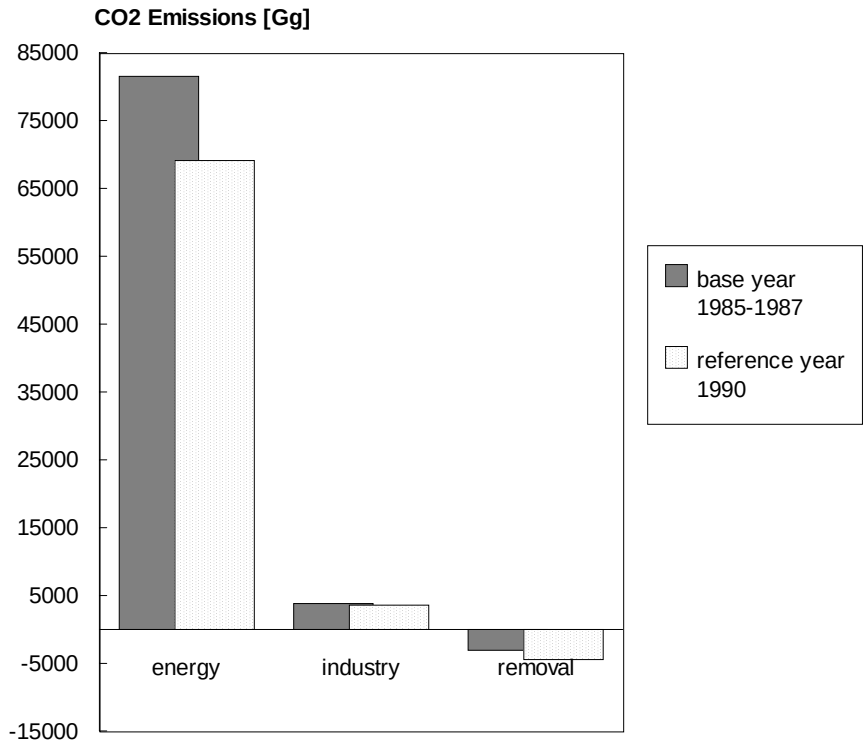
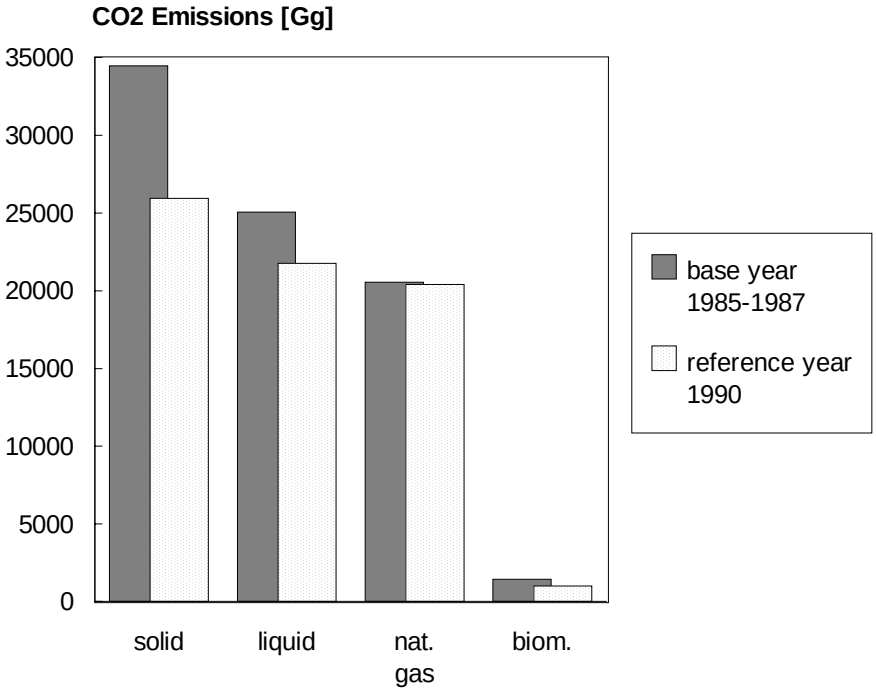


Figure 4.2. Total CO_2 emission and removal by sources



CH_4, N_2O, CO and NO_x emissions

The only category of combustion activities for which emissions are estimated is the biofuel combustion (see below). In lack of specific emission factors there is no estimations at the moment for either sectoral or total CH_4 and N_2O emissions generated by combustion calculated by the IPCC/OECD methodology. Tables 4.2a and 4.2b summarise the biofuel emission for methane, CO, N_2O and NO_x. The emission factors are the recommended default values. It should be mentioned that values for CO and NO_x emissions are only indicative values not to be considered as the part of present inventory calculations.

Table 4.2a. Biofuel emissions in the base period

Biofuel type	**Emissions (Gg/year)**			
	CH_4	**CO**	**N_2O**	**NO_x**
Wood	7.192	62.930	0.049	1.166
Charcoal Consumption	0.005	0.420	-	-
Charcoal Production	0.084	0.140	-	0.002
Agricultural Residues	0.430	9.030	0.010	0.251
Total Biofuels	**7.710**	**72.520**	**0.059**	**1.419**

Table 4.2b. Biofuel emission in 1990

Biofuel Type	**Emissions (Gg)**			
	CH_4	**CO**	**N_2O**	**NO_x**
Wood	5.024	43.959	0.035	0.814
Charcoal Consumption	0.005	0.420	-	-
Charcoal Production	0.084	0.140	-	0.002
Agricultural Residues	0.493	10.360	0.013	0.287
Total Biofuels	**5.606**	**54.879**	**0.048**	**1.103**

4.3.3. Uncertainty

In determination of greenhouse gas emission data it is very important to analyse the reliability of the source information with special regard to reliability of the energy. Reliability of the Hungarian energy statistical data is ensured by a multilevel checking procedures. Two main factors influence the uncertainty of energy statistical data; firstly, the uncertainty of determination of the source data and, secondly, the uncertainty of data collection and data processing. Uncertainty of the source data depends basically on measurement errors. Moreover errors of registration of the measured data also have to be taken into account. This means that uncertainty is determined by the technical conditions the proficiency and precision of data suppliers.

In case of solid fuels the uncertainty in the energy activity data is cca. 5-7 %, while in case of natural gas and oil (crude oil and oil products) it is cca. 3-4 %. The renewable energy sources and wastes used for energy purposes concerns the estimated uncertainty is 10-15 %. It should however be noted that in this group observations does not cover all activities. Taking into account these uncertainty levels, the uncertainty of data concerning the national use of energy carriers is around 4-5 %.

Uncertainty of greenhouse gas emissions depends not only on reliability of energy consumption data, but it is also influenced by the uncertainties in the emission factors. As different emissions

have to be taken into account for different types of energy consumption, it is important to determine the emission factors for the particular technologies and equipment as precise as possible. At present the uncertainties of these factors are greater than those of energy consumption or of other energy data. Future investigations should focus on improvement of the determination of energy consumption and emission factors for those technologies that are relevant from the viewpoint of emission calculations.

QUALITATIVE ANALYSIS OF UNCERTAINTY IN ENERGY DATA

High reliability level

Production and export-import subsystem of fossil fuels (and electricity)
Marketing data of energy suppliers
Energy transformation data
Consumption of relevant consumers

Medium reliability level

Consumption data of smaller consumers
Energetic data of the counties
Energy consumption of different branches

Low reliability level

Specific consumption data of smaller consumers (e.g. consumption for heating or technological purposes etc.)
Production and consumption data for certain groups of renewable energy carriers

Source: State Authority for Energy Management and Energy Safety

4.4. Emissions from non-combustion activities

CO_2 emission form cement production

The largest source of industrial CO_2 emission is the cement production. There is no significant change in the emission between the base period and 1990. However, it should be mentioned that production level of clinker cement can only be estimated at a low reliability level for 1990.

Table 4.3. CO_2 emission from cement production (Gg/year)

Products	Production (base period)	Production (1990)	Emission (base period)	Emission (1990)
Cement	3916	3933	1952	1961
Clinker cement	3225	3170	1635	1608
Total	**7141**	**7103**	**3587**	**3568**

As it is mentioned above, in 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.).

CH_4 emissions from fugitive and agriculture sources

In the present inventory the following sources of CH_4 emission are taken into account:
fugitive fuel emissions, enteric fermentation, animal wastes and rice cultivation.

Such important sources like landfills, wastewater treatment and incineration are omitted in lack of appropriate data. In Hungary coal is produced from both underground and surface mines. It

should be mentioned that in Hungary a considerable decrease of coal mining activity is expected in the next decades. Table 4.4 shows the fugitive fuel emissions. The fugitive sources give around two third of the total methane emissions.

EMISSION FACTORS FOR FUGITIVE SOURCES - COAL MINING
(unit: m^3 CH_4/tonnes)

	Mining	Post mining
Underground mines	17.5	2.5
Surface mines	1.2	0.1

Source: State Authority for Energy Management and Energy Safety

Table 4.4. CH_4 emission from fugitive sources

Fugitive sources	**Emission (Gg/year) base period**	**Emission (Gg/year) 1990**
Oil and Gas Systems	225	199
Coal Production		
- Underground Mines	216	162
- Surface Mines	7	5
Total	**448**	**366**

Tables 4.5a, 4.5b and 4.5c show the CH_4 emissions stemming from enteric fermentation, animal wastes and rice cultivation, respectively. The decrease in methane emission from enteric fermentation and animal wastes is mainly caused by the fall of livestock of beef and sheep. The emission from rice cultivation is regarded as insignificant compared with other sources. The non-combustion CH_4 emissions are summarised in Figure 4.3.

Figure 4.3. Non-combustion CH_4 emission

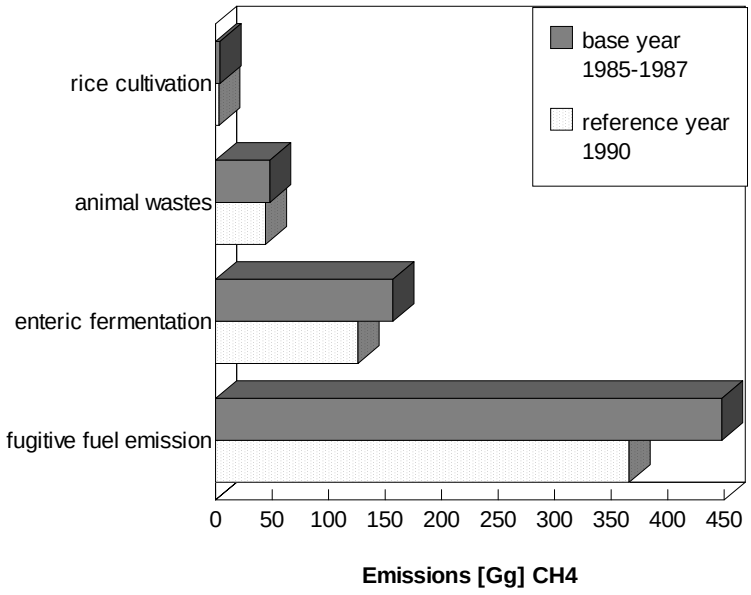


Table 4.5a. CH_4 emission from enteric fermentation

Enteric Fermentation	Emission (Gg/year) base period	Emission (Gg/year) 1990
Cattle		
Beef	79	55
Dairy	56	52
Sheep	12	9
Swine	9	8
Horse	1	1
Poultry	NEF[1]	NEF
Total	**157**	**126**

[1] NEF: No emission factor (no IPCC default emission factors are available)

Table 4.5b. CH_4 emission from animal wastes

Animal Wastes	Emission (Gg/year) base period	Emission (Gg/year) 1990
Cattle		
Beef	4.1	3.8
Dairy	4.2	3.8
Sheep	0.4	0.4
Swine	34.8	32.8
Horse	0.1	0.1
Poultry	4.5	3.5
Total	**48.1**	**44.4**

Table 4.5c. CH_4 emission from rice cultivation

Rice Cultivation	Emission (Gg/year) base period	Emission (Gg/year) 1990
Flooded Regime	1.03	0.66
Intermittent Regime	2.65	2.47
Total	**3.69**	**3.13**

Nitrous-oxide emissions from agricultural soils

The annual N_2O emissions from agricultural soils are estimated to be 6 Gg and 4.1 Gg in the base period and in the reference year, respectively. Estimation was based on the recommended IPCC/OECD methodology.

4.5. Removal of carbon-dioxide

The total area under forest management in Hungary was 1.631 million hectares and 1.674 million hectares in 1985 and 1990, respectively. In Hungary the amount of burning aboveground biomass is negligible (*MoA, 1991, MoA, 1992, MoA, 1994*). According to the IPCC/OECD methodology applied by the default emission factors and conversion parameters, the annual carbon release was 2419 Gg and 3276 Gg in the base period and in 1990, respectively. The carbon uptake was estimated of 845 Gg and 1218 Gg in the same years. In Hungary the net carbon uptake of forests is typically positive. This uptake was also calculated according to the IPCC methodology. The value of CO_2 removal was 3097 Gg in the base period and 4467 Gg in 1990. The uncertainty of agricultural data is cca 2 %.

4.6. Summary of carbon-dioxide and methane emission calculations

The estimates and the recent tendencies

Due to the recent decline of the economy, the CO_2 emission from combustion sources has fallen by 15 % between the period of 1985-1987 and 1990. Owing to the growing sink capacities enhanced by the reforestation, the total net CO_2 emission has dropped about 17 % in the investigated time period. According to the collapse of domestic coal mining and oil production, the methane emission from fugitive sources decreased by 20 % from the base period to 1990. The methane emission from enteric fermentation is also fallen by 20 % caused by the decline of the animal feedstocks. The total methane emission decreased from 616 Gg to 501 Gg by 1990.

Table 4.6. CO_2 and CH_4 emissions and removal summary calculated by the IPCC/OECD methodology (Gg/year)

	base period 1985-1987		**reference year 1990**	
Emission Sources	**CO_2**	**CH_4**	**CO_2**	**CH_4**
Fuel Combustion (CO_2)	80089	-	68105	-
Biofuel Combustion (excl. CO_2)	-	8	-	6
Cement Production	3587	-	3568	-
Fugitive Fuel Combustion	-	448	-	366
Enteric Fermentation	-	157	-	126
Animal Wastes	-	48	-	44
Rice Cultivation	-	4	-	3
Total Emission	**83676**	**665**	**71673**	**545**
Removal	3097	-	4467	-

The overall range of uncertainty

In comparison with the above mentioned preliminary estimations, the CO_2 emission calculated according to the IPCC/OECD methodology is lower. The difference less than 10 %. It shows that the default IPCC/OECD emission factors for carbon-dioxide are not far from the real figures although these country-specific emission factors may be higher than the default values. Moreover, there are other activities which were not taken into account in present inventory (iron, steel production, etc.) in lack of appropriate data. According to our estimations the effect of these activities is cca. 2-3 % difference in CO_2 emission. The uncertainties are more significant in the case of methane emissions, although no quantitative evaluation is available.

Chapter 5
DESCRIPTION OF POLICIES AND MEASURES

5.1. Introduction

The primary objective of the present chapter is to permit an evaluation of all efforts and incentives which meet Hungary's commitments under the Convention. As a highly efficient tools in the emission reduction the far-reaching energy saving programme is discussed. The following section summarises the role of rising of public awareness on the energy consumption in the residential sector. Further, the emission reduction programme of VOCs is presented. The next section introduces the Hungarian forest policy in context of carbon sink enhancement. Although it is encouraged to include the greenhouse gases not controlled by the Montreal Protocol in the National Communication, we also present the country programme for ozone depletion substances. Finally, as a plan for the future, the possible financial mechanisms of greenhouse gas emission stabilisation is discussed.

5.2. National programme of energy efficiency improvement and energy conservation

The efficient use of energy should become the general habit of the actors in the economy. To reach this purpose the preparation of the National Energy Efficiency Improvement and Energy Conservation Programme (NEEIECP) was started in 1991. The Resolution of Parliament (21/1993. /IV.9./OGY) prescribes that a programme should be presented to promote energy saving conservation and efficiency increasing (*MIT, 1994b*). The programme will be implemented in two phases:

- Phase I. The Ministry of Industry and Trade has elaborated the concept of the programme. This concept was accepted by the Government in April. 1994.
- Phase II. On the basis of the concept, the deadline for the preparation of action plan on the legal, financial and institutional background is the end of 1994.

5.2.1. Ongoing energy rationalisation measures in the recent past and currently

During the past two decades some efforts have been taken to promote the efficient use and rationale production of energy. (It should be mentioned that this historical overview is not the part of NEEIECP.

Energy production sector

A wide range of energy rationalisation and diversification programmes has been supported by the World Bank for the last decade:

- The first agreement ("Energy Rationalisation and Diversification I") was signed in 1983 and the programme finished with success in 1990. The total amount of the loan was 109 M USD. The main goals were as follows:
  - energy saving,
  - fuel switching,
  - energy intensity decreasing,
  - structural changes,
  - investment of effective products and technologies.

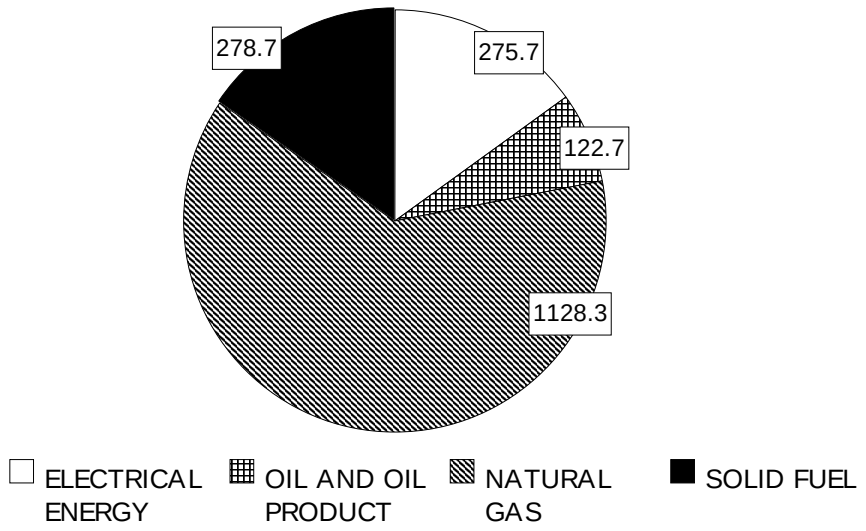
- The second loan agreement (“Energy Rationalisation II“) was signed in 1986 (24 M USD) and finished in 1993. It was subdivided to two subprogrammes (A and B). The goals of programme "A" are similar to the terms under the Loan I (above), whilst programme "B" developed and established a new energy saving monitoring and evaluating system.
- The third loan programme (“Energy Rationalisation III“) agreement was signed in 1989, the planned deadline is 1995 the total amount of the loan is 10 M USD. The main aim is energy-related investments with direct energy saving.
- The fourth loan agreement (“Energy and Environment“) was signed in November 1993 the amount is 100 M USD. The loan is raised by the Hungarian Power Company Ltd. The main goals are the next:
  - a new combined cycle co-generation power plant unit,
  - new dispatching centre,
  - enhanced environment monitoring system,
  - human resource management system development.

The planned deadline is the end of 1999.

Energy consumption sector

In 1991 the German Government made 50 million DEM available to support the purchase of coal by households in order to offset the unsatisfied demand for coal in Hungary ("German coal aid" energy saving credit tender system). On the basis of an agreement signed by Germany and Hungary. the Government declared that the 60 % of the amount received from the sale of coal worth 50 million DEM may be spent on preferential credit facility aimed at energy saving.

Figure 5.1. "German coal aid" credit system: summarised results in energy saving (TJ)



This soft loan programme based on the financial service of the Hungarian Credit Bank which developed a credit tender system with the following aims:

- improvement of end-use efficiency,
- reduction of energy loss,

- utilisation of energy optimising technologies,
- waste-heat utilisation,
- renewable energy utilisation,
- peak demand reduction,
- computer controlled processing system with energy saving,
- improved heat insulation systems,
- lighting system modernisation,
- increase the service background.

In the last three years there were 139 applicants with 25 M USD total investment demand and with 177 M USD soft credit demand. The Tender Jury accepted 57 applicants with 72 M USD loan demand (total investment 95 M USD). The implementation of the accepted tenders resulted about 1.7 PJ in the overall energy saving. The estimated financial benefit of this energy saving cca. 5 M USD/year. The details is given in Figure 5.1.

HISTORY AND RESULTS OF PAST ENERGY RATIONALISATION EFFORTS IN HUNGARY

1954-1968	Programme was mainly based on support received from the budget and included the traditional rationalisation of energy consumption.
1971-1973	Programme based on the increasing role of hydrocarbon fuels (oil and natural gas)
1974-1980	Programme aimed at reducing the impact of the energy crisis.
1981-1990	Several investments were carried out partly supported by the state budget and the World Bank credit facility. Since 1988 saving in energy has not been financially supported directly by the State anymore.
	Results
1954-1990	saving cca. 100 PJ that is approximately 10 % of the total energy consumption of 1992.
1981-1990	cca. 62 PJ fell on the total energy consumption on the last ten years mainly acknowledged by the World Bank soft loans for the implementation of the industrial energy saving and energy diversification.

5.2.2. Objectives of the programme

The basic idea of the NEEIECP is to set up an operational capability for the energy conservation (*MIT, 1991*). The main goals of the energy savings programme can be summarised as follows:

- environment protection,
- reducing the dependency on imports,
- saving domestic energy resources,
- postpone the construction and installation of a new base load power plants,
- increasing the competitiveness of the economy,
- adjustment to the energy policy of EU and to the OECD/IEA recommendations.

5.2.3. Targets and key assumptions

Two targets for medium-range (5 to 10 years) and an other two for long-term (15-20 years) have been set up. The minimum target has the following key assumptions:

- the annual growth rate of GDP is expected to decrease up to 1995. Beyond 1995 the annual growth rate would increase by 1-2 %/years;
- the price system of energy carriers should reflect the realistic expenditure in the years of 1995 and 1996 and the cross-financing to be ceased;
- energy awareness should be developed as a consequence of price rising of the energy carriers;
- centralised subsidy and international aid programmes (e.g., PHARE) are assisted through a system of competition for loans from "German coal aid" and by reduction on corporate tax.

THEORETICAL POSSIBILITIES OF ENERGY SAVING IN HUNGARY

Energy-conscious behaviour:	Amount to 50 to 100 PJ can be theoretically saved by efficient organisation for production and transport
Energy-technological modernisation in industry and agriculture:	Saved energy is about 50 PJ
Heat and power co-generation:	50 PJ would be saved by the utilisation of all possibilities for CHP in district heating
Decreasing losses from energy transport and distribution	?
Improvement in the efficiency of energy producing and consuming equipments:	Heat losses of district heating may be estimated of 15-18 PJ. This value can be really diminished by 3-5 PJ.
Improvement in the energy management of buildings:	The total energy consumption for heating amounts to 200 PJ. The theoretical saving possibility is about 35-50 PJ
Increased utilisation of renewable energy:	Renewable resources can reduce the consumption by 30-50 PJ
Total (considering full utilisation):	200-300 PJ
Energy conservation target (up to 2000)	50-100 PJ

Source: MIT, 1994b

Table 5.1. Summary of NEEIECP targets, expenses and benefits

Target	saved energy	saved energy cost	total investment	relative investment
	PJ/year	MUSD	M USD	M USD/PJ
medium term minimal	63.7	373.0	422.0	6.6
medium term maximal	124.4	708.0	1250.0	10.0
long term minimal	193.4	1120.0	2148.0	11.1
long term maximal	309.3	1739.0	4036.0	13.0

Source: MIT, 1994a, 1994b

In case of the maximum target, the key assumptions (not specified here) will lead to an energy savings of more than 300 PJ on long term as compared to the business-as-usual projections. To implement the NEEIECP, energy conservation is to obtain the support of legislation to the highest degree and to have significantly increased volumes of the central subsidy (e.g. in form of the projected central energy conservation fund and/or by increasing the funding opportunities from other sources).

5.2.4. Possibilities of energy conservation within the sectors of economy and society

According to the recent decline and uncertainties of the economy, the sectoral analysis is only presented for the medium-range minimum target. Below, the measures included in NEEIECP have been described by sector. The quantitative effects of several energy conservation measures in the sectors of the economy is summarised in Annex E.

Energy sector

The total fuel-related consumption in the energy sector might be reduced by 2.3 %. The most significant contribution could be expected from the efficiency improvement of energy transportation (2.5 PJ) and from the co-generation (2.7 PJ).The improvement of energy awareness in the production side might lead to an energy conservation of 1 PJ.

Industry

The industrial energy demand might be reduced by 13 PJ. About half of those might be reached by improving the energy awareness. An other important sources of the energy conservation would be the updating the energy technologies in industrial production and the improvement of thermal insulation by 2 PJ and 1.5 PJ, respectively.

Agriculture

This sector has significant potential in the energy conservation of 12 % related to the overall sectoral consumption (30 PJ). The primary source of savings would also be the improvement of energy awareness.

Transportation and infrastructure

The energy conservation in the transport sector is supposed to be 13 PJ. This amount consists of the improvement of energy awareness, optimising the public transport co-operation and reduction of energy consumption of vehicles with almost equal extents. The savings in the transport sector might assure about the 25 % of the total energy conservation.

Communal institutions

The overall energy savings in the trade, services, governmental institutions and municipalities are expected to be 9.2 PJ. The main contribution of the conservation is also the improvement of energy awareness by 7 PJ.

Residential sector

The energy savings in the households (17 PJ) is the most significant part of total conservation. The primary sources of the efficient use of energy in the households might be the improvement of energy awareness (81 %) and the efficiency improvement of consumer's equipment (11 %)

5.2.5. Legal and institutional framework

Beside the direct energy regulations it is also necessary to revise the legal provisions in order to promote energy saving investments. Existing barriers preventing the financing of energy saving investments by third parties need to be eliminated. From this aspect Act on Taxation and Act on Accounting have to be revised. The Act on Taxation should be amended so that energy saving investments and/or the repayment of loans are tax deductible as costs to a maximum extent. The possibility to provide tax benefits for energy saving investments from the personal income tax company tax or VAT should annually be revised.

The Hungarian Energy Office was established in August 1994 (based on provisions of the Act on Natural Gas Supply) and the Energy Saving Department is the part of this new governmental body. The implementation of the energy savings programme belongs to this department - primarily in the field of electrical power and gas supply. There are two other institutions in the field of energy saving namely the State Authority for Energy Management and Energy Safety and the Hungarian-EC Energy Centre. The share of responsibility in the field of energy saving should be revised. The National Technical Development Committee and the Bureau of Standards shall also play an important role in the organisation and management of energy saving.

5.3. Raising public awareness on efficient use of energy

In the past ten years there have been three major - nation-wide - energy saving campaigns in Hungary:

- a nearly five year campaign from 1985 based on a cartoon character called "Walaki" (i.e. "Valaki = Somebody" though the 'W' in the name refers to Watts),
- a short but intensive advertising "Awareness building" campaign financed and organised by the Hungarian Ministry of Industry and Trade in autumn 1992,
- the PHARE energy saving campaign in early 1993.

5.3.1. The "Walaki" campaign

Started in September 1985 the "Walaki" campaign was aimed initially at the younger generation (i.e. children, although it later outgrew this scope and left its effect on adults too). "Walaki" a cartoon figure was brought to life in a series of short films focusing on energy saving possibilities in households. Later on "Walaki" clubs were formed an annual competition was held various publications (e.g. Walaki diary, Walaki story books etc.) were printed and sold out. Two public opinion surveys during this long-term campaign indicated that the "Walaki" figure had been accepted by both the younger and older generations throughout Hungary. In facts, a generation was well on its way to growing up with this figure a constant reminder of energy conscious living. Unfortunately due to lack of sufficient finances the campaign was discontinued.

5.3.2. Energy saving campaign - autumn 1992

This campaign (conducted by the Ministry of Industry and Trade) with a short but intensive burst was aimed primarily at the Hungarian adult population. Its aims were to:

- call attention to the inefficient use of energy in Hungarian society,
- present good energy saving techniques,
- promote a new energy conscious behaviour.

With a rather restricted budget the campaign nevertheless made use of mass media. Short TV advertisements and regular newspaper communications "bombarded" the public. A continuation of the campaign was planned (e.g. the logo would have been used for the labelling of energy efficient household appliances) but once again due to the lack of funds this turned out to be unfeasible.

5.3.3. PHARE energy saving campaign - 1993

As part of the PHARE 1991 Energy Programme (*Brown, 1991*) an energy saving campaign was undertaken by the Ministry of Industry and Trade which was co-ordinated by the Hungary-EC Energy Centre. The campaign itself was realised during February - April 1993. The objectives of the PHARE energy saving campaign were to spread awareness about:

- a direct connection between the energy consumption and the environmental impacts and/or damages,
- the possibility to save energy while at the same time maintain or increase your standard of living,
- saving energy as a sign of efficiency and a positive and fashionable concept,
- the possibility for each individual to do something and that the actions of each individual matter.

<u>The media campaign</u>

The media campaign made use of television, cinema and press advertising. This was the central element in the campaign. Television was given an extremely strong weight in order to maximise the reach and the frequency of sending the message to the target audience. Cinema (approximately 3-4 weeks) was used as a support to the television advertising and was used particularly to target the younger generation. The television campaign was divided into two parts. In the first part a 60 second advertisement was used for the intensive initial 'burst' of the campaign (it was broadcast 16 times) while in the second phase a 30 second advertisement served as a reminder (broadcast 40 times). In the cinema campaign the 60 second advertisement was used throughout (approximately on 50 occasions). The slogan of the campaign was "you pay twice" i.e. once for the wasted energy and once for the environmental damage. Press advertising in four national newspapers in 1/1 and 1/2 size was used to provide information on energy use and environmental damage (approximately 30 times).

<u>Public relations</u>

A public relations campaign was used to support the media campaign. The campaign was launched and closed with a press conference attended by radio TV news and print journalists. A weekly press release was issued throughout February and March (eight in total) each a different theme - energy saving at home, how to save energy in cooking water use etc.

<u>Energy saving tips leaflet</u>

In support of the media campaign a leaflet was prepared and were 400,000 copies printed. This leaflet was of A4 format folded three times. The leaflet gave simple no or low cost energy saving tips for householders and included information on the environmental effects of gas and electricity production and use. It was distributed in various parts of Hungary in co-operation with the electricity distribution companies.

PHARE AND HUNGARY-EC ENERGY CENTRE

PHARE
is the European Community's effort to assist the ongoing process of economic reconstruction by providing financial and technical support to help Central- and Eastern European countries. Originally set up for Poland and Hungary alone. The support was later extended to other countries from the region. PHARE programmes have clear policy reform objectives concentrating on the core sectors of agriculture, industry, energy training environmental protection and trade and services.

HUNGARY - EC ENERGY CENTRE
One of the projects of the PHARE Energy-1991 was the setting up of the Hungary EC Energy Centre. The purpose of the Hungary-EC Energy Centre is to strengthen the cooperation inside Hungary, as well as between Hungary and the European Union in the field of energy management, in particular energy conservation and energy efficiency including its technological aspects to ensure sufficient energy supplies for economical and social development. The European Commission supports the work of the Centre through three main programmes: the PHARE Programme, the THERMIE Programme for energy technologies and the SYNERGY Programme of the Directorate-General for Energy.

Schools programme

A school campaign aimed at children aged 10-14 years was also developed and implemented. This programme included the design and production of a leaflet which gave information on energy use the environment and energy saving in a simple question and answer format. The separate slogan of "help save twice" was used for the schools campaign (i.e. save energy and save the environment) which was a deliberate mirror of the main campaign ("you pay twice").

An integral part of the schools programme was a competition for the children which asked questions about energy use and energy saving which was contained on a tear off strip in the leaflet. Prizes of 1000 T-shirts and 1000 mugs all with the logo and slogan of the campaign were offered. 100 000 leaflets were printed and distributed in all elementary schools in Budapest. Distribution outside Budapest was impossible for budgetary reasons. (In the first half of 1994, however, a similar schools campaign was organised in nine major Hungarian cities).

Conclusions of the campaign

There are both positive and negative lessons which can be learned from this project and which should be noted for future campaigns (*Saatchi and Saatchi, 1993a,b)*:

- Publicity campaigns can succeed in changing attitudes to energy use and the environment in Hungary and such campaigns can even succeed in changing deeply held attitudes.
- The campaign was successful because of the accurate targeting of the message and because the advertisement was creative and had a strong impact.
- The most effective way to influence attitudes in Hungary is though TV advertising. This was by far the most important media in the campaign and was responsible for the results achieved.
- Press advertising is useful as a support to TV advertising. Cinema advertising appeared to be ineffective.

OTHER ACTIVITIES OF HUNGARY-EC ENERGY CENTRE

Energy saving tips booklet:	published an information booklet for the household sector in 1 million copies. The booklet expands on the tips given in the campaign leaflet and deals - in detail - with: insulation and heating, cooking, hot water use, washing, refrigerators/freezers, lighting. The booklet will be distributed free of charge throughout Hungary with the help of the six regional electricity utilities at the start of the heating season (in early October).
Technical Journal	a quarterly published 16 page colour Technical Journal aimed at a wide range of readers from energy managers to decision makers. Each issue shall focus on a particular technology or end use sector. It includes information on particular technologies case studies etc. The journal is available to subscribers free of charge.
Technical Manual	a series of detailed reports on various technologies and end use sectors. The material provides in depth information for professionals taking into account the present possibilities but also looking towards the future and presenting the most up-to-date methods.

5.4. Volatile organic compounds emission reduction programme

Hungary has signed the ECE-Protocol (*ECE, 1991*) for the reduction of VOC-emissions in Geneva on the 19th of November 1991. The participating countries have undertaken to reduce emission levels at least by approximately 30 % up to 1999 however, several countries including Hungary the standstill principle applies. The base year for Hungary is 1988. According to this agreement the Hungarian Government will implement a National VOC Emission Reduction Programme based on the obligations and recommendations of the ECE-Protocol.

5.4.1. VOC emission in Hungary

Data collection

Hungary has set a database on the VOCs emissions (*DHV, 1993*). All companies have to declare their emission for those components which have national standard for sampling and analysis.

To increase accuracy, correction factors were calculated on the basis of more detailed emission inventory in Baranya and Somogy counties made by the South-Transdanubian Environmental Inspectorate. The Central Statistical Office collects data regularly and systematically on the national economy as whole. Information was collected on the production of paints and thinners as well as other products containing VOCs.

VOC-emission inventory

The Hungarian VOC-emission in 1988 and 1991 is shown in Table 5.2. The methodology and emission factors used are presented in (*DHV, 1993*)

RELIABILITY OF VOC EMISSION DATABASES

- Uncertainty in the emission of VOCs will be larger than for SO_2 and NO_x, for several reasons: e.g., some new emission sources were added which were originally not considered or small emission sources were enlarged. This causes 30 - 50 % inaccuracy.
- For industrial sources the self-declaration system is available for the Environment Protection Inspectorates. There are also measurement data available for the last 5 years. The reliability of the database of self-declared data for purpose of a total emission estimate is however doubtful for several reasons:

  - the allowed level is low declaration is not necessary,
  - declaration under the limit value (low emission).

Table 5.2. The Hungarian VOC-emission (Gg) in 1988 and 1990

Source category	**1988**	**1991**
Energy production	1.0	1.0
Oil industry (mining, storage, refineries, etc.)	35.0	25.0
Traffic (inc. refuelling)	90.5	72.5
Solvent use	78.5	44.5
Total	**205.0**	**143.0**

Source: DHV, 1993

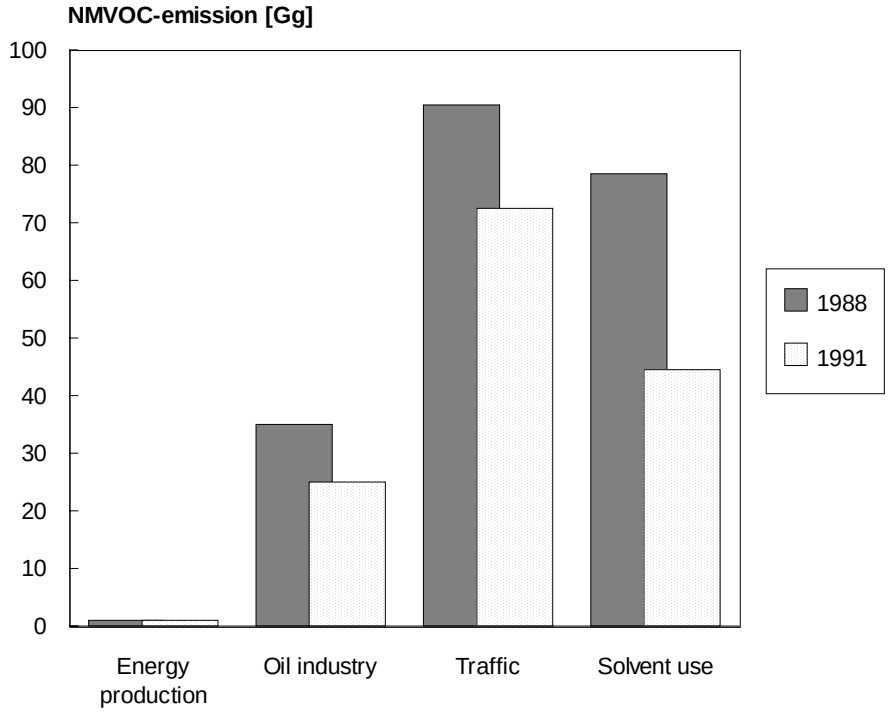
5.4.2. Content and goals of the programme

The main target of the VOC Programme is to prepare a strategy consisting of a reduction plan and an implementation plan for the VOC emissions in Hungary (*VROM-MERP, 1993)*. Phase 1 of the project completed in 1993. The result is a survey of the emission of the selected industries in Hungary. Phase 2 of the project should result in a reduction plan for the selected industries which are as follows:

- Graphic industry,
- Metal surface industry,
- Textile printing industry,
- Painting processes (various industries),
- Storage of chemical and oil products (chemical and oil industry),
- Rubber and plastic industry.

The reduction plan indicates emission sources and summarises the type of associated measures. In Phase 2 some workshops for the selected industries will be organised to achieve the goals of the reduction plan (*VROM-MERP, 1994)*. The aim of the workshops is to reach consensus on the possible measures for the oil and chemical industry. The results will include a list of (potential) measures for specific types of sources, as well as the special conditions and uncertainties of these measures. Conditions and uncertainties can be e.g. technical or economical or can be the competitive position relative to other countries. Furthermore the indicative costs (e.g. in HUF per kg VOC) and the possibilities for financing measures should become more clear in Phase 2 of the project.

Figure 5.2. Sectoral distribution of VOC emission (1990)



Source: DHV, 1993

5.4.3. Possibilities of VOC reduction within the sectors of economy and society

There are several possibilities for the control of VOC emissions. Measures for the reduction of VOC emissions focus on products and/or process modifications (including maintenance and operational control) and on the retrofitting of existing plants. The following list gives a general outline of measures available which may be implemented either singly or in combination:

- Substitution of VOCs e.g. the use of water-based degreasing baths and paints inks, glues or adhesives which are low in or do not contain VOCs,
- Reduction by best management practices such as good housekeeping preventive maintenance programmes or by changes in processes such as closed system during utilisation, storage and distribution of low-boiling organic liquids,
- Recycling and/or recovery of efficiently collected VOCs by control techniques such as absorption condensation and membrane processes ideally organic compounds can be reused on-site,
- Destruction of efficiently collected VOCs by control techniques such as thermal recatalytic incineration or biological treatment.

Emission reduction measures

VOC emission reduction going on at present is due the economic decline and the autonomous and voluntary measures made by the enterprises. In several cases the necessity on environmentally friendly investments of the companies coincide with their business interests even some savings are available (e.g. Hungarian Oil Co., printing industry).

Key assumptions and targets

It is very uncertain to forecast now the VOC emission for the future. After the political changes the Hungarian economy has been in recession: industrial production and energy consumption have decreased, therefore VOC emission has reduced, as well. The greatest annual VOC emission of Hungary was 263 Gg in 1986. This value dropped to 205 Gg in 1990.

The estimation of the future VOC emission is calculated on the basis of GDP growth scenarios. The projected VOC emission outlook for 1995 supposing the efficient implementation of the reduction programme ("with measures scenario") is 125 Gg while the “business as usual scenario” is 145 Gg with an uncertainty of 15 %.

Some percent of the annual growth of GDP is assumed in the period 1995-2000. Republic of Hungary will have ratified the VOC Protocol by that time. Therefore, probably several reduction measures will have been in force these years. So VOC emission outlook for 2000 in the case of "with measure" scenario is 110 Gg while in the case of business as usual” is 170 Gg. The estimated uncertainty is 20 %.

NETHERLANDS-HUNGARY CO-OPERATION ON VOC CONTROL POLICY

In March 1993 started the project "Control Strategy for the Emission of Volatile Organic Compounds". The assignment has been given to DHV and Environmental Protection Ltd. by the Hungarian Ministry for Environment and Regional Policy and the Dutch Ministry of Housing Physical Planning and Environment. It was agreed to follow the approach of the Dutch programme “KWS 2000” as far as possible projected on the Hungarian situation. The “KWS 2000” project was executed in 2 phases:

- formulation of the strategy
- implementation of the strategy

The final results of the Dutch project are:

- reduction plan (detailed emission reduction for each source type)
- implementation plan (implementation instruments timing)
- implementation project organisation (set up after the formulation phase).

The type of measures to be implemented should be as far as possible process integrated and not end-of-pipe.

Source: VROM-MERP, 1993

5.5. Enhancement of sink capacities: the forest policy

The long-term and stable supply of the manifold demands raised by the society must be considered as goal of the forestry sector. As it is shown in Section 4.5 the carbon removal is enhanced from the base year to 1990. The qualitative evaluation of the forest policy and its impact on the enhancement of carbon sink capacities is presented.

5.5.1. Forest resources

Forest area

Hungary used to be a country of great forest cover. In the 17th century, however, the forested area started to decrease following the European pattern. Beside the increase of the population and the extension of agriculture, it was mainly caused by the industrialisation process of the 19th century. At the time of the turn of the century, however, Hungary still had as much forest as 7.4 million hectare. In 1930, as a consequence of the country's territorial losses after the World War I treaties, the amount of forests dramatically fell down to 1.1 million hectare**.** After World War II, the primary goal of the forestry policy in Hungary was to increase wood supply. To cope with the shortage of wood and to decrease its

import, forestry had to focus on the quantity of wood production. Later on, as a result of large scale, still ongoing national afforestation programme, the forested area of the country has been increased by 600,000 hectare and reached the present rate of 18.2 % or 1.7 million hectare.

Various studies on future agriculture in Hungary suggest that about 500,000-1,000,000 ha of currently agricultural land has to be converted to other land use and that majority 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 which is one of the major actual concerns in Hungary.

Tree species composition and wood production

Unlike in most countries in Europe, an overwhelming majority of the forests is covered by broad-leaved species in Hungary (Table 5.3). 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.

Table 5.3. Forest distribution and composition in Hungary

Tree-species	**Area (ha)**	**Area (%)**
Oaks	360,524	23
Turkey oak	178,075	11
Beech	102,343	6
Hornbeam	96,179	6
Black locust	307,020	19
Other hard.br	58,340	4
Poplars	152,184	10
Other soft br.	86,756	6
Scots pine	149,546	9
Other conif.	98,791	6
Total	**1,589,760**	**100**

Source: Hungarian Forest Office

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.

5.5.2. Forest policy

As a tool of the development in forestry, forest management planning (which includes the periodical mapping, inventory, planning management of the forests, and supervising human activities in them) as well as some kind of organisation has been operating in Hungary for more than 200 years.

Forest ownership structure

The former co-operatives and their successors owned 535,000 ha of forests, and there were about 10,000 ha of forests that were private properties before the transition era. This latter figure is increasing as privatisation and compensation proceeds, and the forests owned by co-operatives is being distributed among those private persons who owned them before the collectivisation of the agriculture. From the legal point of view since 1991, the co-operative forest has been a private property, too. Due to the latest estimation, the total number of new forest owners are as high as 250,000 and the area of forests which are private or which will be private - including the former co-operative forests - is considered to be 700,000 ha.

Legislation

The Forestry Law currently in force was enacted in 1961. The main objective of this law is to increase forest resources, to maintain and intensify special forest functions and to develop harmonised wildlife management. The Forestry Law regulates stocked forests, clearings, roads, alleys, nurseries, open lands embraced by forests, i.e., all lands under forest management, but it ignores ownership.
The main statements of forest policy involved in Hungarian Forestry Law can be outlined by the following items:

- Forests can be converted to other land use after authorised approval only.
- Each forest property exceeding 400 ha should employ a professional forester.
- Management in the forest should be practised according to management plans approved by the Minister of Agriculture.
- Management planning is financed by the state budget and the plans are provided free of charge.
- Forest owners should follow the plan's recommendations. The state inspects the owners' activities through State Forest Inspectorates.
- Depending on the logging carried out, the forest owner/user must pay a certain amount of money into a special Forest Maintenance Fund.
- Logging sites must be reforested. The cost of regeneration is covered by the Forest Maintenance Fund on a normative basis. This subsidy is intended to include some profit to encourage faster regeneration.
- Afforestation, as well as furnishing of the existing forests for welfare services are considered as special investments of national interest, so they are financed by the state budget.
- Primary management objectives are defined by the law; management on protective and nature conservation areas is controlled by the Minister of Environment and his local authorities.
- Forests are allowed to be freely visited by public. Everybody is allowed to collect minor forest products for non-commercial use, and to use the forest for recreational purposes.
- The right of hunting is state competency, but it is subject of renting. The renter is responsible for wildlife management and for the damages caused by games.
- Grazing domestic animals in the forests is prohibited.
- Forestry as a sector belongs to the Ministry of Agriculture.

The increasing public concern over the health of forests, air pollution effects, and the threat of possible climate change focused the public attention on forestry issues. The main emphasis is shifting towards the non-wood benefits of forests, while wood production is controlled by market conditions rather than central decisions. These, as well as the changing ownership structure call for adjustment in forestry policy, which finally should result in a new Forestry Law.

The key issues of the new forest policy to be implemented in the new Forestry Law, of which certain elements are already in effect in lower level regulations, are as follows:

- to define forest in a complex way with the priority of long term interest for human health, nature conservation and the maintenance of forest resources;

- to define the role of forest in nature conservation, protection, welfare-oriented use and recreation;
- to define the role of forest in wood supply, and the necessary economic and institutional background;
- to define the prerequisites of sustainable management under changing ownership structure, and to develop the system of guaranties of maintaining forest heritage;
- to define the desired ownership structure (the share of state forest is expected to exceed 50-55 % on the long run);
- to define the co-ordinating and controlling role of the state in ensuring sustainable management;
- to define the role of foresters, their education and training, and the conditions of their employment;
- to define the role of public relations; finally;
- to define the role of international relationships.

The degree of conformity with international agreements is intended to be as high as possible. Some coincidental contradiction might exist, and imperfect implementation may occur. If any, they will be revised and corrected during the legislation procedure ahead.

In Hungary, the rights of local people, as declared in the Hungarian Constitution, are in accordance with all international recommendations. Forests must be kept open for the public. Local people are allowed to use the forests for recreational purposes, to collect wild flowers, mushrooms, and wild fruits free of charge for their own use. Grazing in forests is, however, prohibited.

Institutional background

Forestry as a whole is under the control of the Ministry of Agriculture. The Office of Forestry and its local authorities, the 10 State Forest Inspectorates take control the management of forests, with the exception of that of strictly protected forests where the Ministry of Environment and its local authorities are the responsible bodies. Forest inspection does not consider ownership, so the decisions made by the inspectorates are compulsory for each and every forest owner. Management plans, on which the inspection is based are provided by a governmental institute, the Forest Management Planning Service, which has country-wide responsibilities. This institute is working under the control of the Office of Forestry, and has eleven local bureau and one headquarter. During the transition process, the 19 state forest companies were attached to the State Assets Handling Joint-Stock Company, a 100 % state holding responsible for managing state properties. Those state farms which are planned to exist in the present form on the long run operate under the control of the State Assets Handling Joint-Stock Company, too. That part of the wood processing industry which has already been privatised, is inspected by the Ministry of Industry and Trade. State farms to be privatised (and their forests) are belonging to the State Property Agency, a body which is responsible for privatisation. Although the Hungarian Association of Agricultural Producers provides different services for the agricultural co-operatives, these co-operatives, the private forests, as well as the forests of the local governments are controlled by the Ministry of Agriculture through the Forest Management Planning Service and the Forest Inspectorates.

Forestry research is conducted in the Forest Research Institute (FRI), as well as the School of Forestry and Forest Industries. The FRI, as well as basic forestry education is also controlled by the Ministry of Agriculture through the office of Forestry and the Department of Education, but the School was just recently attached to the Ministry of Public Education. Establishing regional bodies for private forest owners in order to ensure professional assistance is under consideration.

Forest Management Planning

The main characteristics of the present practice of management planning can be listed as follows:

- in accordance with the Forestry Law, the total forested area of the country with no respect to ownership is under the regulation of management planning;
- while mapping, inventory, planning and yield regulation are done periodically in every 10 years (i.e., one tenth of the forest area is covered annually), the supervision of the management is done on an annual basis;

- management planning as a whole is in the interest of the society, thus 100 % of the operational costs for all owner/user are covered by the state budget;
- the output, including maps, reports, plans and statistical tables, is supplied for owners, agencies, and supervising bureau free of charge;
- a dynamic approach is applied to process information on forests and forest management. This includes using archive data on stands and operations (cut, reforestation, thinning etc.) and other happenings. Through the use of sophisticated simulation programs, the management planning is able to update the database, as well as plans (e.g., the allowable cut) for all Hungarian forests on an annual basis.

Both management planning and supervision are supposed to be unbiased. To avoid, however, that supervision might force forest owners and managers to be dictated by unfeasible, ill-prepared management plans, planning and supervision are made separately. The Forest Management Planning Service is responsible for nearly all aspects of forest management excluding supervision. The latter is done by ten independent local State Inspectorates. Human and financial resources of both institutes could meet the demands of the present system, but the increasing number of forest owners, and the increasing share of private properties call for reorganising the tasks of these institutes. Management planning procedures should be differentiated according to the size and type of forest property, and the level and intensity of control should also be adjusted appropriately.

5.6. Country programme to phaseout ozone depleting substances

The Montreal Protocol and its amendments is an international agreement to reduce the production and consumption of chlorofluorocarbons (CFCs), halons and other ozone depleting substances (ODS). Hungary acceded to the Vienna Convention and the Montreal Protocol in 1989. The London Amendments to the Protocol was ratified by Hungary in November 1993 and the Copenhagen Amendments in June 1994.

The Government enacted these international conventions into the national law and order by ministerial decrees. The Ministerial Decree No. 13/1992 (V.12.) of the Ministry for Environment and Regional Policy given out with the authorisation of the government regulate the use of ozone depleting substances in full accordance with the London Amendment. The enforcement of the Copenhagen Amendment is ensured by the 22/1993 (VII.20) Decree of the Ministry for Environment and Regional Policy that replaced the previous decree.

The decree sets up deadlines for phasing out of the controlled substances in different field of consumption, bans establishing new technology using the controlled substances, obliges to authorisation their import. It also prescribes obligatory reporting about the use of controlled substances as well as penalise for violating the regulations. The prevailing decree sets up so early deadlines comparing to the banning deadlines of the Copenhagen Amendment in some fields of use that meeting them caused difficulties for some ODS user companies.

Although the Ministry for Environment and Regional Policy gives the permission for postponing the deadline of phasing out ODS by fixing the available quantity of ODS taking into consideration that in 1994 and 1995 the country's whole used quantity of ODS can nor exceed the limited level given by the Copenhagen Amendment.

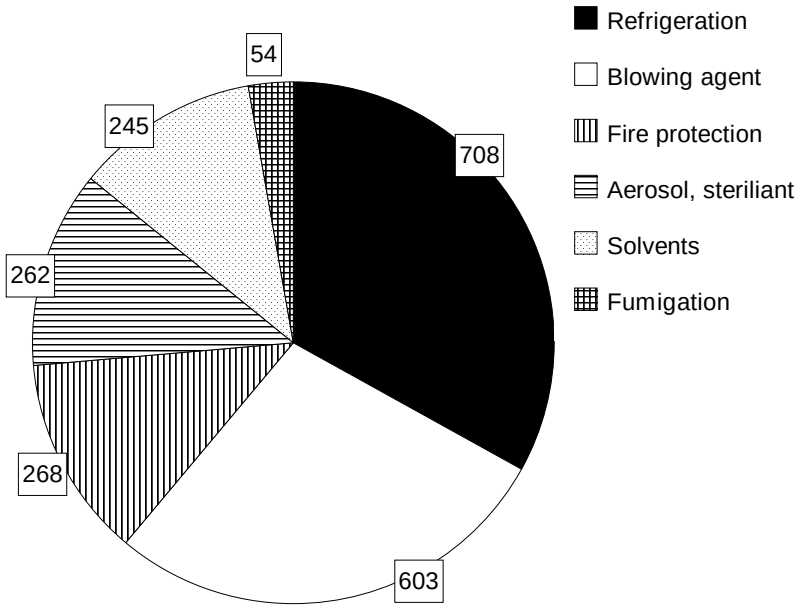
5.6.1. ODS consumption in the recent past and currently

Hungary is not a producer of regulated substances. There are no ODS production facilities for the substances regulated under the Montreal Protocol nor for the transitional HCFC substances and HFC substitutes. ODS are imported mainly from the European Union and former Soviet Republics by Hungarian distributors. Table 5.4 gives an overview of the ODS use by the end-user in Hungary.

Table 5.4. Use of ODS by the end-users in Hungary (metric tonnes)

SUBSTANCES	1986	1989	1991	1992	1993	1994 plan
CFC-11	1483	1120	806	690	651	290
CFC-12	2087	2100	1544	1090	937	791
CFC-11/12	1620	1370	160			
CFC-113	160	160	120	90	62	31
CFC-114	10		30	10	10	8
CFC-115					8	
All CFCs	5360	4750	2660	1880	1668	1120
Halon 1211	446	425	255	150	54	
Halon 1301	7	15	20	20	10	
Halon 2402	2				1	
All Halons	455	440	275	170	65	
CTC (carbontetrachlorid)	700	630	320	200	124	70
MCF (methylchloroform)	570	780	580	447	290	250

Figure 5.3. Distribution of total ODS use in Hungary in 1993 (metric tonnes)



Source: MERP, 1994b

5.6.2. Content and goals of the programme

The project of the Country Program for ODS phasing out will be prepared by the Ministry for Environment and Regional Policy considering the applications of the companies analysing and check-

ing the data of different field of ODS users. It will work up the appropriate actions for the stimulation of phasing out regarding the national economic regulations. The objectives of the Country Programme for the phaseout of ozone depleting substances are as follows:

- Summarise the usage of ODS including CFCs, halons, 111-trichloroethane or MCF, carbon-tetrachloride and HCFCs in Hungary;
- Present a breakdown of ODS usage by substances for the refrigeration, aerosols, solvents, foams and fire extinguishing sectors and detail the regional distribution of usage;
- Assess the factors that effect ODS demand;
- Identify possible alternative substances and technologies for ODS phaseout;
- Quantify phaseout time scales, incremental costs and environmental benefits;
- Describe the institutional and policy framework of the Country Programme.
-

5.6.3. Possibilities of phaseout of ODS within the sectors of economy and society

The decrees of the Minister for Environment and Regional Policy on the protection of the ozone layer (13/1992. (V.12.) KTM ; 22/1993. (VII.20.) KTM) were introduced after ratifying the Montreal Protocol and the amendments decide in London and Copenhagen.

The decrees include all regulations which were signed by Hungary in the international agreements. The foreign trade of ODS (regulated materials) is obliged to license. The official statement of the Ministry For Environment And Regional Policy is necessary in getting the license. It is proposed to put the ODS on the import list of prohibited goods according to the deadlines fixed in the decrees.

Emission charges and customs policy

The economic regulators exhaust the incentive force of the taxes customs charges and the rules of accounting and in some cases funds are accumulating for realising the given environmental target. In the new environmental regulation as well in the new Law on Environment more emphasis is put on the product charges and on charges loading the environment (emission charges). The charge is paid by the producer or trader, the expenses are reversible in the prices. The collected charges flow into the Central Environmental Fund and are used for mitigate the harms caused by the given product or emission. The Parliament already approved the product charges on fuels. The proposal of the law refers also to the charges for packaging materials. The charge on refrigerators used oil and air pollution (emissions) is in the elaboration phase. The authoritative regulation is set in laws.

In order to realise the obligations accepted by signing of the international agreements, the modification of the customs regulation is a viable tool. The limitation in foreign trade of environmentally harmful materials by the modification of customs regulations is acceptable for the authorities of GATT and of EU with proper reasons. It is important to emphasise that because of the treaty between Hungary and the EU, the modifications in the customs regulation are obliged to reconcile with the EU. In the Hungarian custom regulations, there are only a very limited possibility for duty free customs procedure. As the regulation becomes more normative, the duty free customs procedure is only available for the selected developing countries and for those goods that were imported through the framework of an international agreement. The use of contingents is the most common tool of trade preferences. There is a possibility for suspending the customs for a given period or given goods. In the cases of important economic policy targets through the so-called licensing procedure, the customs of imported goods are to be suspended or reduced. These regulators serve as a tool of import limitations but they can promote the preferential import of materials substituting the ODS and machines for processing the substitutes.

OTHER SUPPLEMENTARY TOOLS	
Monitoring	The regional environmental authorities should control the firms with a special emphasis of those producers who use ODS as solvents and aerosols.
Regional action plan	The regional inspectorates should start the preparation to implement the decrees. They should support the consumers of ODS and the trading-catering companies in implementing the rules of the decrees.
Long-term agreements	More chambers and alliances were founded among the producers, consumers and traders of ODS. The different chambers and alliances of ODS consumers agreed to introduce a product charge for refrigerants. With the help of the collected resources the central environmental fund can help in phasing out the ODS.

Strategies of ODS phasing out in different sectors

According to the experiences of the countries acting initiative role in phasing out ODS it is the most simple to phase out using aerosols as propellants: this sector gave 50 percent of the whole national ODS consumption in Hungary in 1986. The rapid decrease of the quantity of CFCs used as propellants is not only the result of the Governmental Decree 13/1992 (V.15) which set up the elimination deadline as 1st July 1993 but also of the fundamental changes in the economy: the decline of the living standard caused slackening demand and the liberalisation has increased the import. The Ministry for Environment and Regional Policy consulted with the Hungarian Association of Plastics Industry about the necessary and technical possibilities of phasing out CFCs used in the plastic foam production. According to these consultations it can be said that the firms aware the regulations of the Montreal Protocol. They get acquainted with the different technical forms of phasing out and substitution and they use the experiences of other countries but they can not perform similar measures or introduce new ODS technologies because of the declining economic situation.

Table 5.5. Summary of the evaluation of the selected regulators.

REGULATORS	a	b	c	d	e
Law on the Environment	+	0	+	0	+
Ministerial decrees	++	++	+	+/0	+/0
Import/export licensing	++	0	+	+	+
Economic incentives/regulators		b			
planned product charge	++	0	++	++	+
raising the customs	++	0	+	+	+
custom preferences duty free	+	0	+	-	++
assistance preferential credit possibilities	++	0	+	-	+
Other instruments					
controls of the authorities	+	+	++	-	+
Plan for preparation	+	-	+	0	+
chambers of ODS consumers	0/+	+	+	0	+
voluntary product charge	++	-/0/+	+	+	+

a:	environmental efficiency	+	effective tool;
b:	short-term implementation	++	very important instrument to meet the criterion
c:	effects on actors of the economy	O	not effective or independent instrument;
d:	use of non-budget resources	-	instrument causes contradictional effect
e:	acceptable by actor of the economy		

5.6.4. Legal, institutional and financial framework

The Ministry for Environmental and Regional Policy regulate the national implementation of the international convention on the protection of the stratospheric ozone layer by the Ministerial Decrees No. 13/1992 (V.12) and No. 22/1993 (VII.20). According to the agreement between the different bodies of the Government, principally the Ministry for Environment and Regional Policy is responsible for the co-ordination of phasing out of ozone depleting substances in Hungary. The Environmental Inspectorate and its Network of Regional Environmental Inspectorates act as first instance environmental authority. The ODS user companies submit them their annual report and these Inspectorates control the compliance with the decree.

The Ministry of Industry and Trade has the competence in permitting of the import of ozone depleting substances. The permissions are countersigned and recommended by the Ministry for Environment and Regional Policy considering the aim of use and the annual limit of the ODS use. The industrial policy includes the tasks given by the international conventions such as the Montreal Protocol. However, they have to consider that these conventions shouldn't result disadvantages situation for the Hungarian companies (their products or services) towards the foreign firms.

The Ministry of Finance is responsible for preparing the economic regulation system (taxes fees, preferences etc.). The National Headquarters of Customs Office financially belongs to and works under the supervision of the Ministry of Finance. The professional partner of the National Headquarters is the Ministry of Industry and Trade.

In order to gain the assistance of Global Environment Facility (GEF) the Hungarian Government has to promote the phaseout of ODS as well. The Central Environmental Fund can give assistance for environmental reasons and the Funds For Promoting Foreign Trade can assist too. It important to stress that the promotion of these funds mean quick financial resources and reduced interests but the loans are to be paid back to the funds.

5.6.5. Accounting and monitoring of the consumption of ODS

Ozone depleting substances are not produced in Hungary so the whole used quantity is imported. The obligatory import permission and limitation of the annual amount of import is important part of realising the prescribed decrease of consumption and monitoring the annual use. According to the Decree 22/1993 the importers have to make an annual report on the imported amount of ODS. Those firms using more than 100 kg ODS have to make a report for the Regional Environmental Inspectorate (about 120 users). The large users are also importers while some commercial firms provide with the smaller users. One of them is the First Chemical Industrial Corp. which provides the 85-90 % of the whole used quantity. The Ministry for Environment and Regional Policy together with the Ministry of Industry and Trade consults with the distributors and the importers at the beginning of every year. They discuss the total quantity of annual consumption, as well as the demands of different firms and on this base they limit the import permissions. According to the regulation, only 25 % of CFCs can be used in 1994 and 1995 comparing to the base year and 15 % of CTC and 50 % of MCF is allowed to use in 1995.

5.7. Financial instruments for greenhouse gas emission reductions

5.7.1. Some unable economic means in the Hungarian environmental policy

Emission charges

In the further development of the Hungarian regulatory system a significant role is to be played by emission charges (*HAS, 1994*). These charges have to be paid by the emitter after each unit of pollution emission and can be regarded as the price of pollution. This charge appears as a cost of the enterprise and constitutes a part of individual cost-benefit calculations. The effect of these charges is double: partly it is stimulating and partly redistributing. In most cases the sum of the charge is not big

enough for the cost-effect to dominate. According to analyses the redistributing effect dominates. A charge in itself cannot be the only salutary solution even in a cost-sensitive enterprise and market system.

In this system of emission charges it is very difficult to determine the level of the charge at which private marginal cost nears social marginal cost. It is important to mention that existing galloping inflation spoils the effect of charges. An inflation similar to that in Hungary softens the system. The stimulating effect is significantly reduced and so is the redistributing effect as the forming funds are continuously devaluated. Emission charges function in a given norm system. Polluters above the norm pay fine and after a given period of time they are obliged to stop their polluting activity. In case of exceptional environment pollution penalty sanctions should be enforceable. That is why those bearing personal responsibility have to be named unambiguously. From the point of view of positive economic simulation it is important that those whose emission is far below the norm are given preference when paying the charges. It seems expedient to reduce the charge to be paid per unit emission if possible.

Product charges

A separate group of charges is the product charges. Product charges are levied on products that are harmful to the environment when used in production processes consumed or disposed of. These charges are very important in particular for fuels. Tax differentiation is closely related to the pervious charges. Tax differentiation systems are characterised by two features:

- the combination of the two additional charges added to existing product tax: a positive product tax for a polluting product and a negative tax for a cleaner alternative,
- fixing the level of the tax in a way that the total financial effect (positive and negative should be neutral from the point of view of the budget).

Subsidies

An important component of the economic tools is the system of subsidies. The following subsidies are found in this field:

- grant
- soft loans
- tax reductions.

The sources of subsidies are the charges and the state budget. In connection with subsidies we have to mention the principle generally accepted in OECD countries. The Polluter Pays Principle (PPP) the essence of which is that the polluter should bear the costs of pollution reduction. Granting subsidies tax reductions incompatible with the Polluter Pays Principle if the following conditions are jointly fulfilled:

- it is related to an industry a territory or a plant where there are great difficulties;
- it is limited to a well defined transitional period which is connected with the specific socio-economic problems resulting from the introduction of the environment programme of the country;
- it would probably cause serious distortions in international trade and investment.

In Hungary these three conditions exist in many areas so besides the principle of responsibility for environmental pollution subsidies are justified.

Tradable permits

In case of this regulation the objective is to create artificial markets where the actors may purchase "permits" for their real or potential pollutants or where they can sell their "pollution permits". (This regulation is used primarily in the United States.) Emission trade is the alternative often times the substitute of the use of pollution charges. With this approach the same emission limits are set for the polluters as in case of standard pollution control programs. However, in the case the emitter emits less pollution than given in the limit the company may sell the difference between its actual emission and the permitted one to another company which in this way will have permit for surplus emission. These actions may take place within a plant within a firm but also among different companies.

5.7.2. Criteria to choose the economic means to influence climate policy in Hungary

In the former centrally planned countries there is a specific situation that although micro structures are more energy intensive than the OECD average the existing macro structures are more energy saving and in this way environmental friendly (*Szlávik, 1994*). Transport and its energy demand justify the above statement. As it is well-known the system works with outdated vehicles having high energy demand. Since however, the rate of public transport within all the transport services is relatively high the efficiency of the whole system is not lower than the OECD average in this case. As the above example indicates the processes must be handled in their complexity and the benefits similar to the above ones must be exploited with subsidies and preferences and not to let them disappear.

Of course, the solution should not be more subsidies from the overburdened central budget but a price structure a tariff system which will not make motor ways more economical than railways. The capital exports of international organisation financial institutions is also a great problem since to-day it much easier to attract capital for road construction with concessions than railway development or the development of combined transportation system. As probably all the above facts indicate the task is really manifold but advance is not hopeless. Certain fields require detailed analysis and in this way this short essay may be regarded as the introduction of a longer analysis.

Chapter 6
PROJECTION OF FUTURE GREENHOUSE GAS EMISSIONS

In this chapter the results related to the historical trends in the fuel demand and associated CO_2 emission, as well as the future greenhouse gas emission scenarios are summarised. The overall effect of implementation of the energy saving programme (see Section 5.2.) on the greenhouse gas emissions is evaluated, compared with the Business as Usual Scenario. The projection of emissions from non-combustion sources are also presented. It should be mentioned that a simplified methodology of emission calculation is used which provides the opportunity to get insight in the longer term tendency of the emissions. Accordingly, no direct correlation with the results of the inventories of greenhouse gas emissions (see Chapter 4) and the actual emission presented below. The simplified methodology makes possible to consider other gases (CO, NOx, N_2O) than have been presented in the inventory calculations.

6.1. Recent trends in fuel combustion and associated carbon-dioxide emission

For better understanding the present and the future energy situation and the fuel-related greenhouse gas emissions in Hungary the past trends in fuel consumption and associated emissions are discussed. One of the most characteristic features of the Hungarian energy system is the lack of sufficient domestic energy resources. Thus in the earlier periods the continuos increasing energy demand of the country has to be satisfied by increasing import. The share of the energy import in the fifties-sixties was in the range of 10 - 20 percentages of the production while the domestic energy production and the import was nearly equal in the year 1992.

The structure of the domestic energy production drastically changed in the recent period. In the fifties-sixties the solid fuel, specially the coal mining was dominant. The domestic coal production peaked in the mid-sixties. Behind this period the structure of the domestic energy production is significantly changed, specially the role of the nuclear energy and of the hydrocarbon mining increased and the coal production specially the deep-mining drastically decreased. Nowadays, in the domestic primary energy production the share of the coal mining is only 33 % the hydrocarbon-mining is about 42 % while the share of the primary electricity is roughly 25 %.

Regarding the energy import in the 1950's the low energy import was dominated by the coal (80-90 %) later on the hydrocarbon, the electrical energy and the nuclear fuel import increased significantly. In the period 1965-1990 the coal import specially the briquette for households and the coke for metallurgical utilisation remained practically constant but sharply decreased behind the 1980's. The crude-oil import peaked in the 1980's. Later on a sharp decrease occurred as a reason of the drop in the demand of the motor fuel. Nowadays, the share of the hydrocarbons in the energy import is in the range of 85 %. The electrical energy import peaked about 28-29 % of the gross domestic electrical energy demand but in the nineties it is decreased about one-third of its former level.

As a result of the significant energy import, the main features of the Hungarian energy system is import dependency. Regarding the electrical energy demand of the country it peaked in the last eighties by 40 TWh. After this period the consumers demand declined as a result of the economic depression. The decline in the electrical energy consumption of the households was not significant even a slight increase occurred. The real decline was in the demand of the industrial sectors.

Figure 6.1. Long-term tendency in the energy import in Hungary

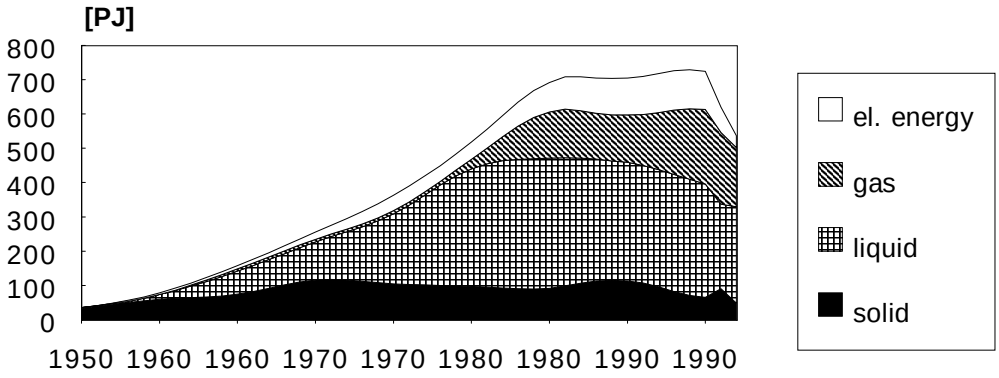


Figure 6.2. Long-term tendency in the energy consumption at the Hungarian Power Co.

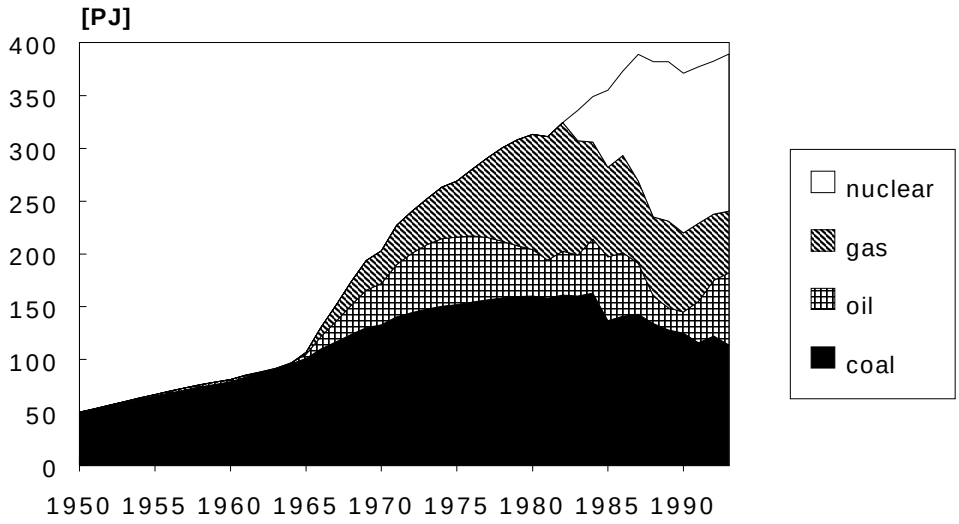
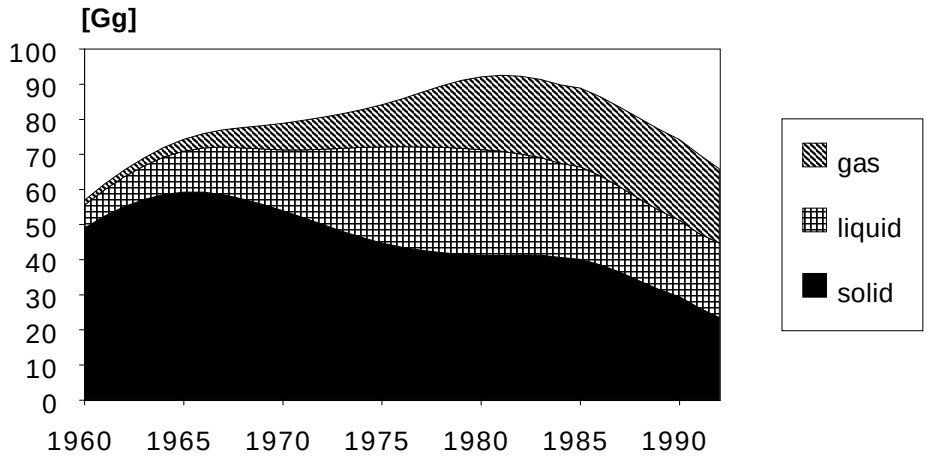


Figure 6.3. Long-term tendency in the CO_2 emissions



The share of the import electricity decreased significantly in the last years as a consequences of the electrical energy situation in the former Soviet Republics. The consumers demand decreased in this period too thus by increasing the domestic production of the fossil-fuelled power plants the electrical energy demand of the country could be satisfied.

The share of the coal and the lignite in the domestic electricity generation is now only about one-third. The share of the fossil fuels in the electrical energy generation decreased to about 60 % and the share of the hydrocarbons exceeds the share of coal. Nowadays the nuclear electricity covers about 45-50 % of the domestic electrical energy generation.

6.2. Future greenhouse gas emissions from combustion activities: effects of implementation of the energy saving programme

6.2.1. Scenarios and key assumptions

As it is presented under the key assumption of NEEIECP in Section 5.2, it was supposed that the overall economic prosperity would occur after the years 1995 - 1996 only. Due to the prolonged recession of Hungarian economy, the original scenarios made in 1991 during the preparation of NEEIECP are lost their reliability and therefore could not serve as a useful variants for the analysis of future greenhouse gas emission projections. Regarding these facts, slightly modified scenarios were prepared for the present analysis using similar key assumptions.

Two scenarios are investigated: a business as usual (BAU)-scenario and an energy saving scenario (S), as well. Nevertheless the so-called BAU-scenarios are not formal extrapolations of the past tendencies because of the process in reconstructing of the economy and of the transition from the central planning system to a modern market economy. The BAU-scenario can be defined as a variant without significantly promoted energy saving and energy conservation.

The energy saving scenario (S) based on the short term targets of NEEIECP (see in Table 5.1). It is supposed that in the year 2000 the effective implementation of NEEIECP would lead to an energy saving of about 60 PJ compared with the BAU-scenario (As it is mentioned in Section 5.2., the energy conservation target is about 50-100 PJ up to 2000) . The S-scenario expects the gross national electrical energy consumption of 37 TWh only as an effect of the electrical energy saving too compared with the 40 TWh in the BAU-scenario. In the following the 2000BAU symbol reflects the values of the BAU - scenario in the year 2000 while 2000S reflects those of the energy saving scenario. Both cases the main courses and developments in the economy are nearly the same regarding the transition period.

The calculations of emission values both for the reference year (1990) and the scenarios are completed by using of simple mass balance method (*Tajthy et al., 1990*) different from IPCC/OECD methodology. The emissions are calculated as follows:

$$E_{ijk} = e_{ijk} * T_{ik}$$

where:

- E emissions by sectors, gases and fuel types
- e emission factor
- T activity/production data
- i is the index of the consumer groups (e.g. households, service sector, agriculture etc.)
- j is the index of the type of the emissions (e.g. CO_2, NO_x, N_2O etc.)
- k is the index of the activity data (e.g. coal, wood, oil, gasoline, diesel, oil etc. and consumption).

Estimating the fuel-related emission factors the physical-chemical properties of the fuels and the technical parameters of the firing devices are also considered. The aggregation of the emission factors by sectors and by fuels is based on the mass balance calculation by using the stochometric equations (*Tajthy, 1993a, Tar and Tajthy, 1990)*. Some cases the calculated emission factors can be verified by measured data of the domestic emissions. Due to the parallel application of emission estimation methods, some insignificant differences can be expected in the 1990 greenhouse gas emission values (see in Section 4.6.) calculated by the recommended IPCC/OECD methodology and the results referred to 1990 shown below.

SCENARIOS FOR THE PROJECTION OF FUTURE CO_2 EMISSIONS

BAU (without measure scenario):

- transition to market economy,
- GDP growth rate:
  -1-0 % (1995-1996)
  0-2 % (1997-)
- restructuring the energy sector,
- moderate increase in energy prices,
- no specific energy saving measures

S (with measure) scenario

- transition to market economy,
- GDP growth rate:
  -1-0 % (1995-1996)
  0-2 % (1997-)
- restructuring the energy sector,
- additional increase in energy prices,
- implementation of NEEIECP
- assuming 60 PJ overall saving

6.2.2. Expected fossil fuel demand in Hungary in the future

Taking into consideration the scenarios for the energy consumption the future fossil fuel demand should be determined (*Döfner and Tajthy, 1994).* The estimation of fuel demand is based on the key assumptions on growth rate and pricing detailed in Section 3.1 In the case of the BAU-scenario the fossil fuel consumption amounts to about 950 PJ in the year 2000 while with significant energy savings and conservation amounts to 890 PJ only (according to the S-scenario).

6.2.3. Projection of future emissions from combustion activities

CO_2 emission outlook

Both in the BaU2000 and S2000 scenarios the fuel-related CO_2 emission do not exceed the base year level (Table 6.1a and Table 6.1b). Nevertheless the BAU scenario is higher by 7 % compared to the S scenario.

Figure 6.4. Fossil fuel demand in Hungary by sectors

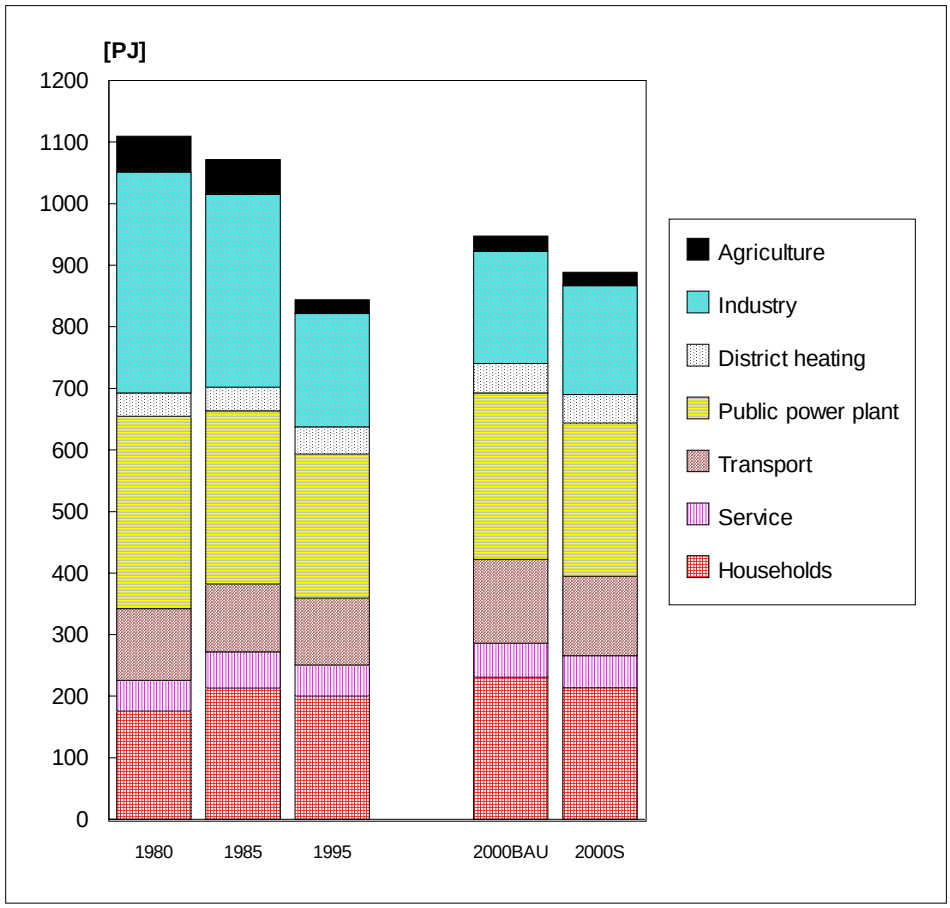


Table 6.1a. Projection of fuel-related CO_2 emission (Gg) in Hungary by sectors

SECTORS	**1985-1987**	**1990**	**1995**	**2000BAU**	**2000S**
household	19240	17590	15768	17960	16493
service	4490	3540	3858	4144	3 947
transportation	8150	8780	7906	9949	9361
public power plants	23870	19660	19893	22715	21095
district heating	2550	2380	2895	3154	2983
industry	23590	19130	13818	13608	13181
agriculture	4010	3120	1737	1921	1681
total	**85900**	**74200**	**65875**	**73451**	**68741**

Table 6.1b. Projection of fuel-related CO_2 emission (Gg/year) in Hungary by fuel types

FUEL TYPES	1985-1987	1990	1995	2000BAU	2000S
solid	37990	29420	20861	21207	19782
liquid	25420	21850	22619	27685	25112
gas	22500	22930	22396	24560	23847
total	**85900**	**74200**	**65875**	**73451**	**68741**

CH_4 and N_2O emission outlook

Both the fuel-related emissions of methane and nitrous-oxide show significant decreasing up to mid-1990's. Nevertheless, it should be notice that the emissions from transport sources would increase by 10-13 % between 1990 and 2000BAU.

Table 6.2a. Projection of fuel-related CH_4 emission (Gg) in Hungary by sectors

SECTORS	1985-1987	1990	1995	2000BAU	2000S
households	10.17	7.88	5.14	5.52	4.84
service	1.21	0.70	1.16	1.18	1.09
transportation	1.28	1.55	1.40	1.75	1.62
public power plants	0.24	0.20	0.20	0.23	0.21
district heating	0.41	0.34	0.43	0.45	0.37
industry	8.00	5.04	3.31	3.31	3.10
agriculture	0.61	0.42	0.42	0.43	0.34
total	**21.92**	**16.13**	**12.06**	**12.87**	**11.57**

Table 6.2b. Projection of fuel-related N2O emission (Gg) in Hungary by sectors

SECTORS	1985-1987	1990	1995	2000BAU	2000S
households	1.91	1.63	1.37	1.52	1.39
service	0.37	0.29	0.28	0.30	0.28
transportation	0.76	0.86	0.77	0.96	0.91
public power plants	2.30	2.03	1.69	1.79	1.73
district heating	0.17	0.15	0.18	0.19	0.17
industry	1.59	1.32	0.97	0.92	0.90
agriculture	1.26	0.97	0.49	0.52	0.48
total	**8.36**	**7.25**	**5.75**	**6.21**	**5.86**

NO_x emission outlook

In the projection of future NO_X emissions the contribution of the transportation sector remains dominant in compliance with the liquid fuel consumption (Table 6.3a. and Table 6.3b).

Table 6.3a. Projection of fuel-related NO_X emission (Gg) in Hungary by sectors

SECTORS	1985-1987	1990	1995	2000BAU	2000S
households	20.9	18.4	15.8	17.8	16.2
service	7.3	5.8	5.7	6.1	5.8
transportation	110.7	111.3	101.5	128.3	121.9
public power plants	56.3	35.0	36.2	42.2	38.9
district heating	3.7	3.3	4.0	4.4	4.1
industry	24.6	19.5	14.0	13.7	13.2
agriculture	8.1	6.3	3.3	3.6	3.2
total	**231.7**	**199.6**	**180.5**	**216.0**	**203.4**

Table 6.3b. Projection of fuel-related NO_X emission (Gg) in Hungary by fuel types

FUEL TYPES	1985-1987	1990	1995	2000BAU	2000S
solid	66.7	42.7	29.4	30.1	28.4
liquid	139.2	131.4	125.0	157.9	147.7
gas	25.7	25.5	26.1	28.0	27.4
total	**231.7**	**199.6**	**180.5**	**216.0**	**203.4**

In the BAU-scenario the NO_X emission in the year 2000 may be 216 Gg while with energy saving programme it slightly might exceed the 200 Gg value only.

CO emission outlook

In the projection of fuel-related future CO emissions, as in the case of the NO_X emissions the transportation sector might remain dominant even its share may increase (Table 6.4a and 6.4b), compliance with this regarding the CO emissions by fuel types the overwhelming share comes from the liquid fuel consumption.

Table 6.4a. Projection of fuel-related CO emission (Gg) in Hungary by sectors

SECTORS	1985-1987	1990	1995	2000BAU	2000S
households	169.8	134.2	81.0	87.1	76.3
service	2.6	1.8	2.2	2.3	2.2
transportation	524.6	564.8	497.9	619.7	577.2
public power plants	28.4	19.4	14.9	15.9	15.2
district heating	1.2	1.1	1.3	1.4	1.3
industry	14.6	10.9	7.7	7.5	7.3
agriculture	1.9	1.4	1.0	1.1	0.9
total	**743.2**	**733.6**	**606.0**	**735.1**	**680.3**

Table 6.4b. Projection of fuel-related CO emission (Gg) in Hungary by fuel types

FUEL TYPES	1985-1987	1990	1995	2000BAU	2000S
solid	196.7	147.5	85.9	90.1	79.1
liquid	534.3	572.4	505.4	628.1	585.1
gas	12.2	13.7	14.6	16.9	16.1
total	**743.2**	**733.6**	**606.0**	**735.1**	**680.3**

The CO emissions in the BAU - scenario and in the year 2000 might be about 735 Gg while promoted energy saving it may be reduced to 680 Gg.

6.3. Future greenhouse gas emissions from certain non-combustion activities

6.3.1. Methane emissions from livestock

Key assumptions

In determining the methane emissions connected with the domesticated and undomesticated animals the default emission factors presented in the IPCC/OECD methodology have been used. The domesticated animal population decreased dramatically in the recent years mainly because of the collapse of the eastern markets. The increase of the export is very uncertain but it might recover in medium-term.

There are no generally accepted scenarios for animal livestock, therefore a stock is estimated on expert judgement basis. It is supposed that in the year 2000 the domesticated animal population will approximate the mean value of the present and the earlier peak stock. The cultivated land and the forest ratio is not supposed to modify significantly thus in the “first guess approximation” the methane emissions produced by the different type of lands might be regarded as constant. The scenarios for stock of domesticated animals and the associated CH_4 emission projection are shown in Table 6.5a, 6.5b and 6.5c.

Table 6.5a. Stock of the animals (thousand heads)

	1990	1992	1995	2000
cattle	1571	1159	1050	1365
swine	8188	5364	5200	6750
horse	80	68	65	75
sheep	1865	1752	1700	1850
poultry	45690	39635	38500	44500

Table 6.5b. Methane emission (Gg) from enteric fermentation

	1990	1992	1995	2000
cattle	108	79	72	93
swine	8	5	5	7
horse	1	1	1	1
sheep	9	8	8	9
poultry	NEF	NEF	NEF	NEF
TOTAL	**126**	**93**	**86**	**110**

Table 6.5c. Methane emission (Gg) from animal wastes

	1990	1992	1995	2000
cattle	7.6	5.6	5	6.6
swine	32.8	21.5	20.8	27.0
horse	0.1	0.1	0.1	0.1
sheep	0.4	0.4	0.4	0.4
poultry	3.5	3	2.9	3.4
TOTAL	**44.4**	**30.6**	**29.2**	**37.5**

It can be seen that in the case of horse, sheep and poultry the stock of the animals would again reach the 1990 level by 2000. The most dramatic changes occurred in the number of swine and cattle that decrease by 17 %/year and 13 %/year respectively between 1990-1992. Due to the significant collapse in the stock of the animals the CH_4 emission from enteric fermentation would fall by 32 % by 1995 related to the 1990 values. Up to 2000 these emission would not reach the 1990 level. The methane emission from animal wastes and cattle sources would significantly drop by 15 Gg between 1990 and 1995. The methane emission from animal wastes would decrease by 15 % in 2000 related to 1990 level.

6.4. Conclusion: fulfilment of the stabilisation commitments

As it is described in Section 2.1, the Government of Hungary has declared that - in the light of characteristic features of processes of its economic transition - the period of 1985-1987 which precedes the current economic recession is considered as the base year period for comparison of the greenhouse gas emissions. It is also stated that the carbon-dioxide emission should be returned to the base year level by the year 2000. It should be emphasised that the greenhouse gas emission reduction target therefore refers to stabilisation of carbon-dioxide emission at a level of 1985-1987.

In Table 6.6 the fulfilment of the emission reduction target is summarised. Some illustrative values for 1990 and 1995 and the analysis for methane emission are also shown.

Table 6.6. The fulfilment of CO_2 reduction target

	CO_2[1](Gg)	**CH_4[2] (Gg)**
base period (1985-1987)	81534	604.9
reference year (1990)	69116	491.6
1995	65875	310.1
2000BAU	73451	232.2
2000S	68741	

[1] The recent fuel-related CO_2 emission calculated by the recommended methodology and the future projection of fuel-related CO_2 emissions estimated by simplified method are compared. The projection is presented as "with measures" (2000S) and "without measures" (2000BAU) scenarios regarding the implementation of the National Energy Efficiency and Energy Improvement Programme. (The net emissions including the non-combustion sources and removals are not calculated in the projections. The difference between the net CO_2 emission and fuel-related ones is less than 5 %.)

[2] Accordingly, the methane emissions from fugitive sources and enteric fermentation for the base year and the reference year are derived from the IPCC/OECD methodology. The future projection of methane emission from same sources is based on the referred simplified method. (The net emissions including the fuel related methane sources are not calculated in the projections. The difference between the net CH_4 emission and emission from fugitive and enteric fermentation is less than 2 %.)

It is shown that, owing primarily to the general economic decline, even in the case of 2000BAU the 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 programme the growing rate of annual CO_2 emission can reach of 1.5 Mt/year in the second half of present decade, that lead to exceed the base year level around 2005. The methane emission would drop to one third of the base year level by 2000 according to the collapse of the domestic coal mining and due to the significant changes in the animal livestock.

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Annex A
ACTIVITY AND PRODUCTION DATA

Source and sink categories	1985-1987 (base period)	1990 (reference year)
1A. FUEL COMBUSTION (PJ)		
1A1. Energy transformation	477.55	388.90
1A2. Industry	148.20	111.50
1A3. Transport	113.70	120.70
1A4. Commercial and trade	48.75	51.90
1A5. Residential	214.10	206.00
1A6. Agriculture and forestry	47.55	37.50
1B. FUGITIVE FUEL		
1B1. Oil and natural gas (PJ)		
oil production	78.38	78.50
gas production	236.90	159.58
oil refining	344.05	318.51
gas consumed	379.41	373.17
1B2. Coal mining (Mt)	23.61	17.83
2. INDUSTRIAL PROCESSES (Gg)		
2A. Iron and steel (crude iron)	2101.21	1697.00
2B. Non-ferrous metals		
alumina (Al_2O_3)	827.64	826.00
smeltered aluminium	73.68	75.12
2C. Inorganic chemicals		
nitric acid	961.30	540.22
sulphur acid	564.73	NAD
hydrochloride acid	116.76	NAD
soda	183.96	NAD
2D. Organic chemicals	NAD	NAD
2E. Non-metallic products		
cement	3915.67	3933.00
clinker cement	3225.03	3170.00
lime	816.40	NAD
hydrated lime	146.53	NAD
plastic raw materials	467.04	614.55
3. SOLVENT USE	NAD	NAD
4. AGRICULTURE		
4A. Enteric fermentation (1000 heads)		
cattle	1725	1571
swine	8687	8188
horse	44	80
sheep	2337	1865
poultry	58060	45690
4B. Animal wastes	same as 4A	same as 4A
4C. Rice cultivation (kha)		
- flooded regime	2.80	1.70
- intermittent regime	10.05	8.80
- others	-	0.30
4D. Waste burning	-	-
4E. Savannah burning	-	-
4F. Nitrogen fertilisers and manure (Gg)	380.98	259.31
5. LAND USE AND FORESTRY		
5A. Forest clearing	-	-
5B. Grassland conversion	NAD	NAD
5C Logging/managed forests (kha)	1670.65	1715.90
5D Abandonment of managed forests	-	-
6. WASTES	NAD	NAD

NAD: No activity/production data available
blank: No (or almost negligible) values

Annex B
CO_2 EMISSIONS (Gg) BY SOURCE AND SINK CATEGORIES

Source and sink categories	1985-1987 (base period)	1990 (reference year)
1A. FUEL COMBUSTION	**80089**	**68105**
1A1. Energy transformation	36928	29746
1A2. Industry	10893	7893
1A3. Transport	7741	8208
1A4. Commercial and trade	3403	3290
1A5. Residential	16639	15125
1A6. Agriculture and forestry	3132	2462
1A7. Other	1353	1381
1B. FUGITIVE FUEL		
1B1. Oil and natural gas	NEF	NEF
1B2. Coal mining		
2. INDUSTRIAL PROCESSES	**3587**	**3568**
2A. Iron and steel	NEF	NEF
2B. Non-ferrous metals	NEF	NEF
2C. Inorganic chemicals	NEF	NEF
2D. Organic chemicals	NEF	NEF
2E. Non-metallic products	3587	3568
2F. Other		
3. SOLVENT USE		
3A. Paint application		
3B. Dry cleaning		
3C. Chemical products		
3D. Other		
4. AGRICULTURE		
4A. Enteric fermentation		
4B. Animal wastes		
4C. Rice cultivation		
4D. Waste burning		
4E. Savannah burning		
5. LAND USE AND FORESTRY[1]	**- 3097**	**- 4467**
5A. Forest clearing		
5B. Grassland conversion	NAD	NAD
5C. Logging/managed forests	- 3097	- 4467
5D. Abandonm. of managed lands		
6. WASTES		
6A. Landfills		
6B. Wastewater		
6C. Other		
TOTAL	**83676**	**71673**

NEF: No emission factor available
NAD: No activity/production data available
blank: No (or almost negligible) emissions
[1]: not included in the total emission

Annex C
CH_4 EMISSIONS (Gg)

Source and sink categories	1985-1987 (base period)	1990 (reference year)
1A. FUEL COMBUSTION	**7.7**	**5.6**
1A1. Energy transformation	NEF	NEF
1A2. Industry	NEF	NEF
1A3. Transport	NEF	NEF
1A4. Commercial and trade	NEF	NEF
1A5. Residential	NEF	NEF
1A6. Agriculture and forestry	NEF	NEF
1A7. Other (biofuel combustion)	7.7	5.6
1B. FUGITIVE FUEL	**448.3**	**366.0**
1B1. Oil and natural gas	225.4	199.0
1B2. Coal mining	222.8	167.0
2. INDUSTRIAL PROCESSES		
2A. Iron and steel	NEF	NEF
2B. Non-ferrous metals	NEF	NEF
2C. Inorganic chemicals	NEF	NEF
2D. Organic chemicals	NEF	NEF
2E. Non-metallic products	NEF	NEF
2F. Other	NEF	NEF
3. SOLVENT USE		
3A. Paint application		
3B. Dry cleaning		
3C. Chemical products		
3D. Other		
4. AGRICULTURE	**208.4**	**173.0**
4A. Enteric fermentation	156.6	125.6
4B. Animal wastes	48.1	44.3
4C. Rice cultivation	3.7	3.1
4D. Waste burning		
4E. Savannah burning		
5. LAND USE AND FORESTRY		
5A. Forest clearing		
5B. Grassland conversion		
5C. Logging/managed forests		
5D. Abandonm. of managed lands		
6. WASTES		
6A. Landfills	NAD	NAD
6B. Wastewater	NAD	NAD
6C. Other	NAD	NAD
TOTAL	**664.4**	**544.6**

NEF: No emission factor available
NAD: No activity/production data available
blank: No (or almost negligible) emission

Annex D
SUMMARY TABLE OF ESTIMATION FOR GHG EMISSIONS

Greenhouse gas emissions calculated by the recommended IPCC/OECD methodology

	1985-1987 (base period)		1990 (reference year)	
Emission Sources	**CO_2[1]**	**CH_4[1]**	**CO_2[1]**	**CH_4[1]**
Fuel combustion	80089	7.7	68105	5.6
Fugitive fuel		448.3		366.0
Industrial processes	3587		3568	
Solvent use				
Agriculture		208.4		173.0
Wastes				
Total Emission	**83676**	**664.4**	**71673**	**544.6**
Land use and forestry (removal)	3097		4467	

Greenhouse gas emissions calculated by simplified methods

	1985-1987 (base period)				1990 (reference year)			
Emission Sources	**N_2O[2]**	**NO_x[2]**	**CO[2]**	**VOC[3]**	**N_2O[2]**	**NO_x[2]**	**CO[2]**	**VOC[3]**
Fuel combustion[4]	8.36	231.4	743.1	91.5	7.25	199.6	733.6	73.5
Fugitive fuel				35.0				25.0
Industr.processes								
Solvent use				78.5				44.5
Agriculture	4.56				4.10			
Wastes								
Total Emission	**12.92**	**231.4**	**743.1**	**205.0**	**11.35**	**199.6**	**733.6**	**143.0**

[1] Calculated by IPCC/OECD methodology
[2] Estimation methodology based on Tajthy (1993) except for N_2O from agricultural soils which has been calculated by the recommended methodology
[3] The base year and reference year for VOC emission calculations is 1988 and 1991, respectively. The estimation methodology was developed by the Institute of Environmental Protection, Hungary
[4] Including transport related energy use

Annex E
POSSIBLE ENERGY SAVINGS IN THE IMPLEMENTATION OF MEDIUM RANGE MINIMUM PROGRAMME OF NEEIECP

Energy conservation measures (savings in PJ)	energy sector	industry	agriculture	transport	communal	residential	Total
1. Energy awareness	1.0	6.5	2.0	4.0	7.0	14.0	**34.5**
2. Updating energy technologies in industrial production		2.0					**2.0**
3. Updating energy technologies in agriculture			0.5				**0.5**
4. Efficiency improvement of energy production equipment	0.2						**0.2**
5. Efficiency improvement of energy transportation	2.5	0.5					**3.0**
6. Efficiency improvement of consumer's equipment	0.3	0.7	0.5		1.0	2.0	**4.5**
7. Reduction of energy transmission and distribution losses	0.6	0.8					**1.4**
8. Cogeneration	2.7	0.1					**2.8**
9. Improvement of energy management in buildings	0.3	0.5			1.0	1.0	**2.8**
10. Improvement of thermal insulation		1.5					**1.5**
11. Optimising the public transport cooperation				5.0			**5.0**
12. Reduction of energy consumption of vehicles				4.5			**4.5**
13. Use of renewable energy resources		0.1	0.4		0.2	0.3	**1.0**
Overall energy savings (PJ)	**7.6**	**12.7**	**3.4**	**13.5**	**9.2**	**17.3**	**63.7**
Total energy consumption (PJ)	327.5	219.3	29.8	105.9	106.2	257.8	**1046.5**

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