National Climate Change Action Plans:

Interim Report for Developing and Transition Countries

October 1997

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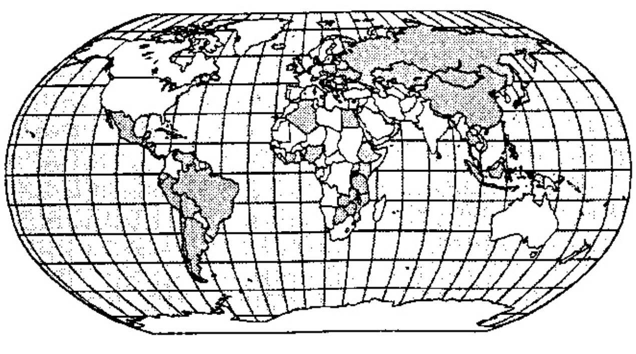

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HUNGARY

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Summary

This chapter summarizes the main focuses and priorities of the Hungarian mitigation plan. The country's strategy is based on ongoing programs in the energy and forestry sectors. The main tasks in the near future are as follows:

- The efficiency of power generation will be increased by application of up-to-date technologies, which will replace aged and inefficient coal-fired power plants.
- The utilization of renewable resources, especially of geothermal sources, will be enhanced.
- New areas will be afforested to increase carbon sequestration.

These programs are being conducted in the midst of an ongoing privatization process, which raises several obstacles to implementation.

Introduction

In the framework of the U.S. Country Studies Program, the Hungarian Country Study Team developed the national greenhouse gas (GHG) emission inventory and elaborated the mitigation options for different sectors of the economy in 1995–1996. In 1997, the development of a National Action Plan (NAP) has begun as a continuation of this work. This interim report contains the initial results. The study should be completed and published by the beginning of 1998.

Results of Past Studies

Emissions Inventory

Results of the inventory study showed that GHG emissions decreased from the selected base level (i.e., from the yearly average emissions of 1985–1987) until 1994 by about 25%. However, this decrease was caused primarily by a deep economic recession. Therefore, our policy makers have to face the problem of economic recovery without a significant increase in GHG emissions in the near future. This is the main focus of our mitigation analysis and national action plan.

Mitigation Assessment

Analyses showed that Hungary has the best opportunities for stabilizing or reducing GHGs in the energy and in the forestry sectors. In these sectors there are already ongoing governmental programs that may contribute to the GHG emission reduction, although these programs were primarily designed for other purposes (energy savings, job creation, etc.).

Objectives

The Hungarian National Action Plan on climate change has the following general objectives and considerations:

- The economic development predicted for the near future must not lead to a drastic increase of GHG emissions. Therefore, the NAP should concentrate on economic restructuring, first of all in the energy sector. It also has to take into account the special problems arising from the privatization of all sectors of the economy.
- The resources for financing environmental protection measures are still very limited. Therefore, the NAP should be based on ongoing programs that may also serve environmental goals, such as the reduction of GHG emissions.
- The NAP is devoted also to promoting the development of the National Communications.

Table 1. Summary of Plan Priorities and Measures

Priority Sectors and Subsectors	Proposed Measures
Mitigation	
Energy	■ Replace inefficient coal-fired power plants ■ Increase use of natural gas ■ Increase use of renewable energy ■ Conduct efficiency improvements in public buildings
Forestry	■ Expand the area of forests for wood products ■ Establish fuelwood plantations ■ Introduce new, more resilient species

Methods

Establishing the Planning Team

In Hungary, the Ministry for Environment and Regional Policy is responsible for the development of the National Communications and the NAP. In this work, the Ministry relies on Systemexpert Consulting Ltd., which is the main supporting institute in this field. Systemexpert is the focal-point institute of the U.S. Country Studies Program on behalf of Hungary. A great number of experts are being drawn into these activities from institutions such as the following:

- Ministry of Industry, Trade, and Tourism
- Hungarian Energy Office
- Forest Research Institute
- Budapest University of Economics
- Budapest University of Technology
- Budapest University of Horticulture
- Research Institute of Computer Sciences and Automation

The Hungarian Country Study Team also includes a member of the Hungarian Commission on Sustainable Development. This governmental commission, led by the Minister of Environment and Regional Policy, is responsible for the submission of the National Communication. Measures have been, and are continuing to be, selected and evaluated in regular scoping meetings. Nongovernmental organizations (NGOs) are involved in the development of the NAP through the Commission, which includes two seats for NGOs.

Evaluating and Developing Measures

When reviewing the measures for the different sectors, the experts will select those that are both technically and economically feasible. This phase of the work has not been completed yet, although some progress has been made in the forestry sector (see Measures). Obviously, the economic situation is an overriding concern in selection of the measures. Because of this, priority will be given to mitigation actions that can be integrated into ongoing government programs and projects, such as the state afforestation program or the energy efficiency program conducted by the Ministry of Industry, Trade, and Tourism. However, implementation of even these programs has slowed down because of financial problems. One avenue for financing mitigation measures could be through Joint Implementation projects. At the moment there is only one pilot project (on reducing emissions by city buses), but further projects are planned within this framework (see International Cooperation).

The Country Study Team members have had many years of experience in the field of modeling; therefore, they actively use sectoral and macro models in planning. For the forestry sector, COMAP is being used. For the energy sector, two well-known models are being used to evaluate the scenarios from an environmental viewpoint: the ENPEP program package and the EFOM_ENV. The results of the last two models have significantly influenced the development of the long-term strategies of the Hungarian Power Companies in the past 3 years.

Measures

Energy

Restructuring the power generation sector is the main focus of the Hungarian mitigation strategy. Most existing power plants are old, and their efficiency is very low. The sector has been partly privatized, and the government intends to sell further plants in the near future. And with the predicted increases in demand, it will be necessary to construct at least 900 MW of new generating capacity by the year 2000.

Conventional Power Generation

The Hungarian team has forecasted CO_2 emissions for the Hungarian power plant system using the EFOM_ENV model. Results show that the planned restructuring of the system may prevent a significant increase even in the mid-term. However, since a significant increase in the demand for electricity is expected over the next decade, a 3–5 Mt CO_2 increase seems to be unavoidable. This does not contradict the requirements of the Framework Convention on Climate Change (FCCC), since current overall CO_2 emissions are far lower than those of the base period, i.e., of the yearly average for 1985–1987. (We recall that countries with economies in transition could select a base year or period other than the generally recommended 1990.) Overall anthropogenic CO_2 emissions in Hungary were more than 80 Mt in the base period. They dropped to about 60 Mt as a result of the serious economic crisis that led to the collapse of the previous economic-political systems of the region at the end of the 1980s. However, without restructuring in the power generation sector, the CO_2 increase would be two times higher.

The following conventional power generation technologies are likely to be installed in Hungary in the near future:

- Combined-cycle units (CCGT)
  - CCGT in cogeneration units
  - CCGT in condensation units
  - CCGT using inert gas (60–80 MWe)
- Coal-fired units (650 MWe)
  - Fluid units (150–200 MWe)
  - Conventional lignite power plants (2 × 500 MWe)
- Gas turbines for system regulation

There is, as yet, no final decision about constructing additional nuclear capacity in Hungary. However, nuclear power plants are unlikely to be built in the near future, partly because their share in the power generation mix is already too large.

Timetable for Restructuring. The first phase of the privatization of the electric industry was completed in 1995. Six electricity providers and three power station companies (Mátra, Dunamenti, and Csepel) have been acquired by foreign owners.

In the second round of power station privatization in 1996, the Tiszai Erõmû Rt. was successfully sold, and a decision was made about selling the shares of the Budapesti Erõmû Rt. In the third round, three power station companies with mines in the Trans-Danubian region have again been offered for sale.

Renewable Energy

Current utilization of renewable energy in Hungary has been estimated as 30–35 PJ/year (about 3% of total primary energy demand, TPED). The country's current goal is to increase this share in 2000 to at least 5%–6% of the TPED, and to 175 PJ in 2010. The initial emphasis will be on increased utilization of agricultural residues and the by-products of the logging, forestry, agroindustrial production, and food industries. This goal is realistic and economically viable.

Taking into consideration the potential of renewable energy, the prices and characteristics of the renewable energy sources in Hungary, a wide range of renewable energy technologies may be expected to grow in significance during the next few decades. These are discussed below.

Solar Energy. In Hungary, solar insolation is in the range of 1,150–1,400 kWh/m^2/year (4.14–5.04 GJ/m^2/year), averaging about 1,265 kWh/m^2/year (4.55 GJ/m^2/year). The total direct solar energy received in a year may be estimated to be about 430 EJ in Hungary, which is about 370 times higher than the TPED of the country (1,065 PJ) at present.

Hungary already makes direct use of solar energy for heating water and greenhouses and for drying crops. Although the solar resource is seasonal, prices of collectors are expected to drop enough to encourage increased penetration of low-temperature collectors, especially if penetration is promoted by providing special loans to consumers.

The use of solar energy to generate electricity is currently limited to remote, off-grid applications, in which the load is at least 2 km from the distribution grid. Hungary actually produces photovoltaic cells, but imported cells are cheaper and more reliable at present. Increased penetration will depend on decreases in both the price of energy storage (for off-grid applications) and the cost of the photovoltaic cells and modules.

Biomass Energy. The solar energy stored in the leaves, stems, and branches of plants may be estimated as about half of the annual energy consumption of the country at present. The quantity of the yearly biomass production in Hungary may be estimated in the range of 450 PJ, of which 120 PJ could potentially be used, and about 30–34 PJ could be used economically. The quantity of primary biomass is about 54 million tons in a year: 46 Mt from agriculture and 8 Mt from forestry, of which about 20 Mt (65 PJ) may be utilized economically.

The area covered by forests will increase in the future. Some low-quality croplands will be converted to forests; thus, the fuel-wood production together with the trimming will also increase. Biomass power generation in a closed-loop system, i.e., using wood from these new forest areas, could limit future emissions from the power sector if it is used instead of adding more conventional power plants.

Hydropower. Hungary's hydropower potential has been estimated to be as much as 12 TWh (a fuel equivalent of 42–126 PJ) per year, of which about 7–7.5 TWh is technically exploitable. A determination of economically exploitable capacity is more difficult but, at present, environmental and political factors are decisive.

Current installed hydropower capacity is 48.4 MW. Because of the high cost of construction and hydropower machinery, expansion of Hungary's hydropower capacity is not currently planned.

Wind Power. The average wind speed is very low in Hungary, so special multibladed wind converters are needed, which can start and produce electricity even at low wind speeds. Similarly, their energy output is very low, so relatively big rotors are needed to produce even that small output. Thus, the extensive utilization of wind energy is not economical in Hungary, except for consumers who are at least 2 km from the distribution network.

Geothermal Energy. Hungary has usable geothermal resources. The geothermal gradient in the Carpathian basin (5–6° C/100 m) is double the world average (3° C/100 m). However, geothermal energy is not currently used for power generation because of a lack of the high-temperature (>200° C) resources needed for economical electricity generation using current technologies.

Waste Incineration. Recent studies indicate that one of Hungary's most important sources of anthropogenic methane emissions is the landfill disposal of wastes. The installation of waste incinerators could reduce methane emissions from landfills while serving as a viable management strategy for domestic wastes. To reduce methane emissions associated with open dumping of wastes in rural areas, one solution is to install biogas reactors. If agricultural residues and livestock manure are used in these reactors, they will reduce methane emissions while generating electricity for farms.

Potential for Reducing Emissions. When calculating the reduction in the emissions of the most important GHGs, carbon dioxide and methane, one has to take into consideration that the penetration of renewable energy sources in the energy market will depend on the future price structure of traditional fossil fuels and on the technical status of the devices and appliances utilizing renewable energy sources. If a significant advance occurs in the technologies in the future, this penetration will certainly be accelerated. The following projections assume normal technical development, and are based on only the most credible forecasts. It should also be noted that even these projections of market penetration depend on infrastructure and service systems that do not currently exist. It is, however, supposed that in the transition period of the Hungarian economy, the development of the service sector will accelerate. The expected penetration of renewable energy sources, given these assumptions, is shown in Table 2.

In estimating the reduction in carbon dioxide and methane emissions, it was supposed that the use of solid fuels and electrical energy will be reduced. Table 3 presents estimates of GHG emission reductions.

The reduction in methane emissions is connected mostly with waste incineration, because methane emissions from landfills will be reduced. Table 4 summarizes the different mitigation options envisioned for the energy sector in the near future.

Forestry

Forestry is one of the few branches of the economy that enables the direct sequestration of carbon from the atmosphere. Hungary has great potential to mitigate dangerous levels of carbon dioxide in the atmosphere. Steps will be taken to preserve the level of carbon fixation in soil, vegetation, and wood, and measures that enhance

Table 2. Forecast of Utilization of Renewable Resources (PJ)

Resource	1995	2000	2010	2020
Solar: *direct use*	2.7	8	15	25
Solar: *electricity generation*	0.01	0.05	0.1	0.3
Biomass (agricultural waste, manure, and fuel wood)	25	35	65	85
Hydropower	1.65	1.65	1.65	1.65
Wind power	0.1	0.2	0.3	0.5
Geothermal energy	6.5	9	12	15
Waste incineration and biogas	1.9	1.9	3.8	7.6

Table 3. Forecasts of GHG Emission Reduction by Using Renewable Resources (Kilotonnes)

Greenhouse Gas	1995	2000	2010	2020
Carbon dioxide	5860	8488	15174	20550
Methane	33.0	34.3	68.3	134.5

Table 4. Qualitative Ranking of Mitigation Options in the Energy Sector
(More stars indicate greater potential or greater expected utilization)

Category	Mitigation Option	GHG Reduction Potential	Expected Utilization
Conventional Power and Heat Generation	New CCGT in cogeneration units	****	*****
	New CCGT in condensation units	**	*
	New CCGT running on inert gas	*	***
	New fluid units	***	****
	A new conventional lignite plant	*	****
	A new conventional import coal power plant	*	*
	New gas turbines	***	***
	A new nuclear plant	*****	***
Renewables	Solar and biomass energy	***	**
	Hydropower and wind power	***	*****
	Geothermal energy	****	***
	Incinerators	***	***

carbon sequestration, primarily afforestation, will be given priority in Hungarian forestry.

With respect to forestry, Hungary is among the most developed countries in the world. The rules of sustainable forestry were established long ago, along with the professional, institutional, and legal requirements for sustainable management of forests. A new Forestry Act was enacted on June 18, 1996.

Nevertheless, some recent processes, namely the privatization of land and forests, as well as profound economic and political changes in the country, have perturbed the development of forestry. Privatization will be completed in a few years, and every piece of forested land will be owned by one of the many types of forest owners: a single individual, a group of people, cooperatives, companies, institutions, and the state. The economy has entered a phase of growth, which will mean growing demand for wood products.

Priorities in the Forestry Sector

With respect to carbon mitigation, the priorities in forestry are rather clear. Mitigation measures can be grouped as either management for preservation or management for expanding carbon storage. Table 5 summarizes these measures and their relative significance.

Since forestry is fairly well developed in Hungary, little could be achieved by enhanced regeneration, agroforestry, or urban and community forestry. Among all measures, expanding the area of wood production forests and establishing wood fuel plantations are the most promising for carbon sequestration and will receive detailed analysis for implementation. Although both involve planting trees on abandoned land, the technology, financing, and other aspects can be quite different. They may, therefore, require different carbon-flow and cost-benefit analyses, as well as different implementation measures. Consequently, they are considered separately.

Implementation of Afforestation

According to recent surveys, more than 1 million hectares of former agricultural land will become available for afforestation. One reason for the size of the land to be converted is that, after a large-scale privatization program, a considerable part of the land will be owned by private landowners, many of whom are planning to develop a farm on which agriculture and forestry are combined.

Professional forestry companies are likely to be involved in afforesting these lands. These companies would also help private landowners to assess site conditions, select appropriate tree species, provide the landowners with improved propagation material, and to prescribe and assist in technology. The long traditions of afforestation, many nurseries, the expertise of tending and other silvicultural work, as well as other elements of the professional background of these forestry companies would ensure high efficiency in afforestation.

Most of the land to be converted used to be covered by forests before the intensive extension of arable land centuries ago. Roughly one-half of this area is found in the plain of the Eastern part of the country; the other half is scattered in the hilly parts of the Northern and Western parts. The majority of the afforestation would be for timber production, the rest for protection, mainly environmental protection. Land for conversion could include several thousand hectares of tree belts for arable land protection, channel and canal protection, roadside belts, and snow barriers. In addition to breeding, the latest achievements of research on silviculture and yield can also be used for optimizing tree growth and, hence, maximum CO_2 sequestration.

Mitigation Potential. Four different scenarios were considered:

- Baseline Scenario: Unlikely. This scenario assumes that no afforestation will take place before 2050.
- Mitigation Scenario I: Likely. This scenario assumes that the current rate of afforestation will continue, i.e., 3,000 ha of forests will be planted per year during the next 50 years.
- Mitigation Scenario II: Programmatic. This scenario involves afforesting 210,000 ha by 2010, an annual rate of 15,000 ha, which would require finding additional domestic financing and some foreign aid.

Table 5. Carbon Mitigation Measures in Forestry (More stars indicate greater significance)

Category	Measure	Significance
Preservation of carbon pools	Preservation of forest land	*
	Preservation of carbon density of stands	*
	Preservation of carbon in soil	***
	Preservation of carbon in wood products	*
Expanding carbon storage	Expanding the area of wood production forests	*****
	Establishing wood fuel plantations	***
	Increasing efficiency in forestry	*
	Increasing carbon content of existing stands	**
	Increasing carbon in wood products	*

- Mitigation Scenario III: Achievable. This scenario requires afforestation of almost 600,000 ha by 2050, an annual rate of 11,000 ha. This scenario would afforest all land where the site can be regarded as suitable for forest management with acceptable benefits. However, this rate of afforestation is not comparable any more with the production capability of the country, so foreign aid is needed to help decision makers to engage in this program.
- Mitigation Scenario IV: Technical Potential. This scenario involves afforestation of nearly 1 million ha by 2050, a rate of 18,000 ha per year. This program requires substantial aid for the country. This is, however, the most preferred scenario because of its beneficial effects.

Figure 1 shows the extent of carbon sequestration for each of these scenarios, and Table 6 shows the cost-effectiveness of implementing each scenario.

It is worth noting that most of the carbon sequestered is fixed in the second half of the period. This means that, despite heavy investments, the benefits of carbon sequestration appear only after a rather long period of time. Consequently, afforestation programs should be launched as quickly as possible. It should also be mentioned that the cost of carbon sequestration in forestry is much less than mitigation options in other branches of the economy.

The implementation of either mitigation scenario III or IV would be a major achievement for Hungarian forestry. According to some analyses, the forest cover in Hungary would be optimal at around 25%–30% of the land area. If either of these two scenarios were implemented, the forest cover would be raised to 25% and 28.5%, respectively. This would bring a lot of benefits to the people, as well as to the local and regional environment.

Either of these scenarios would increase the production of wood products, which would be beneficial for the import-export budget of the country. Currently, the country is struggling with a trade deficit, and it is currently reliant on importing timber products from other countries. Another benefit of a large-scale afforestation program would be job creation.

However, such a program requires considerable financial support. The planting and initial thinning costs could amount to several tens of millions of U.S. dollars. This is several times more than what the Hungarian economy is likely to be able to afford in the next decade.

Figure 1. Carbon Sequestration in Four Afforestation Scenarios

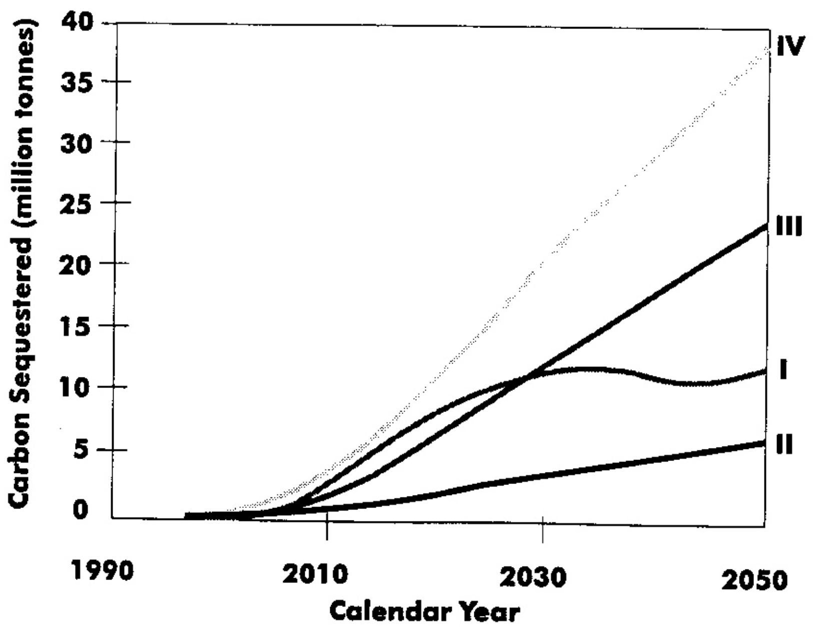

Table 6. Cost Effectiveness Indicators for the Four Mitigation Scenarios

Indicator	Mitigation Option I	II	III	IV
Initial Costs of Establishing Projects				
$/tC	0.007	0.014	0.004	0.002
$/ha	0.425	0.550	0.150	0.092
Total Endowment (Present Value of Costs of Establishing and Running Projects)				
$/tC	25.447	39.921	21.522	18.839
$/ha	1525.093	1616.604	871.549	762.895
Annual Benefits of Reducing Atmospheric Carbon (Present Value)				
$/tC per year	–0.526	–0.487	–0.486	–0.486
Net Benefits of Reducing Atmospheric Carbon (Present Value)				
$/tC	–7.018	–6.491	–6.481	–6.480
$/ha	–420.630	-262.842	-262.451	-262.394

Issues and Lessons

Hungary's mitigation strategy can be based only on ongoing governmental programs, which have originally been launched for other purposes, but which can contribute to a significant reduction of greenhouse gas emissions. These are the energy-saving and afforestation programs. Therefore, the main fields of emission mitigation will be in the energy and forestry sectors. The main reasons for this are as follows.

- Overall energy efficiency is far lower than that in industrialized market economies. Efficiency on both the demand and the supply side has to be increased, even in the short run. As far as the supply side is concerned, restructuring of the power plant system is unavoidable, since a lot of plants are old.
- There is a certain potential in the country for the utilization of renewable resources.
- Forestry management is already well developed, and there is enough land for a large afforestation program.

International Cooperation

Hungary is unlikely to find the domestic resources to support big mitigation projects in the near future. Therefore, opportunities for international cooperation — especially opportunities for Joint Implementation — must be considered. Foreign sources could support ongoing programs, which have slowed down because of financial problems, or new projects can be based on them. Hungary is currently seeking partners to finance the following projects:

- Efficiency improvements to lighting systems in some public buildings
- Afforestation of selected areas
- Utilization of geothermal resources in selected sites

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