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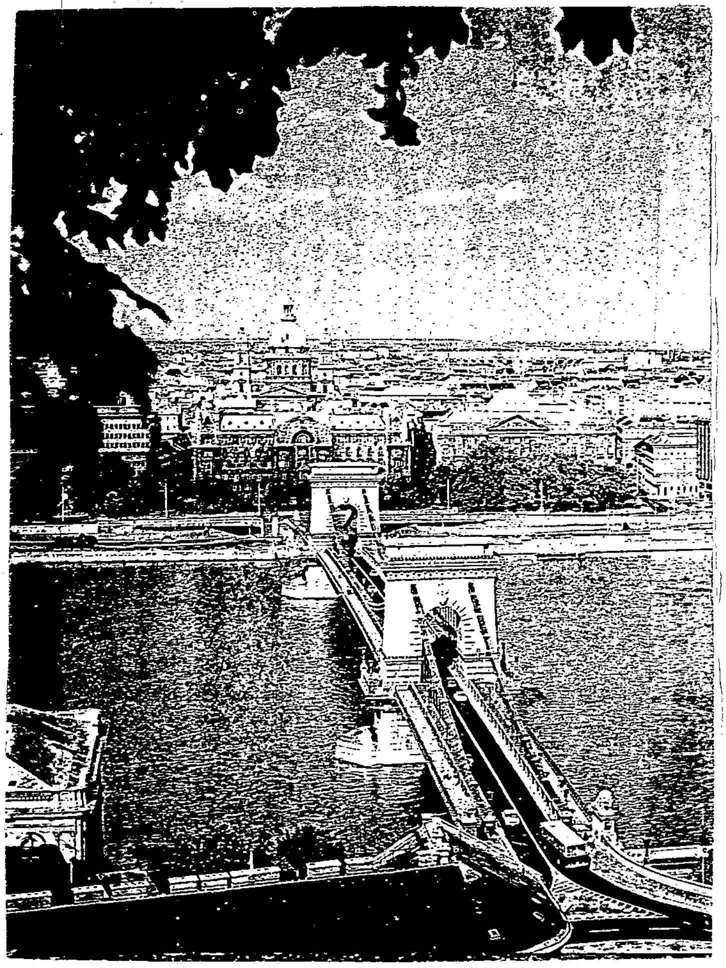
PREFACE

This report was prepared on request from the Norwegian Ministry of the Environment as a part of the agreement on co-operation on environmental management between Hungary and Norway. The project should partly give a background for the Hungarian communication to the United Nation's Framework Convention on Climate Change. The Hungarian Ministry for Environment and Regional Policy has contributed by outlining the issues to be discussed. The authors would like to thank dr. Tibor Faragó especially for his active support at this early stage. The Norwegian Ministry of the Environment has funded the project.



"For me the centre of Central Europe is the mid point of the Chain Bridge"

"But why is the air in this city so full of dust, lead, and acids?"

György Konrad

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EXECUTIVE SUMMARY

This report discusses the main challenges for environmental policy making in Hungary. At present, the management of economic problems is regarded more urgent than dealing with environmental problems by the Hungarian government. However, due to international obligations and local pollution the authorities will have to give priority to environmental issues in the near future. To design a sound and cost-effective environmental policy is, however, a complicated matter. Different human activities cause several environmental problems, and a particular environmental problem may origin from several sources. The fact that Hungary is in a transition towards a new social, political and economic system increases the difficulties. In order to establish an environmental policy, it may therefore be helpful to relate experiences from other countries to the Hungarian case. The aim of this report is to contribute to this process.

To assess environmental policy challenges for Hungary requires a thorough assessment of the expected social and economic development over the next 5 to 10 years. Even the near future is, however, highly uncertain. It seems unlikely that environmental policy will be controversial in Hungary before the turn of the century. One can live with the uncertainty as long as the questions of initiation, type and extent of environmental measures can be solved when the problem occurs. However, in some cases decisions are more or less irreversible. In such cases, environmental effects should be taken into account at once. Else, one takes the risk of being stuck with high environmental costs in the future, which might be avoided by modest investments now or in the next few years.

The emissions of air pollutants and greenhouse gases in Hungary have decreased since the late 1980s. This is mainly due to the economic recession and an increase in the use of nuclear energy, but can also be explained by introduction of low-emission technology programs in the power plants, natural-gas programs etc. Depending on the economic development and the emphasis put on environmental issues, fairly stable emissions or minor increases are expected until the turn of the century. NO_x and CO-emissions represent exceptions since it is difficult to avoid an increase due to increased transportation.

The relationships between exposure to pollutants and effects are generally uncertain. However, air pollutants are likely to cause significant health effects in many densely populated and industrial areas in Hungary. The data suggest strongly that suspended particles are the most health-damaging component. However, there seem to be some inconsistencies in observed concentrations which must be sorted out. Ozone concentrations probably cause 5-10% crop loss for cereals. It is likely that pollution affects forests to some extent, but forest damage in Hungary is less serious than in for example Poland and the Czech Republic.

One may point at a few properties of the Hungarian economy that seem likely to be present around year 2000. First, there is economic growth, and the economy is at least to some extent restructured such that firms mainly within manufacturing industries, now being unprofitable and with gloomy prospects, have been faded out. Structural changes beyond 2000 will probably follow the pattern known from other industrialized market economies; a gradual transition from agriculture and manufacturing industries towards service sectors. Finally, consumption is likely to grow.

As for environmental policy, this implies firstly, that it becomes increasingly difficult to find an easy way out of environmental problems. Environmental improvements as a result of economic restructuring, which is likely to be significant before 2000, will not be equally easy to attain later. A more efficient market will enhance the cost of imposing environmental standards. Thus, great concern should be directed towards environmental problems occuring from expanding sectors such as the transport sector, generation of electricity, and not at least private consumption. In addition, new environmental problems may occur. Secondly, the conflicts between economic growth and environmental goals may sharpen, partly because Hungary will have to deal with global environmental problems to a higher extent. Both factors lead to more expensive environmental policy.

The ranking of strategies and measures intended to improve health and environment is complicated by the fact that the problems are interrelated and require an integrated approach to be analysed. An important objective for this work has been to identify and characterize the main problems related to emissions. This is, of course, necessary for discussing strategies and measures for a future policy which emphasizes health and environment. So far it has not been possible to discuss specific measures in detail. However, some general recommendations can be given: Care must be taken not to reduce the importance of public transport. Better maintainance of buses and cars, in particular diesel vehichles, is likely to have a high benefit/cost ratio. Energy saving measures are important as the efficiency gap in Hungary has been estimated to 15-30%.

An important task is to raise the public awareness of environmental issues. More emphasis must be put on environmental issues in legislation in a way suited for market conditions. In this connection, it is important that Hungary as a candidate for membership is obliged to harmonise relevant energy and environmental policy and legislation with that of the European Union. International-level obligations both in terms of environemntal and climate policy as well as general harmonisation of market rules with the EU will work positively to forge an institutional devleopment in Hungary that compares with that of the other European countries. This will facilitate the integration of environmental critera into other sectoral policies.

There is a strong need for effective institutions with high competence to take responsibility in the management of environmental concerns. At least in a short-term perspective, direct control measures, such as permissions and licensing, must be used to a large extent. A gradual transition to indirect market oriented environmental policy instruments may be advantegous. Extended use of environmental impact assessements (EIA) in connection with decisions, which have considerable environmental effects, is recommended.

1 INTRODUCTION

Within five to ten years, Hungary will have to design an overall environmental policy. In the meantime Hungarian decision makers have an opportunity to make preparations in order to meet domestic as well as global environmental challenges without having to pay too much. This paper discusses the main challenges for environmental policy making in Hungary. Man-made emissions of various compounds to air may have local, regional and global effects. Countermeasures will generally affect emissions of several compounds with consequences in particular for health, materials, vegetation and climate. All important effects should be included in assessments of the measures. This report provides a background for a comprehensive, integrated view of environmental control using data from Hungary with emphasis on the energy sector. It is pointed out that environmental considerations must be included in legislation to a much larger extent than hitherto. Uncertainties in many steps in the analysis are large and only some tentative estimates of damages due to emissions are included. In spite of this our results give an improved basis for including environmental issues in future climate and energy policy in Hungary.

After a long period with increasing political problems, increasing social unrest and economic recession, the new political regime that took over in Hungary in 1989 faced severe problems in nearly every field of the society. Five years later it has been recognized that the transition towards a new political system, including a reorganization of the economy, will not only be painful, but also slower than expected. On this background it is evident that global environmental problems, including climate change, are not rated high among political priorities in Hungary. However, the Hungarian authorities are concerned with the severe domestic environmental problems. As will be discussed later, local and regional environmental problems cannot be treated isolated from global problems. Moreover, it is expected that the importance of dealing with environmental issues, global as well as domestic, will increase around the turn of the century. Therefore, it is wise to prepare for an environmental policy already at present and to evaluate the environmental effects of current decisions in order to avoid irreversible effects with high environmental costs.

The economic recession and other factors have resulted in reduced emissions of greenhouse cases (GHGs) and many pollutants (e.g. SO_2). Continued economic stagnation in Hungary is expected to prevent rapid environmental deterioration for the next 4-5 years. This gives the environmental authorities an opportunity to abstain from hasty decisions and rather plan for a long-term environmental policy and to learn from other countries' experiences. In this process, cooperation between Hungarian and foreign experts may help in combining knowledge about Hungary and environmental policy making in democratic market economies, which has been unfamiliar in Hungary until recently.

The aim of this report is to contribute to this process. However, it is uncertain how the main environmental problems will develop, how well the economy will function and what the institutional setting will be. Our task was therefore first to figure out how Hungary is likely to develop up till around year 2000, and to describe the economic, environmental and political state at that time. Given these descriptions, we discuss environmental policy issues after the transition to a market economy.

We will emphasise that although the description of the present and near future of Hungary constitutes a large part of this report, our scenarios are not necessarily more likely to become true than those presented earlier by others. Our assumptions are partly taken from other sources. The importance of presenting these scenarios should, however, not be underestimated. They provide an important prerequisite for the analysis. Because of the vast uncertainty about the future Hungary, however, their main use is to provide a reference for a discussion of the forces of the economic, social and environmental developments. The basis is an understanding of potential damages to health and environment, which requires knowledge about emissions and relationships between exposure to pollutants and effects. Other important factors include economic development and the building of political institutions.

In this report the emphasis is on greenhouse gases and air pollutants related to the production and use of energy. It seems likely that the benefits from reducing emissions (or dampening increases) in the future may be considerable. Regarding the situation in Hungary we will primarily discuss effects of air pollutants on health, materials, vegetation and climate. Large relative and absolute declines in human health status in Hungary as well as in other countries in Eastern and Central Europe are well documented (Feachem, 1994, WHO, 1994). It is believed that the main causes are lifestyle factors (diet, abuse of tobacco or alcohol), but pollution may also play a role (see Chapter 4). Deterioration of many buildings in Hungary (including the Parliament) illustrates that materials are affected. Effects of acid rain (or related pollutants) on forests have been the focus of much research and debate (see Chapter 4). A comprehensive monitoring program has supplied data for defoliation in most European countries. Figure 1.1 below indicates extent of defoliation (in 1993) for some countries. The defoliation is not necessarily caused by air pollution, but there are strong indications that it is contributing.The figure indicates that the situation is somewhat better in Hungary than in the other countries included. However, the problem is serious enough to cause concern. With respect to climate change the main threat in Hungary may be possible decrease in precipitation in dry areas, and thus increased periods of drought.

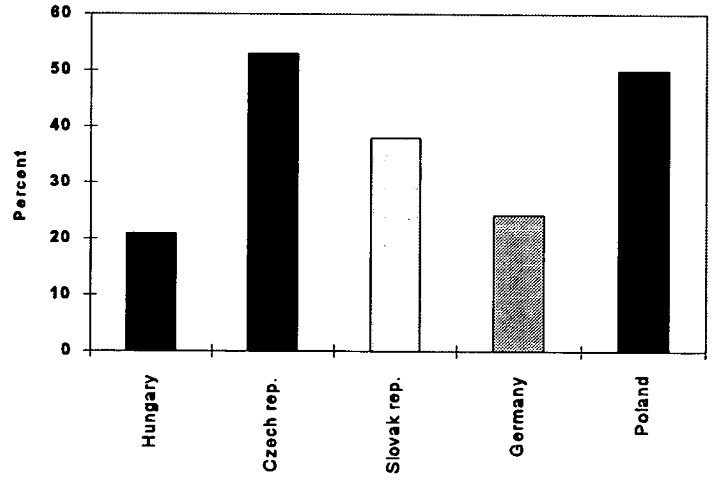


Figure 1.1 Pct. of trees (all species) with defoliation above 25% in 1993 (UN/ECE - CEC, 1994)

The examples given above illustrate that there are ample reasons for trying to limit emissions of pollutants in Hungary, both because Hungary is subject to international commitments with respect to emission of certain gases, and because the emissions cause damages with related social costs. As discussed in Chapter 5, more emphasis on environmental considerations in legislation and policy-making is needed. The present legal tools were not made for the market conditions which are gradually being introduced in Hungary. Further, Hungary will have to develop environmental policy and law that harmonises with that of the European Union over the next few years.

To achieve the highest benefit for each forint spent on emission control, one has to take into account that the causes and effects of emissions are interrelated. Thus, the apparently least costly way to mitigate the emissions of greenhouse gases may be very different from the least costly way to jointly mitigate effects on climate, materials, vegetation and health. This report therefore aims at providing a background for a comprehensive, integrated view of environmental control.

Various approaches may be taken to control emissions and thus improve health and environment. Here we will briefly mention one approach that illustrates the interconnections of different pollutants and environmental problem areas. If we wish to rank a number of possible measures against emissions according to their costs and benefits, a number of steps are required. These are schematically shown in Figure 1.2. One task is of course to estimate the direct costs of the measures (right hand side of the figure). Although in principle straightforward, the uncertainty is sometimes considerable. Other important steps include estimation of the fate of the emitted pollutants and the resulting exposure of humans, materials and the environment. Combining this information with quantitative knowledge of effects of the pollutants, the damages may be estimated. In most cases there are large uncertainties in the estimates in these steps, especially in the relationship between exposure and effect (dose-response relationships). This is discussed further in Chapter 4. Cost-efficient environmental policy choices require estimates of all costs and benefits. Reduction in damages can usually in part be valuated directly (e.g. corrosion of ordinary building material or loss in agricultural crops). However, in a comprehensive approach subjective valuation of environmental qualities (e.g of increased recreational value of a clean environment) should be included. Various methods for monetization have been applied, all of them have weaknesses and problems (OECD, 1989; Navrud, 1994; Wenstøp et al., 1994).

The figure illustrates clearly the important point that one measure generally affects a number of components (pollutants) and that each component may affect the population/recipient in several ways. This implies that environmental problems in general should not be treated separately.

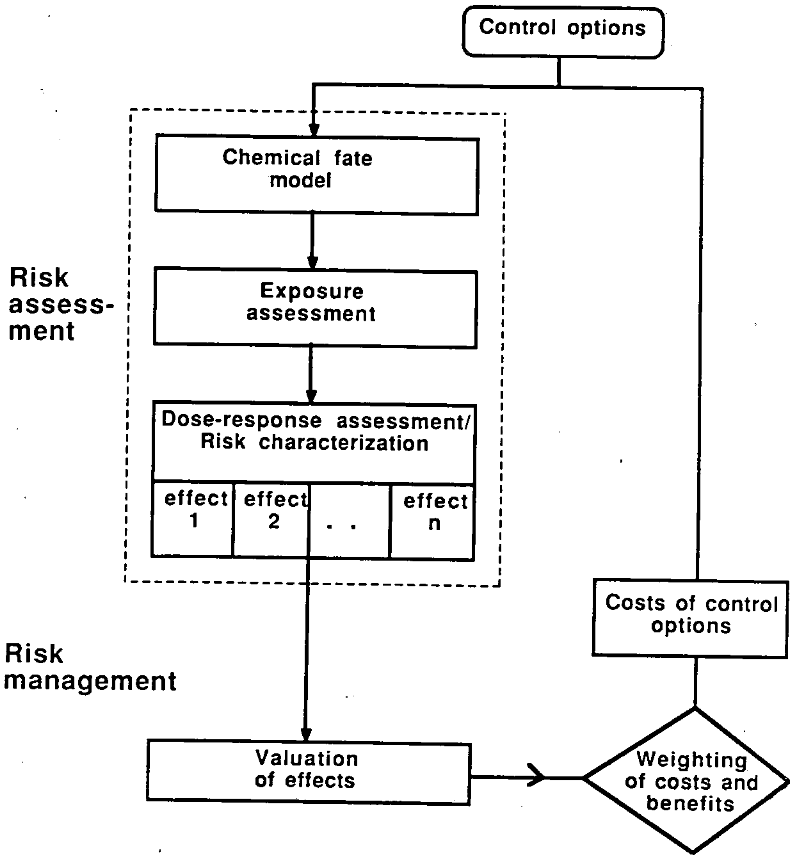


Figure 1.2 Steps in an analysis for ranking control options or other strategies affecting emissions of pollutants. (The figure was originally used in connection with an analysis of possible air pollutant abatement measures in Oslo. SFT, 1987; Trønnes and Seip, 1988).

2 ECONOMIC TRANSITION AND THE ENERGY SECTOR

The economic situation in Hungary does not encourage policy makers to give climate policy issues a high priority at present. However, local environmental problems and international obligations will make environmental policy, including climate concerns, important in the near future. Therefore, it is beneficial in the long term to take environmental issues into account in today's decisions, such as in energy and transport policy. Economic development is likely to stagnate in the nearest years, but a significant growth toward the end of the decade may be achieved. The state of the environment around year 2000 will depend largely on how energy and environmental policy issues are emphasised in the near future. The economic future for Hungary is basically characterised by uncertainy. An understanding of market forces and how to control them is vital to prepare adequately for future challenges.

A number of recent studies, including Ministry of Industry and Trade (1993) and Erlich and Révész (1993), have discussed possible future development paths for Hungary. A common feature in all of them is the emphasis on the uncertainties. These are related to the description of the present state of the Hungarian economy, how difficult the transition towards a market economy will turn out, take the future economic integration with other countries and, not least, domestic policy choices. After the election of a new government last spring, there are several unanswered questions as to what extent decisions made by the former goverment will be followed up. This adds significantly to the uncertainty of forecasts for the future Hungary. For the purpose of this report, however, it was necessary to make a choice. It was agreed that we should make an evaluation of the "common view" from other experts and use the figures that in our opinion are most relevant as a background for the present study.

2.1 Economic prospects

In the framework of the international research program "Eastern and Central Europe 2000", Éva Erlich and Gábor Révész authored a national summarising report for Hungary entitled "The Present and a Possible Future in Hungary, 1985 - 2005", based on studies and summaries of 33 other experts. The report reveals scenarios for six fields of social life: Economy, politics, social processes, science and technology, education, and regional processes.

The following is based on the above report, and summarises the most relevant material for the present study on the past, present and expected future. The production capacities left over from the former socialist regimes were characterised by an old and depreciated technology equipped for the production of mainly outdated products. Accordingly, the former socialist economies are very energy and material intensive. Compared to international standards, Hungary's steel consumption per capita was 1.63 times the average OECD consumption level in 1980 and energy consumption was 1.76 times as high. Erlich and Révész do not provide figures for later periods as the comparative figures at the time of the research were not available. However, they note that the change between 1980 and 1988 was too small (although favourable) to make an influence on their statement. Table 2.1 compares energy consumption per capita in Hungary with the figures of Poland and former Czechoslovakia.

Although Hungary posessed an inefficient economic structure with high energy intensity by international comparison at the time of the political change of the system in 1989, the economic reforms, however small during the soft dictatorship from the mid 1960s, made Hungary better prepared for the change than many other countries with centrally planned economies.

Table 2.1 Energy consumption compared to international standards

Country	International standard = 1	1980 Kg oil equivalents per capita	1988 Kg oil equivalents per capita
Czechoslovakia	2.5	6452	6172
Poland	3.3	5590	4735
Hungary	1.8	3850	3811

According to Ehrlich and Révész the public, including the experts, expected 2-3 years of recession after the political change. One had hoped that a continuous economic and political integration in the developed West would begin and make development accelerate. Due to a declining military threat and a significant savings of military spending in the Western countries, one hoped that a small "Marshall plan" would be offered to former socialist countries. Hungary was expected to have a favourable share of this because of its good image. Till now, this has not happened. It is realized that the transition will be characterised by a deep crisis as shown in table 2.2, and it is expected now that the economy will not recover for several years.

Table 2.2 Main macroeconomic indices for Hungary. Constant prices.

	Preceding year = 100			1989 - 1990 (1989 = 100)
	1990	1991	1992	
GDP	96.5	88.1	95.5	81.2
Industry	92.1	81.9	94.1	71.0
Agric./Forestry	95.3	91.8	86.3	75.5
Services	103.6	94.4	99.1	96.9
Total consumption	97.3	94.7	98.0	90.3
Investments	92.9	88.4	93.6	76.9

Source: Hungarian Central Statistical Office (1993b).

Between 1989 and 1992 total consumption declined by approximately 10 percent and investments by nearly 25 percent. GDP declined by approximately 20 percent. Industrial and agricultural production dropped by almost 30 percent. Although comparisons of constant price figures from national accounts must be interpreted with care, especially under economic transition, there are little doubts that a vast recession actually has taken place. 1993 represented a slow-down in the economic decline, and preliminary figures for early 1994 display a slight recovery. There is, however, a political dispute about how these signals are to be interpreted. The former government considers it a positive trend, while the present government claims that the "recovery" is based on an increasing accumulation of foreign debt. In 1993 the balance of payment was -3.5 bill. USD making the stock of net debt 14.9 bill. USD. In 1994, the stock of net debt is expected to grow to between 17 and 18 bill. USD. To a country with about 10 mill. people, this seriously restricts the opportunities for economic policy-making in Hungary.

Two remarks need to be added. The picture given here is distorted by the fact that the data refer to companies employing over 50 persons. The importance of small companies has significantly increased in later years. The only figure available about their performance is that the value of their production was twice as high in 1992 as in the preceding year. Ehrlich and Révész believe, however, that this fact alleviates, but does not counterbalance, the crisis of the big companies.

The other distorting factor is the significant proportion of the "black economy". A highly uncertain estimate is that these activities produce about one third of the official GDP. A high rate of unemployment and relative high cost of living compared to the average wage level make it easy and attractive for contractors in small units to hire black labour. In addition there is a large supply of labour to the black market. Together with the difficulties in controlling a rapidly increasing amount of small units, the excess supply of labour will probably make it difficult to manage a decrase in the share of the black economy within the next 5 to 10 years.

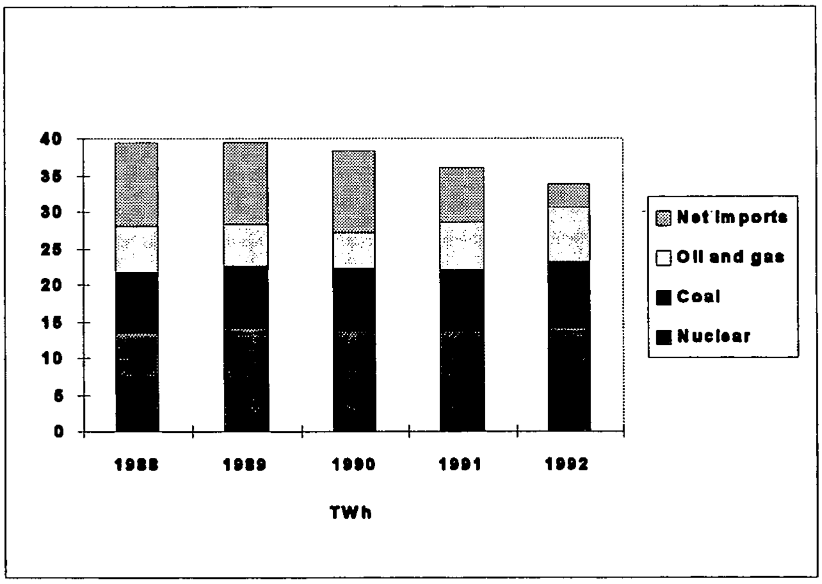


Figure 2.1 Electricity generation 1988 - 1992. Twh

The economic recession has affected the energy sector as well. Energy utilisation has dropped. Érlich and Révész assumed that electricity production in 2000 will be similar to that of 1992, but lower than it was in 1990 and 1991. Simultaneously with the dissolution of COMECON and the Soviet Union the Hungarian electric energy imports have declined significantly. Domestic production had to make up for this cut-back in imports and will probably have to do so in the future as well. While the proportion of imports in total electric energy utilisation in the 80s was about 30%, this proportion dropped to 9% in 1992. Electric energy production of the power plants of the Hungarian Electric Works Joint Stock Company increased slightly despite the substantial decline of electric energy utilisation as shown in figure 2. 1.

2.2 Energy sector reforms

Fourty years of central planning and communism have left behind an energy sector widely different from the requirements of a market economy. As in other countries of Central and Eastern Europe, energy sector enterprises were organised as large State Trusts with no distinction being made between commercial and technical operations on the one hand and regulatory and political dispositions on the other. Energy was in general under-priced, investments in energy sector were pursued far beyond the economic optimum and the operational performance of the energy sector was in general poor. On a broader scale the economic co-operation within the Council of Mutual Economic Assistance (CMEA) created a trading system with under-priced energy flowing from Soviet Union to Hungary in exchange for manufactured products, partly energy intensive.

The reform process will bring about fundamental changes to the energy sector both in terms of the legal and regulatory framework within which enterprises will operate and develop their business strategies and by a new institutional structure of commercial enterprises and regulatory bodies.

The ultimate goal of the sector reforms may be to privatise a major part of the energy sector. Before this can become a practical reality, however, commercialization and corporatization are required first steps to enhance the efficiency of the sector. Commercialization aims at enhancing the business orientation of the enterprises. This requires that enterprises have autonomy especially for pricing, borrowing, staffing, and procurement matters. Corporatization makes enterprises subject to company legislation and is a precondition for privatisation (Richter, 1992).

Hungary has moved fast in the direction of establishing a new legal foundation that regulate energy sector operations. The main initiatives have been

- the Natural Gas Act
- the Electricity Law
- estblishment of regulatory institutions in support of the new Act(s) on Electricity and Natural Gas, e.g. a regulatory body to oversee price setting of the natural monopolies, a body to grant concessions and licences and an energy saving agency.

Under the current political situation, however, there is considerable uncertainty as to what the present government will emphasise.

Oil and gas

The Hungarian National Oil and Gas Trust (OKGT) until 1991 enjoyed a state monopoly in all aspects of upstream and downstream oil and gas activities. Imports and exports of petroleum products were, however, handled by the trading company Mineralimpex. In 1991 part of OKGT was separated out as independent companies (primarily non-core activities). The remainder was established as a stock-holding company (MOL, Hungarian Oil and Gas Company), organised in two main divisions: one upstream and one downstream. MOL controls all activities in exploration and production of oil and gas, the three refineries that supply 95% of the petroleum product demand, operations of transmission pipelines through the subsidiary Gas and Transporting Company (GOV), all distribution of natural gas which is organised in five regional distribution companies, and an important part of wholesale and retail sales of oil products.

MOL, through state ownership, will probably continue to be the dominant enterprise within the oil and gas sector. Certain parts of downstream activities have been opened for independent companies and privatisation is under consideration.

Coal

Coal production is organised in 8 regionally based, state-owned, companies. They were independent entities not subordinate to a trust as is the case for electricity and oil and gas. In order to improve the negotiating position towards the powerful Electricity Board (MVMT) the mining companies have established a joint stock holding company, Mininvest, to represent the interests of the mining companies, and in the current situation arbitrate the allocation of cuts in production (IEA, 1991). Distribution of coal to the household market is for a major part managed by TUZEP (Fuel and Building Matrial Enterprise). Other companies are also active.

The costs of coal-mining differ considerably between deep-mining pits and open pits. Deep mining pits, which produced some 18 out of a total of 25 mill. tons in 1990, produce at very high costs. The average cost of Hungarian coal mining is about 33 percent above the import price, and the coal has a low quality. The restructuring of the economy may therefore lead to a close-down of several coal mines, principally deep-mining pits. However, mining generally takes place in areas with poor alternatives for employment. This probably implies that some coal production will be protected through governmental aid for the forseeable future.

Prices for coal are determined by the state. Direct price subsidies have been substantial but were eliminated as of 1st June 1991. Coal prices for deliveries to power plants have been aligned with a reference price for heavy fuel oil. Recently price increases for thermal coal were negotiated between Hungarian coal unions and the government, implicitly giving workers wage increases. Still, the major part of the Hungarian coal companies are in major financial difficulties and significant debt write-offs are needed (Ft. 30 billion, IEA, 1991).

Electricity

The electricity sector is organized into a two-tier company (MVM Rt) consisting of eight generating companies and six regional distribution companies as the first tier and the high voltage transmission grid and the national dispatching centre as the second tier. MVM Rt is currently owned entirely by the State Asset Management Company (AV Rt), which represents the State's interest in strategic industries. The Government intends to keep at least 51% ownership of MVM Rt. It appears that the current structure with MVM Rt as a holding company controlling all aspects of electricity supply will be retained. Therefore, the individual companies within power generation and distribution will probably not be able to operate as autonomous units which compete with each other. The electricity law opens for independent generation of electricity, but it is unclear whether the independents will become commercially attractive in consideration of the current surplus generating capacity and uncertainty about regulatory practises.

The agreements made between the Hungarian coal union and the government imply that the costs for generating companies increase without these companies being allowed to increase electricity prices. Thus the financial situation of MVM Rt will deteriorate. Restructuring of brown coal-power schemes may, however, save the enterprise of costs.

Nuclear power contributes to approximately 40 percent of electricity supplies in Hungary. The whole electricity system is vulnerable to any disturbances in nuclear production (Kats, 1991). On the other hand, further expansion of the nuclear capacity would contribute to reduced dependence on electricity import. Currently the load factors of the Paks plant is very good (81-85%) and comparable to the best performers in western Europe. Waste storage may however become an increasing problem, and may become an obstacle to further expansion of nuclear capacity. Until recently radioactive waste has been sent to the former Soviet Union. However, Russians are now demanding a high price for retaining high level waste. Moreover there is political and popular resistance against transport of the waste. There is, therefore, a need for permanent storage of waste in Hungary.

District heating.

There are 59 district heating companies in 104 communities (IEA,1991). They purchase from MVMs CHP plants or generate heat at their own heating plants. Price control and responsibilities for the heating systems are as of 1992 the responsibility of the municipalities. There is considerable scope for improvement in the production and transmission of heat. Losses in the networks could range between 30 and 40%. The difficult financial situation of municipalities and the political and practical difficulties of introducing cost related tariffs for district heat make it difficult to raise funds for needed investments to upgrade the networks.

2.3 Scenarios for Hungary

For practical reasons we will refer the discussion of the future options for environmental management in Hungary to scenarios. The scenarios are basically related to two alternative development paths for Hungary, called a "conventional wisdom"-scenario (CW) and an "environmental-friendly restructuring"-scenario (EFR). It should be emphasised that the CW-scenario and the EFR-scenario presented later in this chapter are not identical with the CW-scenario and the EFR-scenario presented in Chapters 3 and 4. However, they overlap each other fairly well in both cases, and are therefore taken to be essentially equal. In this section, we summarise the main differences between CW and EFR scenarios, which are common for the differences of the two economic scenarios and the two environmental scenarios. Both are slightly optimistic with respect to economic growth. GDP is expected to grow by approximately 2-3 percent till year 2000. The main differences are:

i) The restrucuring of the Hungarian economy goes further in the direction of light manufacturing industries and service sectors in the EFR-scenario than in the CW-scenario. However, heavy industry declines in both. The consumption pattern will develop in accordance with "Western" patterns in the CW-scenario, while a more environmentally friendly consumption pattern is supposed to emerge in the EFR-scenario.

ii) Transport is expected to grow only slightly in the EFR-scenario. The share of railway transport and other public transport is maintained on today's level. In the CW-scenario, the total transport activity is expected to increase by 10 - 20 percent; and the share of road-transport will increase.

iii) Both scenarios assume an increase in energy consumption but energy will be utilized more efficiently. In the EFR-scenario a considerable increase in the use of renewable energy is expected, and the share of gas utilization is estimated to increase from today's level of 35 percent to 45 percent. The CW-scenario anticipates only a small increase in the utilization of renewable energy sources and gas. This results in a higher dependency on energy imports in the CW-scenario, while the dependency is unchanged compared to the present situation in the EFR-scenario. Neither of the scenarios assumes a need for a new major electricity plant.

iv) In the EFR-scenario it is supposed that environmental policy will be emphasised more than the custom is at present, while the CW-scenario prolongs the present environmental policy trends.

v) Total energy consumption is approximately 7 percent higher than in 1992 in the EFR-scenario and 14 percent higher in the CW-scenario. As a result the EFR-scenario will also end up with lower emissions by year 2000, compared with the CW-scenario. However, some emission components will increase in both scenarios.

A more pessimistic scenario than these two would be a sementation of the current economic structure, a possibility that assumes continuing recession of the Hungarian economy. The most significant changes compared to the current situation is that recession will not prevent road transport from increasing.

2.4 Driving forces in the development of energy demand

A scenario may be useful as a point of departure for concrete analysis of policy measures. For the scenarios to be useful, however, it is important to provide a general understanding of the implications for energy demand of economic development. To outline the driving forces of energy demand requires a rather detailed description of the economy. It is realistic to assume that Hungary by year 2000 has a "market economy", but it must be realized that market economies can be organized in several different ways. Some mixture of private and state owned enterprises will always exist. State owned enterprises will normally have different targets than privately owned enterprises which maximize some surplus. Although this section focuses on economic relations, it needs to be emphasised that the effect and the efficiency of policy measures also depend on institutional factors which may take different forms within market economies. A discussion of institutional aspects of environmental policy is given in Chapter 6.2.2.

There is a close relationship between economic growth, use of energy and emissions to air. It is relatively simple to predict the emissions of CO_2 from economic data, since they can be calculated by emission coefficients for different energy types. For pollutants, the relations are usually more complex, being dependent on specific technology and the composition of commodities produced or in use. Macro-economic aggregates are often too rough to capture such details, and sectoral analyses have to be made as a supplement (see Chapter 6). Nevertheless, a macroeconomic viewpoint may contribute considerably to get a general picture also for the emissons of other gases than CO_2.

In this section, we look upon demand as a driving force for the energy consumption pattern and thereby the emissions. This is not the only way to analyse the future need for energy. No doubt, the main energy policy measures in Hungary will continue to be directed against the supply side. However, measures on the demand side, especially economic measures such as taxation, may be imposed and perhaps increase its importance from 2000 and beyond. Furthermore, the demand side is to a greater extent subject to indirect regulation than the supply side. It is essential, therefore, to understand the determining factors of the demand side.

The main causes of economic growth are capital formation and technological change. For practical analysis of energy demand in the process of economic growth, however, it is convenient to split these into four factors: The growth in GDP per capita, structural change, change in relative prices and technological advancements.

2.4.1 General economic growth

Economic development in Hungary during the 1990s is roughly expected to fall into three periods. The recession period 1990-1993, a stand-still from 1993 to 1996, and growth by the end of the century. Around 2000, the level of economic activity is expected to be about the same as it was in the beginning of the 1990s. Till now, the period 1985 till 1987 represents a peak in the Hungarian economy, and is chosen as a reference to which Hungary will compare its emissions in its communication to the Climate Convention. As for the emissions of greenhouse gases, it is unlikely that Hungary will meet constraints because of its emissions before 2000. Beyond that, however, the contribution from energy consumption and emissions from general economic growth may be significant. How much the formerly suggested rate of growth, 3.5 - 4 per cent annually beyond 2000, may change the emissions will, however, depend critically on the other main driving forces of energy demand.

2.4.2 Structural changes in and after the transition period.

In order to forecast total energy consumption and emissions it is vital to know what industries are expected to increase and what industries are expected to decline as a result of a transition toward a market economy. The old industry structure was heavily based on energy intensive industries, such as metallurgy, which are expected to decline rapidly in the coming years. These industries have based much of their energy consumption on energy commodities with high polluting rates. Based on the CW scenario in section 2.3 and the study of Erlich and Révész (1993) we have estimated the development of various sectors within the manufactoring industry from 1990 to 2000. Figure 2.2 indicates "winning" and "loosing" sectors in the process of the transition to a market economy in Hungary. Despite the same level of GDP in 2000 as in 1990, the restructuring of the economy will probably imply a reduction of total national emissions.

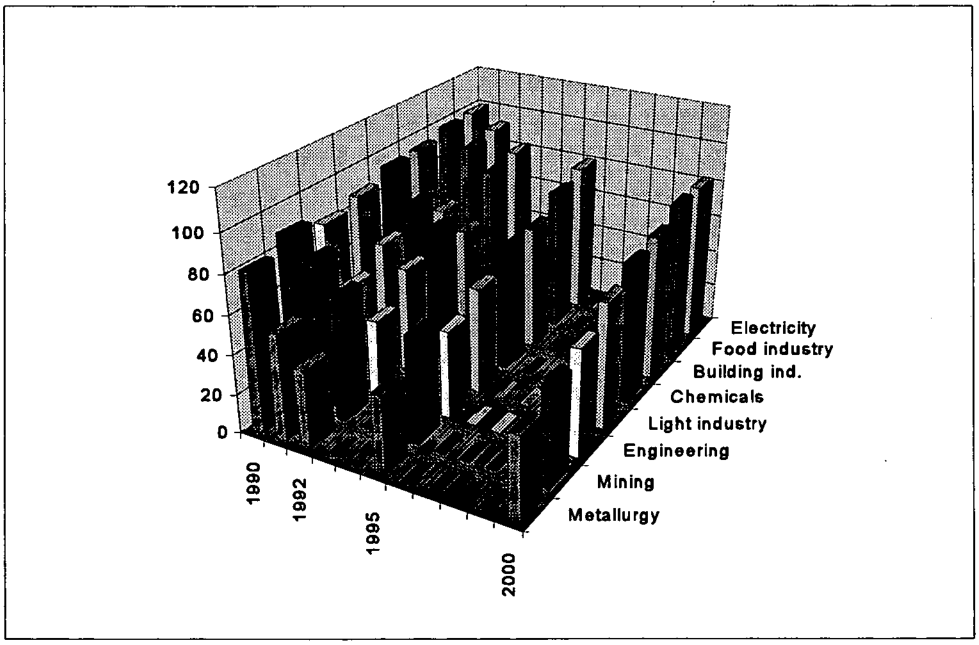


Figure 2.2 Production indices for manufacturing industries 1990 - 2000. 1989 = 100.

Although the energy intensity of the Hungarian economy very likely will decline as a result of structural changes, the extent to which this may happen will depend highly on the strength of the restructuring. In figure 2.3 this is illustrated for total national consumption of converted energy commodities. The bars compare total consumption in 1990 (left bar) with total consumption after a restructuring of the economy, provided that total GDP is the same as it was in 1990. The expected restructuring (the "third" bar, denoted 1) refers to the bars for year 2000 in Figure 2.2. Two more alternatives, one assuming the structural change to be half as strong as expected (denoted 0.5), and the other a half-time stronger than expected (denoted 1.5) are also displayed. The figure shows that except for oil products, the restructuring of the Hungarian economy is likely to decrease the use of energy. The increase in oil products is mainly due to a relative increase in transport and electricity generation. It should be added that structural change may take place also within sectors. That would result in a change in the energy intensity for the sector as a whole. We will come back to this in section 2.4.4 on technological change.

By 2000 most of the currently non-profitable firms are expected to be eliminated. A slower or at least a less drastic structural process is therefore expected. This means that structural change will proceed in a more usual pattern, which includes a substitution from agriculture and manufacturing industries to service-sectors. Within the service-sectors, transport will be of particular importance, and probably constitute the most serious problem with respect to energy consumption and emissions. Transport will need separate treatment as the transport sector itself embraces only a part of the total transport activity.

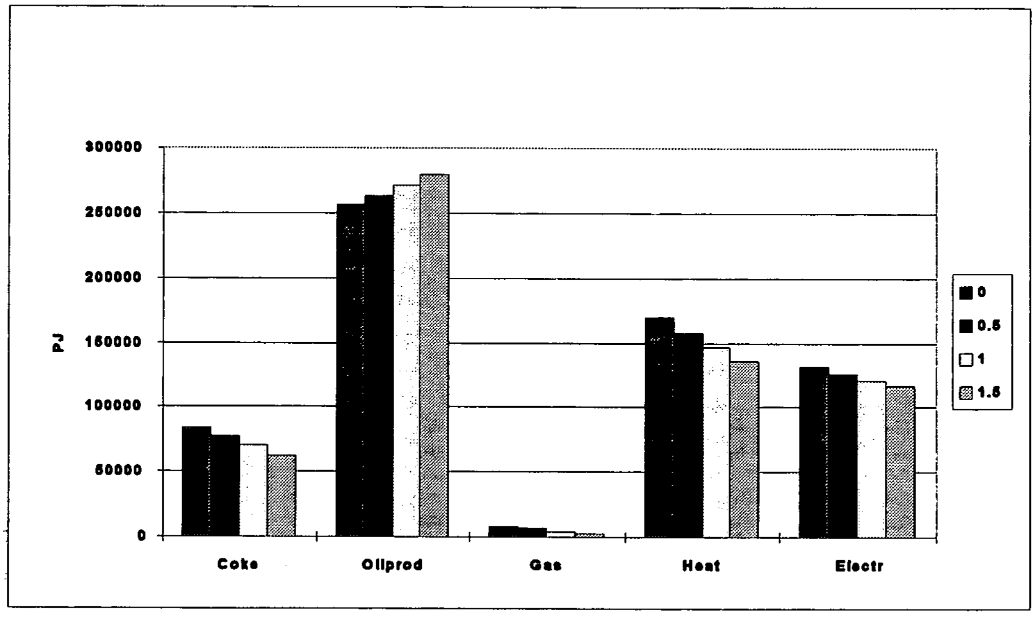


Figure 2.3 Consumption of energy types by year 2000 with different strengths of strucutral change. (See text for explanation)

A particular attention should be paid to the households. In the long run, the households are likely to be one of most rapidly increasing "sectors" with respect to economic growth. In addition, and opposed to many other sectors, the energy intensities of household activities are not expected to decrease. One explanation is changes in life style, such as an increasing use of private cars. Equally important may be demographic changes, however. Energy consumption turns out to depend heavily on size of the family, where in the country people live and so forth. For instance, 50 percent of the increase in stationary energy consumption in Norwegian households during the 1980s can be explained by a higher frequency of people living singly, partly a result of a higher divorce rate (Ljones *et al.* (1992))

2.4.3 Energy prices

In general energy prices are important for two reasons. First, changes in energy price relative to other prices will initiate a substitution between the use of goods. Accordingly, the sharp increase in real energy prices from the first oil price hike in 1973 to the collapse of the oil market in 1986 is a main explanatory factor behind the reduction in energy intensities on the world scale during this period. The second reason is that changes in the relative prices between energy types such as oil and coal, give rise to substitution between them. This may affect emissions, as the polluting components differ significantly between energy commodities.

Hungary is critically dependent on energy imports (cfr. Figure 3.3), and will remain so for foreseeable future. One of the main issues of Hungary's energy policy is to become less dependent on a single supplier of energy. This requires pipelines for oil and gas from more than one country. If Hungary manages to diversify the supply of foreign energy, the energy price will to a large extent be determined on the world market. As noted in Section 2.2, however, the future of domestic coal mining is highly uncertain. A continuation of unprofitable domestic coal-mining will contribute to keep the prices high. This may curb consumption of coal, which is favourable regarding emissions. On the other hand, Hungary may import coal with lower emissions of SO_2 and heavy metals per energy unit than the emissions of domestic coal. Import of coal may contribute to lower prices and thereby enhance demand. Thus, the total effect on emissions is uncertain.

Before the energy prices become subject to market assessments, a deregulation of the energy market is also required. The political will to do so is clearly present, but it needs preparation. There is a danger that monopolies will occur within different segments of the energy sector due to increasing returns to scale, i.e. that the unit cost of production decreases the larger the production unit is. A particular challenge will be to secure free access to the transmission and distribution system. In this context Hungary may draw on the experiences in other countries. For a closer discussion of institutions and national organization of the energy market, see Section 2.2.

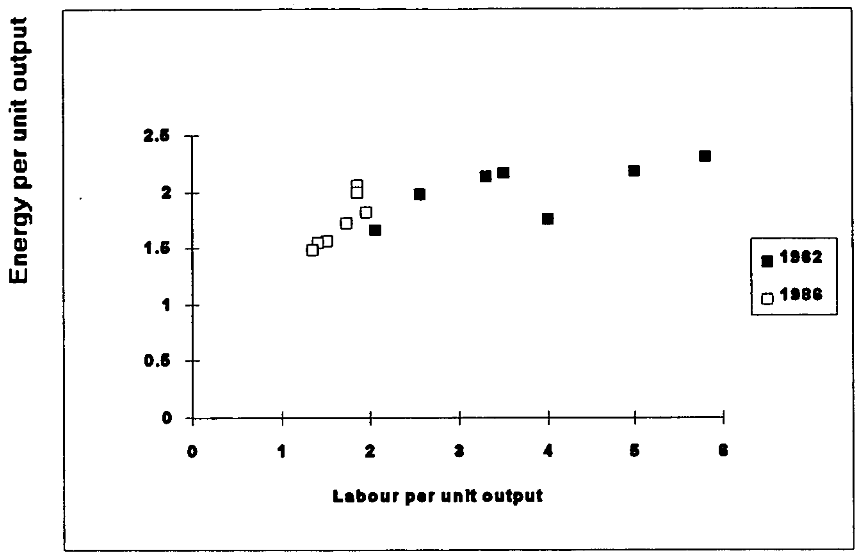
2.4.4 Technological change

The environmental impacts of future economic growth in Hungary will depend critically on the implementation of new technology. Innovations will have direct impacts on the environment by the use of environmental instruments such as investments in environmental friendly technology, but perhaps more important, at least in the nearest future, is the indirect effect on the environment from the change in economic structure and the scrapping of the old capital equipment. However, it is not straightforward to quantify how technological changes will change the national emissions. Detailed information about the internal structure of the most important sectors is required. Below, some rather general comments are offered on the important distinction between energy savings and energy efficiency. What needs to be emphasized is that there may be a large potential for energy savings simply by increasing the energy efficiency. However, a higher energy efficiency does not necessarily lead to energy savings.

To illustrate the difference between energy savings and energy efficiency, consider an industry branch with a number of production units. Suppose that each unit were established at different time, and therefore based their choice of equipment, technology etc. on different knowledge and belief about the future. As for Hungary, these differences are probably substantial at least if we compare units established before 1990 with those established after. Thus, the energy intensity may vary considerably between each unit within the sector. Because of this diversification, the observed energy intensity within the sector may tell us little about the minimum energy input required to produce one additional unit of the sector's output. Then one may ask whether any movement towards the technology frontier will be optimal. The answer is in general no. Although there exists equipment which would be efficient if investing "now", it may be unprofitable to replace the old equipment. A change of prices may therefore lead to little substitution between input factors in the short run because the possibilities are limited by existing capital equipment. In the long run, the supply of e.g. new machines and improved infrastructure will be adapted to the new technology and a new set of prices. Thus, cost-efficient behaviour is not synonymous with a full utilization of the energy saving potential, but may rather be illustrated as a gradual adaptation to a moving target. However, the speed of this process will depend on the diversification of energy intensities within a sector and the age of the old capital equipment.

The next question to be raised is whether cost-efficient changes will reduce the energy intensity. Neither this question can be answered with yes or no. Cost efficiency means that the cost of the composition of input factors is to be minimized. This works as an incentive for technological advancements. Technologcal improvements will usually focus on input factors for which the prices increase relative to other prices. The real price of labour is often the one that increases compared to other main inputs. The result is that new technology has aimed at replacing labor by capital. In this process the energy intensities have been driven up even in times when the energy prices have been increasing. This is illustrated in figure 2.4. The figure displays input of energy and labour per unit output in factories within the aluminium manufacturing industry in Norway in 1962 and 1986. While the input of labour was widely dispersed among factories in 1962, the picture had changed dramatically in 1986: All the factories had a lower labour input-ratio than in 1962 and the ratios were fairly equal among the factories in 1986. For energy only small changes are reported. One explanation may be that the factories have put most efforts in saving labour because the real wage increased by 75 percent in the period while the real price of energy was approximately the same in 1962 as it was in 1986.

The motives for energy saving in Hungary is perhaps stronger than in many other countries due to the dependency of energy imports and nuclear power for which a further expansion may meet severe political difficulties. Despite the economic arguments presented above against an exaggeration of "the energy savings potential" such potentials are clearly present in Hungary. Some possibilities for lowering the overall energy intensity of the country are given below.



Source: Bye and Førsund (1990)

Figure 2.4 Input per unit in aluminium manufacturing in Norway 1962 and 1986.

Modernisation of energy utilisation

There is a significant potential for energy saving within energy consuming sectors. An emphasis on the development of solar utilization in constructions, energy saving material and more energy efficient structure of new buildings may contribute to about 2 - 2.5 percent reduction of total energy use. This requires *inter alia* a significant modification of the design practice for new buildings. Further, a 1 - 1.5 percent reduction can be expected from a more widespread use of better lighting equipment, electric machines, devices, individual measuring and regulating equipment if incentives such as more market oriented prices of energy are worked out. The planning of new power plants built to meet the peaks, may also be avoided by incentives such as peak-load pricing which aims at levelling out the oscillations in energy consumption.

A general modernisation of the capital equipment, including heating technologies, is also expected to reduce the energy intensities significantly. In addition, there is a promising potential in a reconstruction of industrial furnaces and heat generators as well as utilization of industrial waste in connection with district heating.

Modernisation of energy production

One opportunity to reduce the dependency on energy imports is to encourage the utilization of new energy sources, such as biomass, biogas, biodiesel, and solar energy (see e.g. WEC Commission (1993)). Internationally, there has been a great interest in developing new technologies in order to utilize new energy sources in recent years. Increasing the share of such sources would have positive impacts also on the emissions, especially on CO_2.

Modernization of the technology in existing power plants may also contribute to decrease emissions e.g. installation of flue gas desulfurization or to increase the proportion of gas turbines with combined cycle. Reconstruction of the power plant system in this direction has already begun. The import structure with respect to energy types is also important for the emissions. From an environmental point of view a priority of gas imports will be beneficial compared with imports of oil or coal.

3. FOSSIL FUEL CONSUMPTION AND ASSOCIATED EMISSIONS OF GREENHOUSE GASES AND AIR POLLUTANTS IN HUNGARY

This chapter gives data for fossil fuel consumption and associated emissions to air. Use of fossil fuel in industrial processes, products etc. is not included. The consumption of fossil fuels has decreased the last decade in Hungary, mainly due to the economic recession, but also because of introduction of nuclear energy in the power production. The dominant greenhouse gas from use of fossil fuels is CO_2 *and the main air pollutants include particulates (TSP),* NO_x, SO_2 *and heavy metals. In the period 1985-1992 the reductions were approximately:* CO_2*: 26%,* SO_2*: 40%, TSP: 60%,* NO_x*: 28%, CO: 21%, nmVOC (non-methane VOC): 45% and lead: 60%.*

The uncertainties in the emission data given are estimated to ±15%. The source of the emission data is Technical University of Budapest (by dr. Tihamér Tajthy), denoted TUoB in the following. The data were elaborated in 1994. (See also Tajthy, 1993; Tajthy et al., 1990; Tar and Tajthy, 1990).

3.1 Fossil fuel consumption

The total fossil fuel consumption in Hungary has decreased steadily during the last decade as illustrated by fig. 3.1 and 3.2. The decrease (measured in PJ) was 22.3 % in the period 1985-1992, mainly due to the general economic recession which is responsible for a decrease in GDP by 13% in the same period.

The changes in fossil fuel consumption in each sector varied considerably:
- agriculture: 59% decrease
- industry: 38.8% decrease
- service: 17.1% decrease
- public power plants (heat and electricity production): 16.3% decrease[1]
- households: 10.2% decrease
- transportation: 6.7% decrease[2]
- heat from non-public power plants[3]: 4.7% increase (variations highly dependent on ambient temperatures)

In addition to these overall large reductions, the relative distribution of fossile fuel types changed during the period. While the fuel types were quite evenly distributed in 1985 with

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[1] The *total* fuel consumption (PJ) of the public power plants has, however, *increased* with 9.1% in the period 1985-1992, due to increased use of nuclear energy (see fig. 3.6 which also shows that the fossil fuel consumption of the public power plants has been increasing since 1990).

[2] Although there has been an overall decrease in fuel consumption in the transportation sector, there has been a 17.3% increase in the gasoline consumption in the period 1985-1992 (in spite of a sharp decrease from 1990-1992 because the gasoline price was more than tripled). This implies a 28.5% decrease in diesel consumption in the period.

[3] About 2/3 of the district heat supply is from public power plants. The rest is non-public heat supply for district heating (called "heat, non-public" in the figures) which is operated by the local authorities.

solid fuel as a slightly larger group (solid: 35% of total, liquid: 33%, gas: 32%) solid fuel represented the smallest group in 1992 (solid: 26%, liquid:35%, gas: 39%). This tendency towards more use of gas must have contributed to cleaner air in many areas.

Fig. 3.3 shows the energy sources used in Hungary (PJ) since 1950, and illustrates the peak that occured in the mid 1980's. (Nuclear energy production is included in "domestic", while nuclear fuel is not included in "imports"). Imported electricity is represented by the fuel equivalent, i.e. as if it had been produced in an average power plant in Hungary (this also applies to fig. 3.5). The increasing dependency on energy import in the period up to 1990 is evident. If fuel for nuclear energy production is included, the import dependency is over 70% (REC, 1994a).

Solid fuel has become less important in the domestic energy production (see fig. 3.4 and 3.6). The dominant fuel types concerning the import are crude oil and gas (in 1992 respectively 52.3% and 32.2% of the import), see figure 3.5.

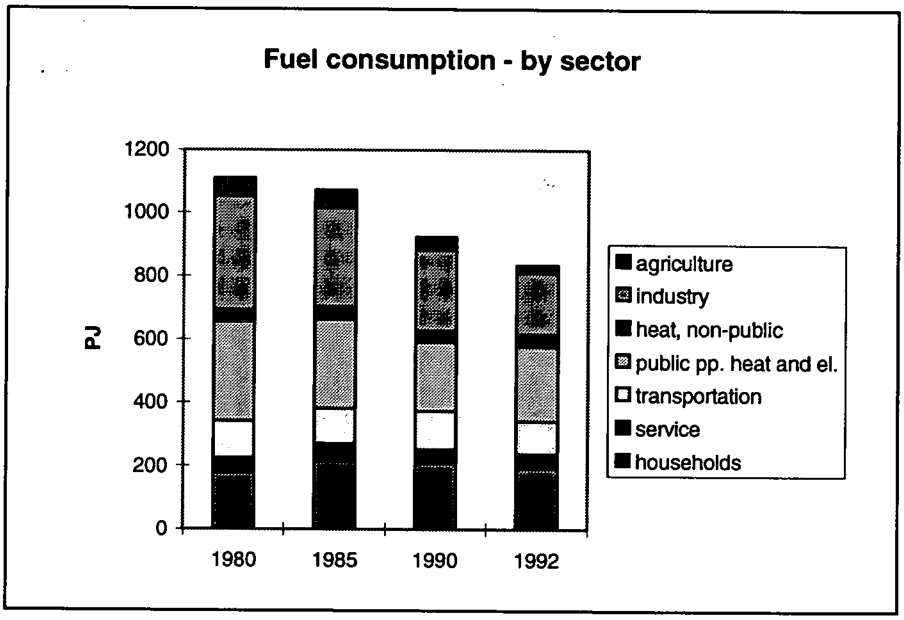

Fig. 3.1. Fossil fuel consumption in Hungary by sector (pp: power plant).

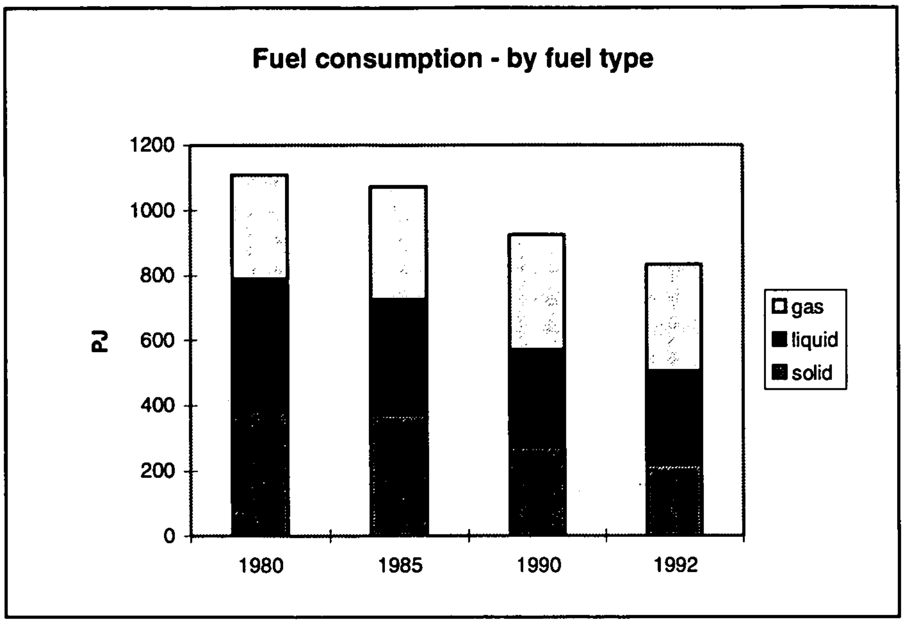

Fig. 3.2. Fossil fuel consumption in Hungary by fuel type.

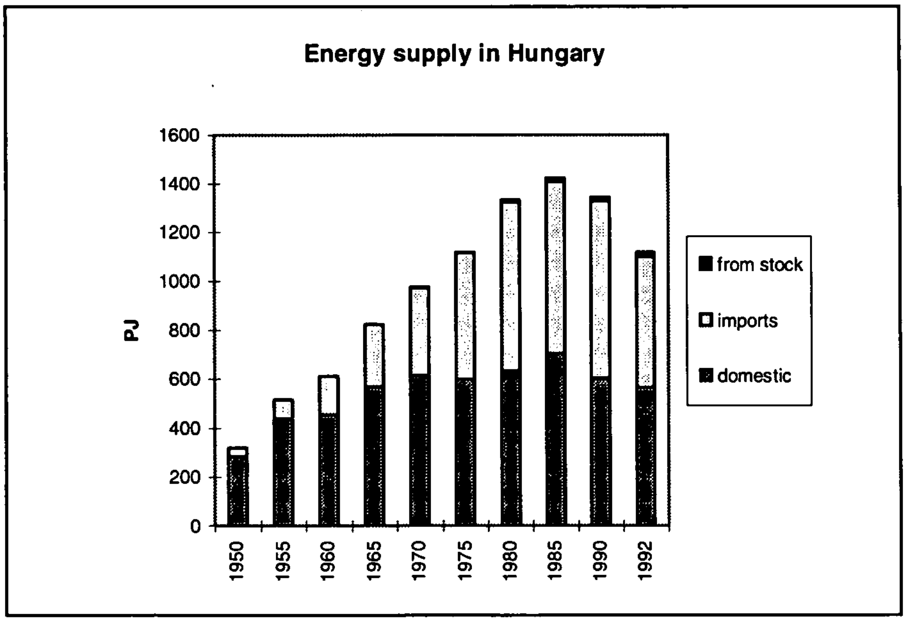

Fig. 3.3. Energy supply in Hungary (all fuel types - see text)

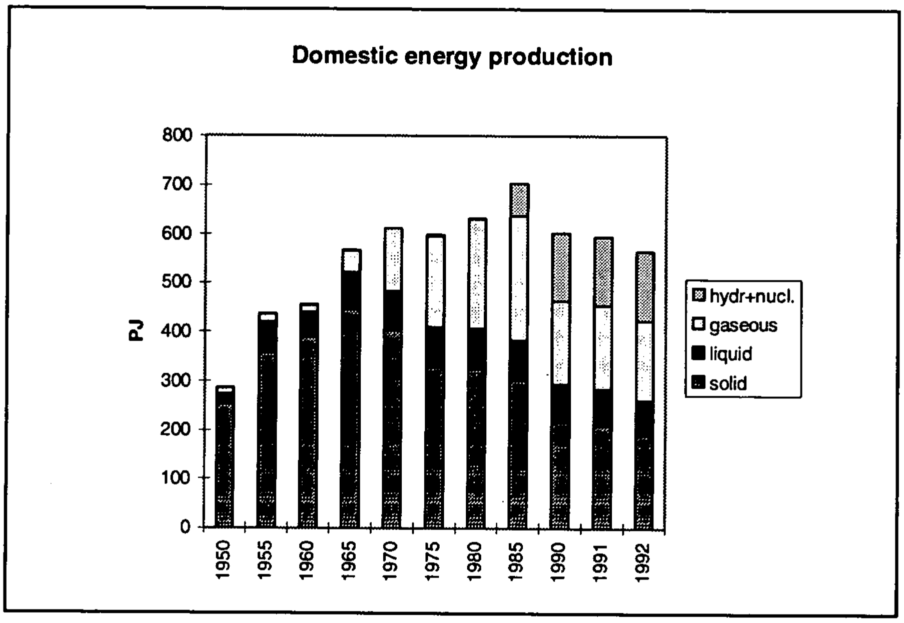

Fig. 3.4. Domestic energy production (all fuel types).

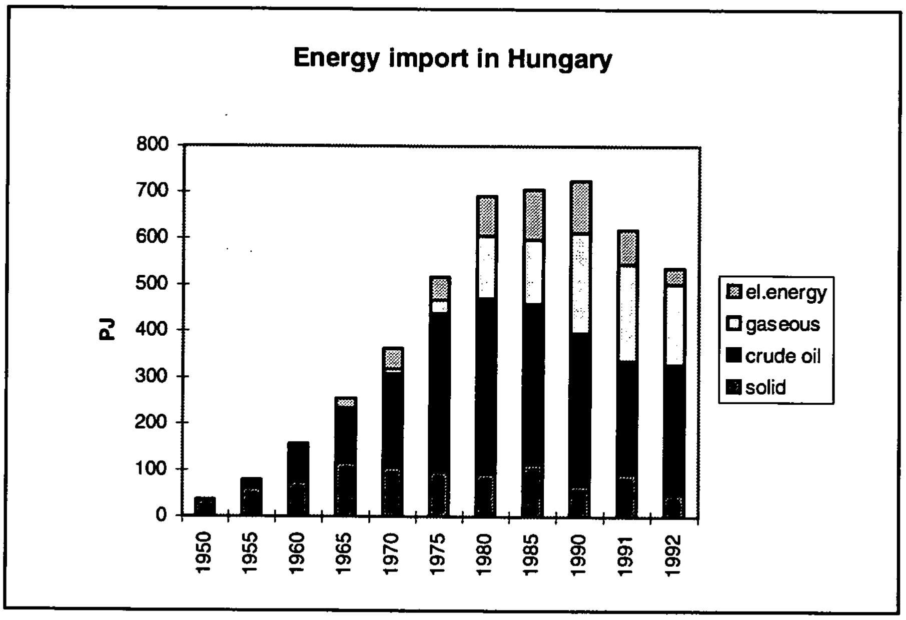

Fig. 3.5. Energy import by fuel type (nuclear fuel not included).

In 1983 nuclear power was introduced in the Hungarian energy market, and in 1985 the share of nuclear fuel in the total fuel consumption (in PJ) of public power plants was 20.5%, almost doubling to 39.1% in 1992 (see fig. 3.6).

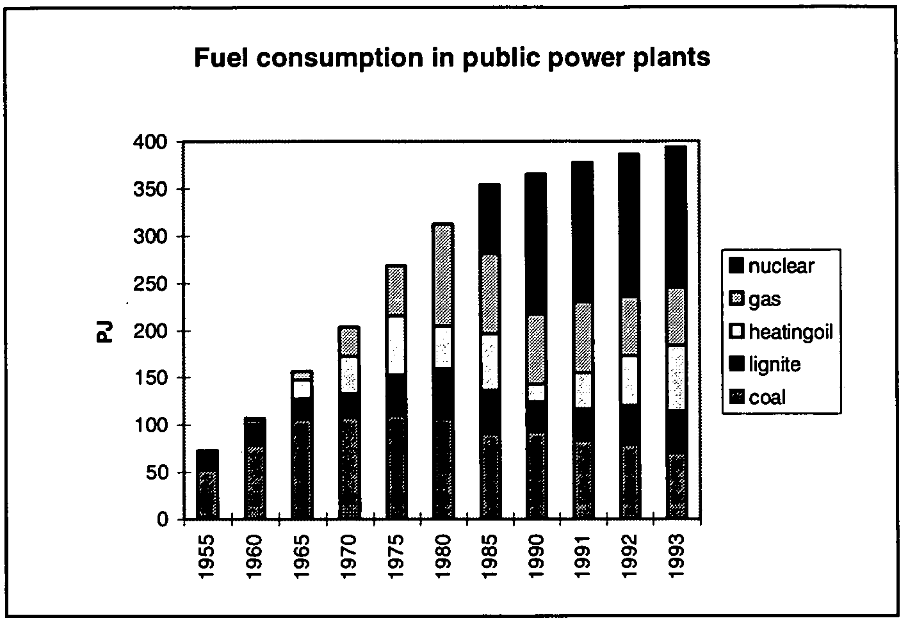

Fig. 3.6. Fuel consumption in the public power plants, by fuel type.

In the decade from the mid 1960's to the mid 1970's the total energy intensity in general decreased substantially, from ca. 70 to 51 PJ/GDP (GDP given in 10^9 1988 US$). Since then, however, the energy intensity has only slightly decreased (see fig. 3.7). This implies that there should be some potential for reduction of emissions if less energy intensive technologies are applied (see also chapter 6). However, an important reason why the energy intensity apparently is high compared to western industrialized countries, is not necessarily that the *technological* energy efficiency is low, but rather that the products that are produced are less valuated on the world market. Restructuring of the economy is likely to result in a relative increase in GDP, i.e. the energy intensity may decrease as a result of an increase in the denominator rather than a decrease in the numerator.

Fig. 3.8 shows that the electrical energy intensity has increased in the same period as the total energy intensity decreased, partly because the sectors that have had the most pronounced recession do not have electricity as a main energy source.

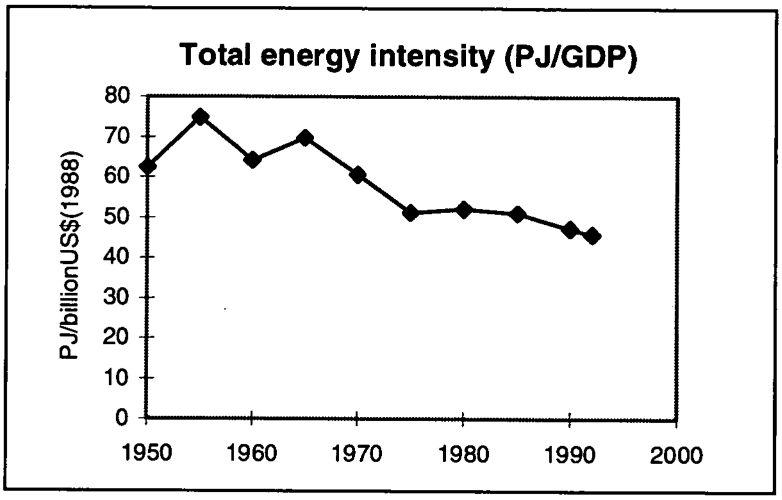

Fig. 3.7. Total energy intensity in PJ/GDP (as billionUS$(1988)).

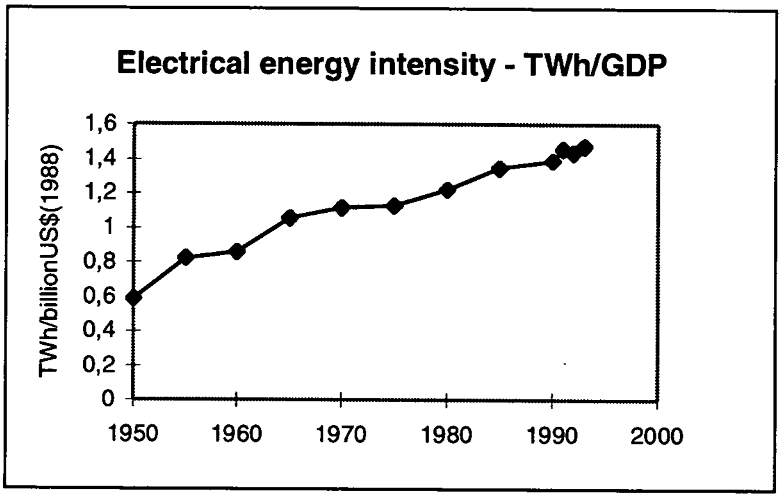

Fig. 3.8. Electrical energy intensity in Twh/GDP (as billionUS$(1988)).

3.2 Greenhouse gases

The main greenhouse gas (GHG) from fossil fuel use is CO_2, although CH_4, N_2O, NOx, CO and nmVOCs (non-methane VOCs) also contribute directly or indirectly[4]. As can be seen from fig. 3.9 the CO_2 emissions are substantially reduced due to the economic recession and the introduction of nuclear power in the energy sector, the reduction in the period 1985-1992 being about 26%. The emission of CO_2 from fossil fuels per GDP unit is relatively high in Hungary compared to the western industrialized countries, but the CO_2-emission per capita is lower in Hungary than the average for the ECE countries.

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[4] The CH_4-emission from fossil fuel use was about 12 kT in 1992. As a comparison the CH_4-emission from enteric fermentation in domestic animals was about 88 kT in 1992 (TOuB).

The total emission of CO_2 from energy use in Hungary (in 1988), as estimated in Subak et al. (1993), was 66.3 million tonnes, which is approximately 0.3% of the world emissions. This estimate is somewhat lower than the figure we will use in this report, where the emission of CO_2 due to fossil fuel use is estimated to be 74.2 million tonnes for 1990 (TUoB). OECD estimated the total Hungarian CO_2 emissions in 1990 to 68.8 mill tonnes, 97% of the emission coming from energy use, only 3% from industrial processes (OECD, 1993). We have chosen to use the figures for greenhouse gases as estimated by theTechnical University of Budapest. These estimates are sector and fuel distributed and are also consistent with the other figures we have used in this report, concerning e.g. fuel consumption and emissions of air pollutants.

Based upon the relative radiative forcing IPCC (1994) has estimated the contributions of current emissions of CO_2, CH_4 and N_2O to total radiative forcing expected for future time horizons (in so-called CO_2-equivalents)[5] (see also Section 4.5). We have calculated the future integrated forcing for current emissions of CH_4 and N_2O using GWP-values (GWP - global warming potential) with 100 years time horizon. As figure 3.10 shows the future radiative forcings due to current emissions from this sector are likely to be dominated by CO_2.

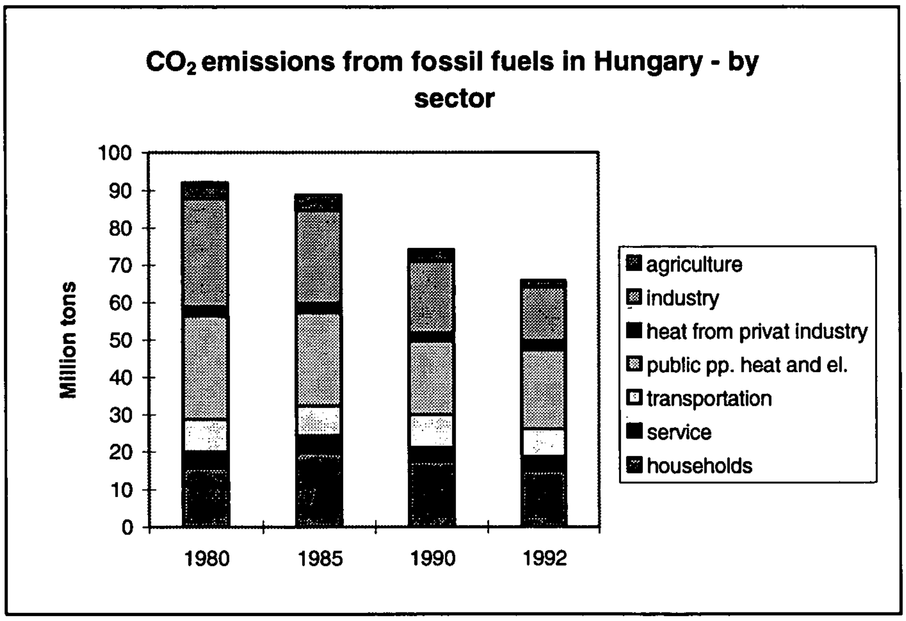

Fig. 3.9. CO_2 emissions from fossil fuel use in Hungary (million tonnes)

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[5] GWPs for NOx, CO and nmVOC are not estimated by IPCC because of too large uncertainties.

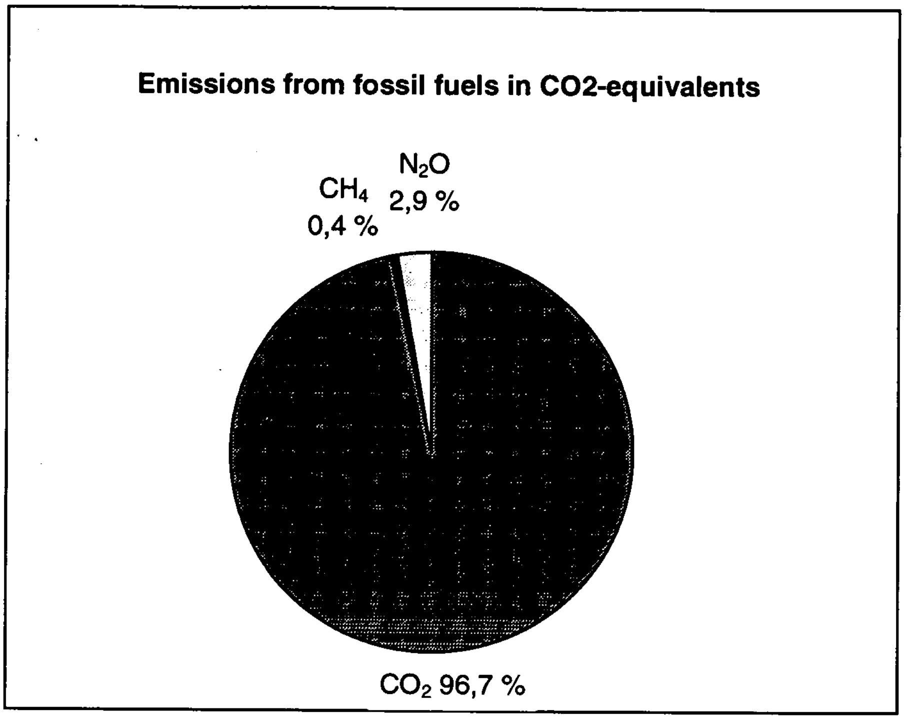

Fig. 3.10. Relative contributions to total future radiative forcing for current emissions of CO_2, CH_4 *and* N_2O *from use of fossil fuels in Hungary: The product of GWP (100 years time horizon) with estimated 1992 emissions.*

3.3 Air pollutants

Components of main concern in relation to local and regional air pollution in Hungary today include particulates, NO_x, SO_2 and heavy metals. We have no data on carcinogenic organic components, but the general features concerning emission sources indicate that these components may be of some importance (see section 4.2.1.). Fluoride from aluminium smelters causes local problems in some areas. Generally, the industry is becoming less important compared to other pollution sources.

Heat and electric-power generation (public power plants) are the most important emitters of SO_2 (53% of the total) due to the fact that still coal and lignite with relatively high sulphur content are important fuel types (see fig. 3.6) and the general lack of desulphurization equipment[6]. Households are the dominant source of particulates (42%) due to the widespread use of coal and coke briquettes. Automobile sources are dominant as regards NO_x (54%), and play an increasing role in the continuing deterioration of urban air quality. Traffic has become the fastest growing urban air pollution source in the past 15 years. Two-stroke engines in the vehicle park is relatively frequent[7], and the phasing out is likely to be retarded due to

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[6] There is by now no decision about building e.g. flue-gas desulphurization plants and it may be more economical to switch to natural gas.

[7] In 1990 19.4% of the passenger cars were Trabants, in 1992 this was reduced to 17.0%.

economic recession, unless specific action is taken. Concerning passenger cars in general, 35% are older than 12 years (Hungarian Central Statistical Office, 1992), which implies that they have high specific emissions of many components. While car traffic is increasing, the passenger-kilometres in public transport has generally decreased in the period 1987-1990 (by 15-17% depending on the type of transportation) (Hungarian Central Statistical Office, 1990).

The *SO_2 emissions* have decreased substantially the last 10-15 years and this applies to all the larger source sectors, which are public power plants, industry and households (see fig. 3.11a). The reduction in the period 1985-1992 was *39.8%*. The reason is partly the general reduction in fossil fuel consumption, especially important is the reduction in use of coal and lignite and an intensive natural gas supply program, and partly the reduced use of residual oil which has a higher sulphur content than lighter fractions of the oil.

Concerning *solid particulates* the same pattern as for SO_2 applies. 10-20 years ago public power plants were the dominant source for particulates, but the implementation of an electro-filter program has changed this radically, giving a total reduction of *60.4%* in the period 1985-1992 (see fig. 3.11b). The main source is now households and public power plants, and the transportation sector is increasing its share.

The total *NOx emissions* decreased by *27.7%* in the period 1985-92 (see fig. 3.11c). However, there are large variations in reductions as regards the different sectors. While the emission reduction in industry was 43.2% and in public power plants 39.5%, the reduction in the transportation sector was only 14.7%.

The *CO emissions* have decreased to a lesser extent than SO_2, solid particulates and NOx, still the reduction was *21.4%* in the period 1985-92 (see fig. 3.11d). The reason why the reduction is markedly lower is that most of the CO emission comes from transportation, a source where the fuel consumption did not decrease very much during this period.

The *nmVOC-emissions* decreased by *45.3%* in the period 1985-92 (see fig. 3.11e) mainly due to large reductions in the sectors households and industry. The emissions from transportation have only been slightly reduced.

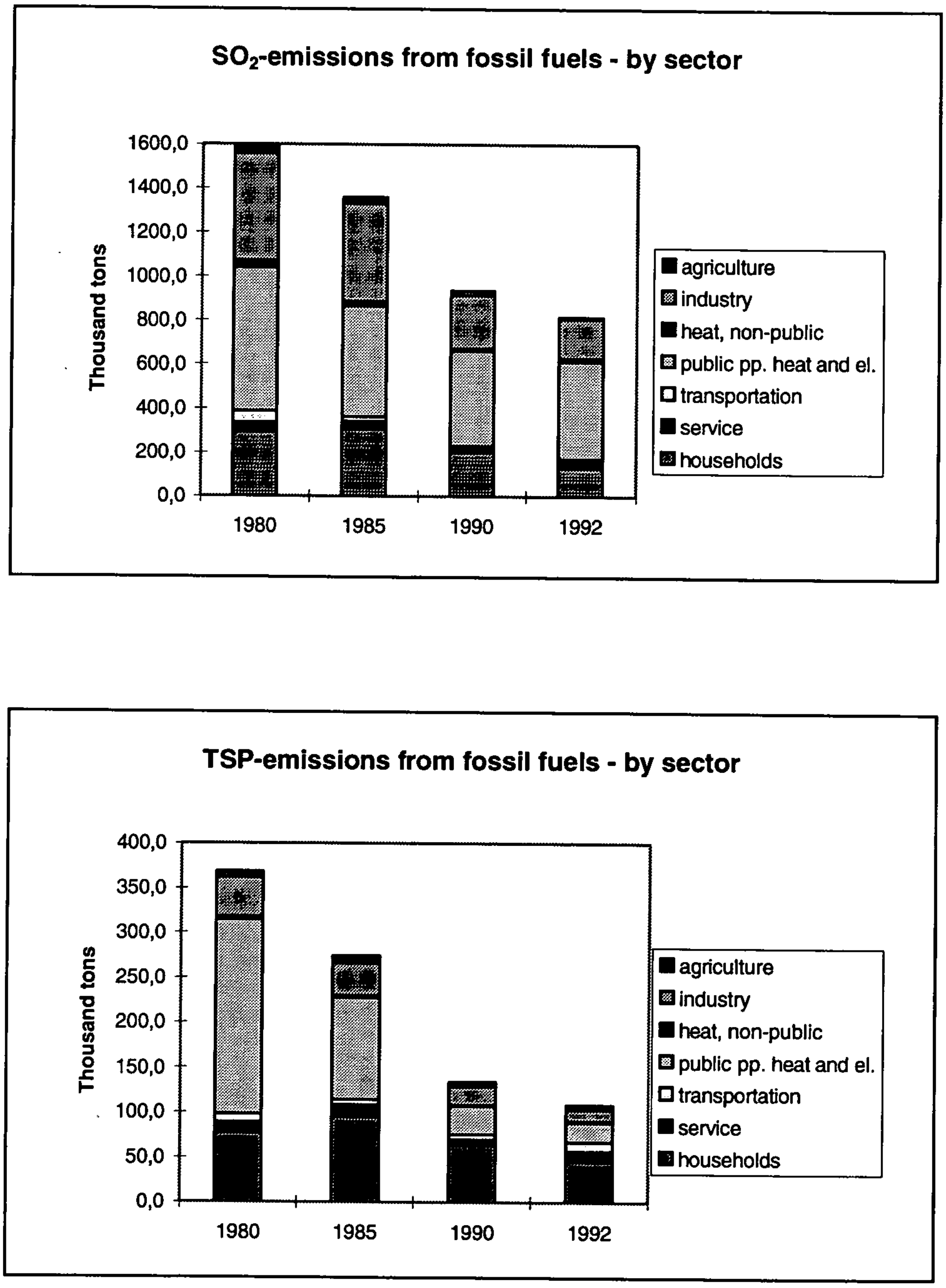
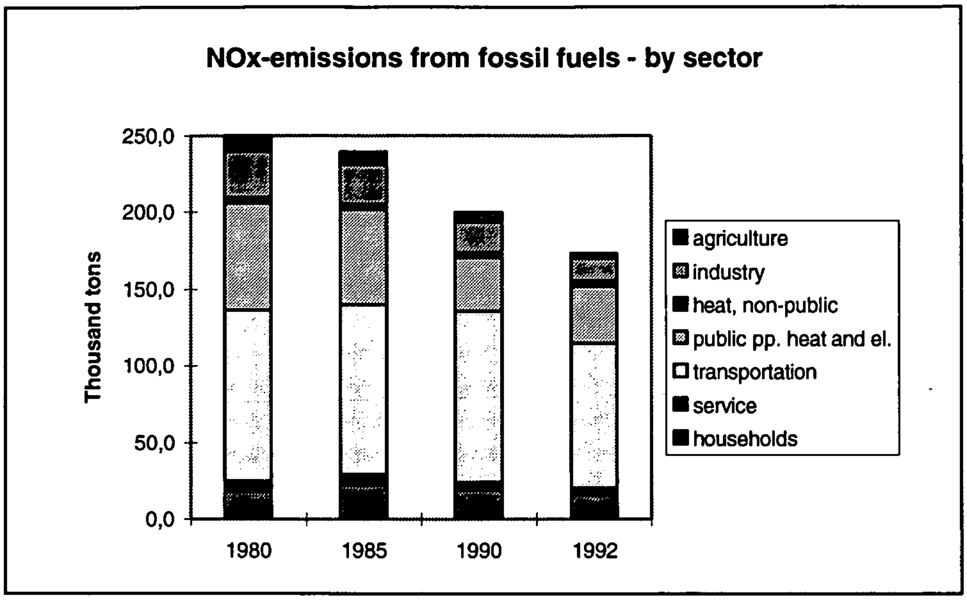


Fig 3.11. Historical emissions of a) SO_2, b) particulates, c) NO_x, d) CO and e) nmVOC, 1980-1992, by sectors.



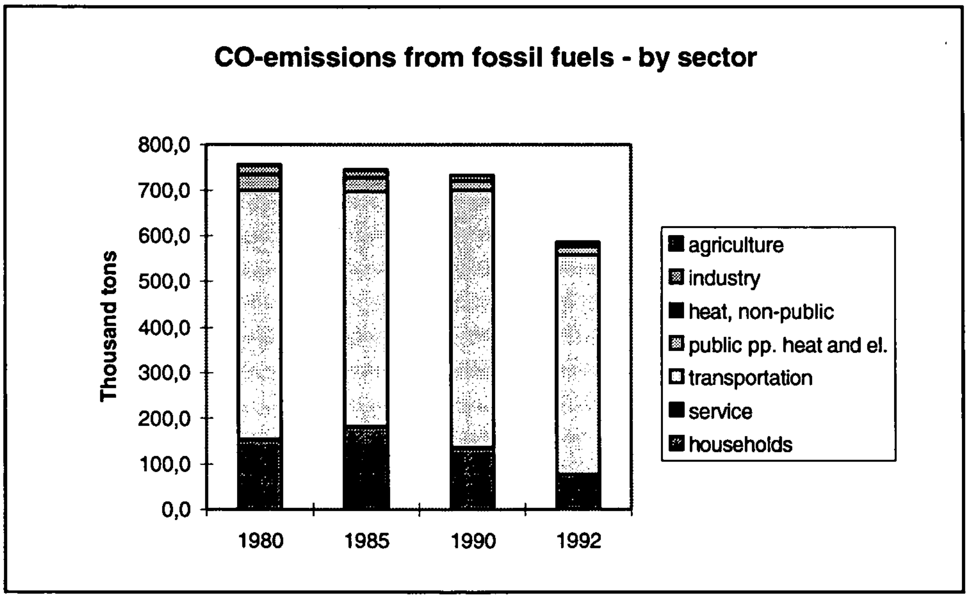


Fig 3.11. Historical emissions of a) SO_2, b) particulates, c) NO_x, d) CO and e) nmVOC, 1980-1992, by sectors (continued).

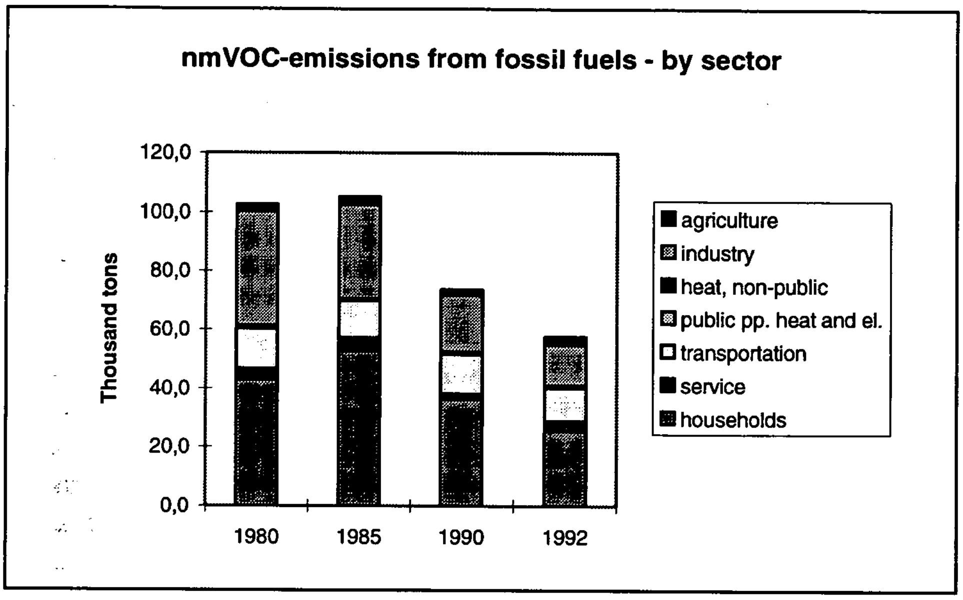


Fig 3.11. Historical emissions of a) SO_2, b) particulates, c) NO_x, d) CO and e) nmVOC, 1980-1992, by sectors (continued).

Fig. 3.12 shows the drop in emissions of *lead* (*59.9%*) due to a reduction in the content of lead in the gasoline (from ca. 0.35g/l before 1992 to ca. 0.15 g/l after 1992), and the introduction of un-leaded gasoline (8% in 1992). The figure also shows emissions of *vanadium* and *nickel* from the use of heating oil. It is assumed in the calculation that only 30% of the heavy metal in the oil escape through the chimney. The reduction in these emissions was *14.5%* in the period 1985-92.

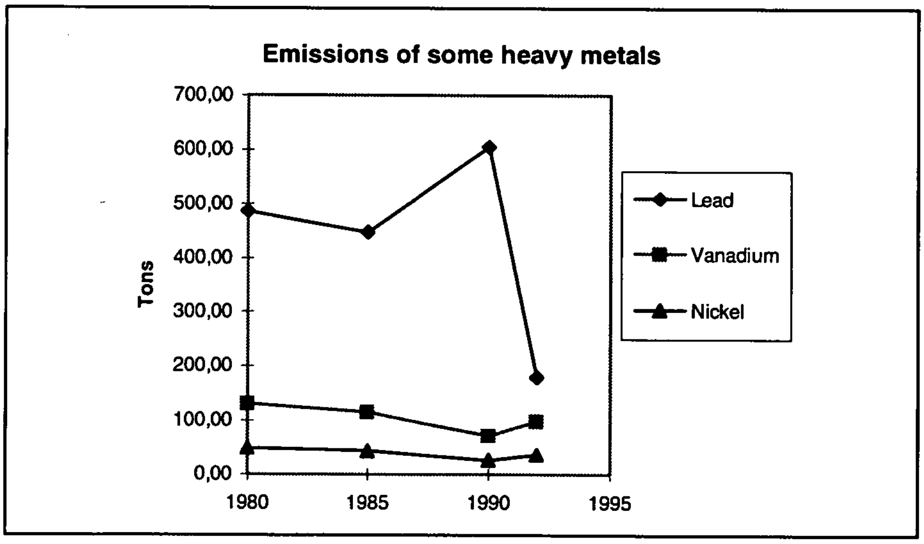


Fig. 3.12. Emissions of lead from gasoline consumption and vanadium and nickel from heating oil consumption. Note that while lead is diffusely distributed according to the traffic, vanadium and nickel are mainly emitted by larger point sources.

3.4 Emission scenarios for the near future - greenhouse gases and some air pollutants

Two emission scenarios have been made by TUoB, a business as usual (BAU) - scenario and an energy saving scenario, here called 2000S (these scenarios are essentially the same as the "conventional wisdom"-scenario and the "environmental-friendly restructuring"-scenario discussed in chapter 2.3). There are large uncertainties in the forecastings because of the reconstruction of the economy, of the old production system, the transformation from the planned economy to a modern market economy, all of which imply significant changes and modifications in all sectors (see chapter 2).

Fig. 3.13 shows the emission trends for CO_2, NOx, CO, nmVOC, CH_4, N_2O, SO_2 and particulates (TSP) associated with the two scenarios. The scenarios are based on the assumption that the percentage changes in fossil fuel consumption in the different sectors will be as indicated in table 3.1. The largest increase is expected to occur in the transportation sector, while the consumption in the industry sector is expected to decrease in both scenarios. The differences in the two scenarios are relatively small as fig. 3.13 indicates.

Table 3.1 Assumed percentage changes in fossil fuel consumption in the sectors.

SECTOR	**BAU 1992-2000 (%)**	**2000S 1992-2000 (%)**
Households	20.6	11.7
Service	14.6	9.8
Transportation	33.3	25.5
Public power plants	14.7	5.9
Non-public heat prod.	19.1	14.1
Industry	-5.0	-7.7
Agriculture	7.8	-4.8
TOTAL	13.8	6.8

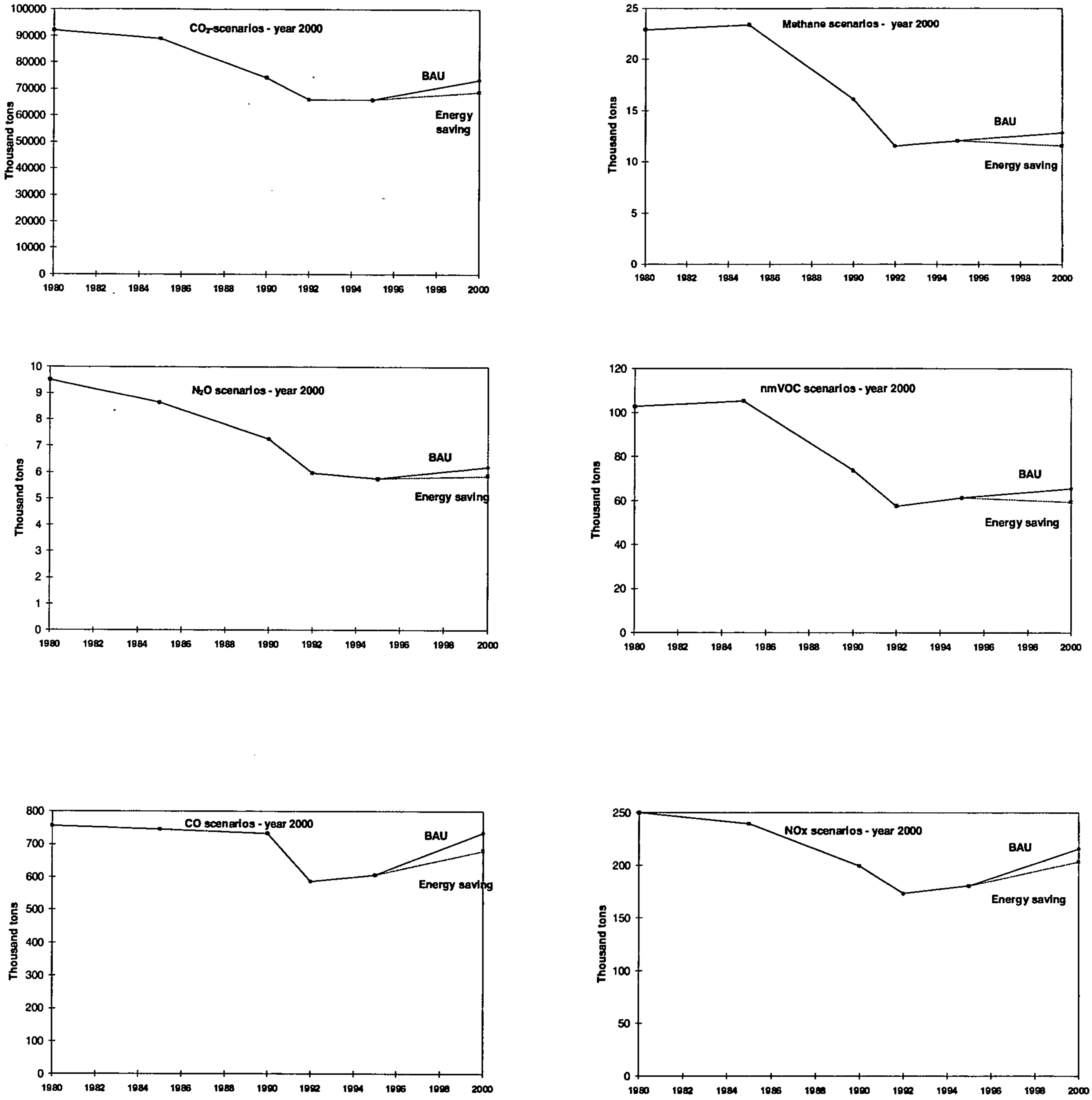


Fig. 3.13. Two emission scenarios for year 2000 for energy related emissions of CO_2, CH_4, N_2O, nmVOC, CO, NOx, SO_2 and TSP: BAU ("Business as usual", or "conventional wisdom") and energy saving.

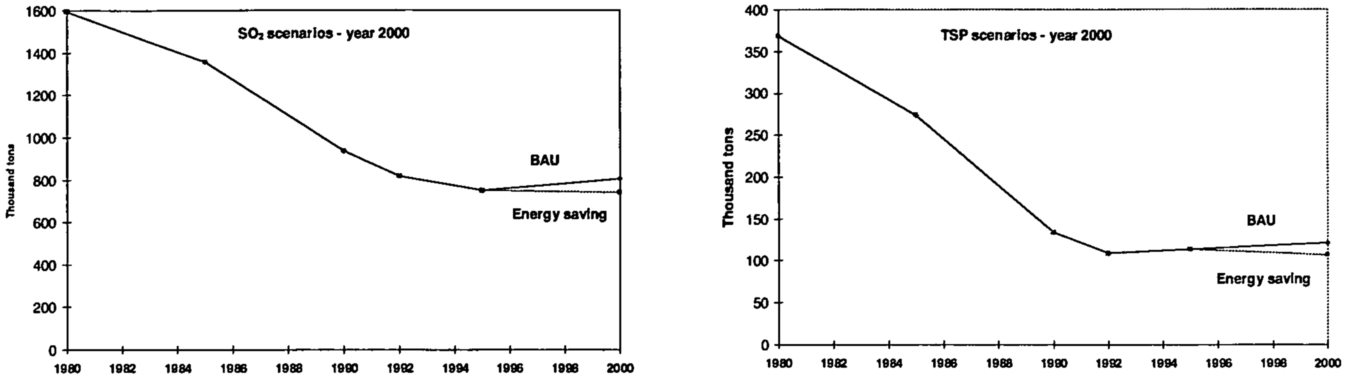


Fig. 3.13. Two emission scenarios for year 2000 for energy related emissions of CO_2, CH_4, N_2O, nmVOC, CO, NOx, SO_2 and TSP: BAU ("Business as usual" or "conventional wisdom") and energy saving (continued).

4 ENVIRONMENTAL AND HEALTH EFFECTS

Suspended particulates is the component that causes most violations of air quality guidelines for health in Hungary. The long-term mean concentration levels that occur in a number of Hungarian cities are far above the levels associated with increased frequency of health effects. The seasonal average concentration of NO_x is also above the guideline in many cities. Violations mainly occur in winter and are not very pronounced. The winter average concentration of SO_2 is markedly above the guideline in a number of cities (Budapest not included). It is , however, a problem that concentration data from different monitoring programmes seem to differ substantially. Ozone is an important component concerning crop reductions. A rough estimate of 5-10% crop loss for cereals implies a direct economic loss in the order of 5-10 billion Ft annually. The role of different air pollutants in the registered forest deterioration is difficult to assess, both acidic components and ozone may contribute. Economic losses due to corrosion of materials have not been quantified, but may be considerable.

4.1 Estimation of effects.

Much work has been done to establish guidelines for air pollutants with respect to effects on health and vegetation. It is assumed that the population and environment can tolerate these levels without serious harm. Values recommended by the Norwegian State Pollution Control Authority (SFT, 1992) are summarized in table 4.1. These guidelines are based on WHO's air quality guidelines from 1987 and newer internationally recognized research results. A rough, semi-quantitative, measure of the health effects may be obtained by estimating the number of people exposed to levels above the guidelines.

Table 4.1. Proposed air quality guidelines (SFT 1992).

Component	Unit of measure-ment	Area of impact	Averaging time						
			15 min.	1 h	8 h	24 h	30 d	6 months	1 year
NO_2	µg/m³	Health	500	100		75		50	
		Vegetation							30
Ozone	µg/m³	Health		100	80				
		Vegetation		150	60			50 [1]	
Suspended particulates, PM_{10} [2]	µg/m³	Health				70		40	
Suspended particulates, $PM_{2.5}$ [3]		Health						30	
SO_2	µg/m³	Health [4]	400						
		Health [5]				90		40	
		Vegetation		150		50			20
CO	mg/m³	Health	80	25	10				
Fluoride	µg/m³	Health				25		10	
		Animals [6]					0,15		
		Vegetation [6]				1,0	0,4	0,3	

[1] Average 7-hour mean (0900-1600 hours) for the growth period
[2] Suspended particulates <10 µm
[3] Fine fraction suspended particulates (<2.5 µm)
[4] Where SO_2 is the completely dominating pollution
[5] Combined with suspended particulates and other pollution
[6] Fluoride in gas phase

A related concept is *critical loads* which may be defined as (Grennfield and Thörnelöf, 1992):

> A quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to our present knowledge.

Critical loads played an important role in the work with the new international agreement on sulphur reductions (cf. Section 5.3). The concept will be discussed in more detail later.

One problem with the guidelines or critical loads is that the relation between exceedance and effects is not considered quantitatively. As far as possible with today's knowledge, dose-response relationships should be used in the follow-up study.

4.2 Health effects

4.2.1 General

In assessing health risk associated with air pollutants one traditionally distinguishes between carcinogens and chemicals that cause other toxic effects, although some compounds may have both types of effects. In general the concentration level of the different components in a specific area will vary dramatically in time and there may be large daily and/or seasonal variations. To what extent it is the short-term peak concentration or the total dose over a longer period ($\sum C_i x \Delta t_i$, where C_i is the concentration in the time period Δt_i) which is the most important for estimation of the effects, is not clear and may also vary from one component to the other. We may also distinguish between acute and delayed effects, which should not be confused with acute and chronic exposure, since delayed effects may or may not require chronic exposure.

For *non-carcinogenic air pollutants* it has traditionally been paid more attention to acute effects of peak concentrations (episodes) than to delayed effects. The classical example is the infamous smog episode in London in December 1952. About 4000 more deaths than expected were registered during about one week. This was due to very high concentrations of SO_2 (max. conc. nearly 2000 μg/m^3) and soot. (The number of deaths does not say much about the number of life years lost.) A significant increase in acute mortality seems to occur when daily mean concentrations of SO_2 and total suspended particulate matter (TSP) simultaneously exceed 500 μg/m^3. Exacerbation of bronchitis is found associated with TSP-levels down to 48 μg/m^3 as annual mean (SFT, 1992). In western countries the concentrations of SO_2 have been dramatically reduced. Typical average concentrations during winter in Norwegian cities are 5-20 μg/m^3. However, in some areas in eastern European countries and in developing countries serious health effects from particulates and SO_2 are likely to occur. A recent study in Cracow (Krzyzanowski and Wojtyniak, 1991/92) indicated a clear correlation between air pollution episodes and mortality during the following four days. This study included the winter months when the PM_{20} concentrations (i.e. suspended particles with diameter <20μm) exceeded 300 μg/m^3 in 21% of the days and SO_2 exceeded 200 μg/m^3 in 19% of the days. (Typical values for areas in Hungary are given in the next section.)

Large relative and absolute declines in health status in Eastern and Central Europe since the mid-1960s are well documented (Feachem, 1994) as illustrated in fig. 4.1and 4.2. It is believed that the main causes are lifestyle factors (diet, abuse of tobacco or alcohol), but pollution may also play a role (up to 9%).

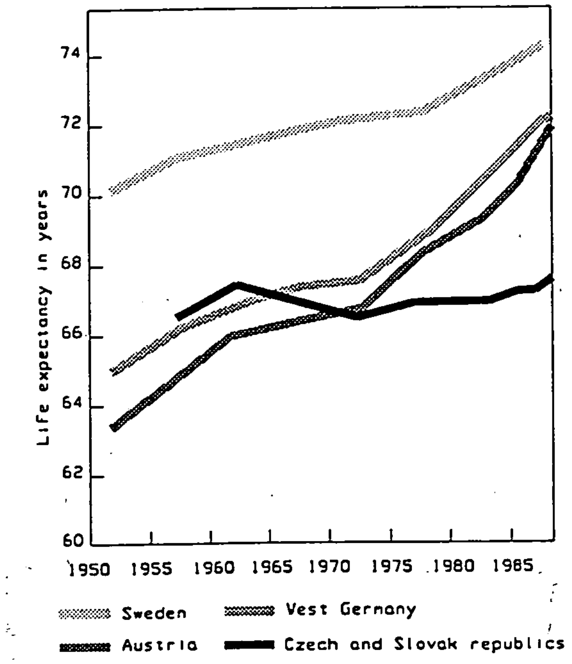


Fig. 4.1. Male life expectancy at birth 1950-1988 in some European countries (Feachem, 1994).

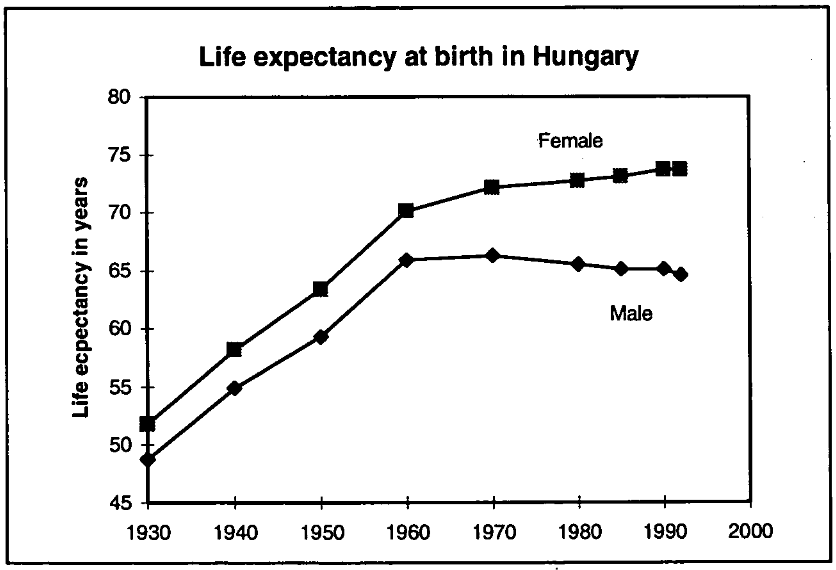


Fig. 4.2. Life expectancy at birth 1950-1988 in Hungary (Hungarian Central Statistical Office, 1993a).

Although the "classical" smog problem is greatly reduced in western countries, air pollutants may still cause health problems. There are indications that irreversible damage and accelerated ageing of the lungs may be connected to living in areas with elevated ozone concentrations (SFT, 1992; McKee and Rodriguez, 1993). An epidemiological study indicated that during an episode in London with high concentrations of NO_x and particulates in December 1991, some 160 people may have died from air pollution. In particular, the health effects of suspended particles have recently been the subject of much debate. It has been suggested that for every 10 $\mu g/m^3$ increase in the concentration of PM_{10} (i.e. suspended particles with diameter <10μm), there is about a 1 % increase in the number of deaths (see Bown, 1994 and Schwarz and Dockerey, 1992). For London this would correspond to nearly 2000 excess deaths annually; this number is, however, very uncertain. Excess deaths occur primarily in older people, and are mainly attributable to cardio-respiratory failure.

For *carcinogenic substances*, there is generally assumed to be no lower limit below which the dose has no effect. The dose-response relation is based on data for high doses and there are large uncertainties about the actual effects at low doses. The relationship is often assumed to be linear, an assumption which may be legitimized by the need for ensuring that the risk is not underestimated (conservative estimates). During the long latence time in development of cancer disease, for lung cancer up to 30 years, the exposure may vary enormously because of possible changes in occupation, smoking habits, place of residence etc., thus strongly complicating the possibilities for assessing the cause-effect relation (Aunan, 1994).

Carcinogenic compounds are treated similarly to radiation as regards regulations. An "acceptable exposure level" based on calculated life time risks is usually given. Establishing acceptable levels implies considerations beyond natural and medical sciences.

Carcinogenic components are produced by incomplete combustion of hydrocarbons. An important chemical group in this connection is polycyclic organic matter (POM), a collective term including i.a. polycyclic aromatic hydrocarbons (PAH), substituted PAHs and heterocyclic aromatic hydrocarbons. Benzo(a)pyrene, BaP, is a specially potent PAH compound and is often used as an indicator of the carcinogenicity of PAH (SFT, 1992). WHO (1987) indicated a life time cancer risk of 9×10^{-5} at an exposure of 1 ng BAP/m^3 in 70 years, while Törnqvist and Ehrenberg (1992) have estimated the risk to be much higher (12×10^{-4} per ng/m^3). While estimates of urban cancer risk have previously focused primarily on the particulate fraction, it is now an increasing attention also on volatile and semi-volatile compounds.

Comparisons of urban and rural nonsmokers indicate that urban lung cancer death rates are approximately twice those found in rural areas. It has proved difficult to confirm that air pollution *per se* causes the increase in lung cancer observed in cities (Godish, 1991). However, studies in the Silesia region in Poland give indications of biological changes on the molecular level that indicate a connection (Perera et al., 1992). Törnqvist and Ehrenberg (1989) have made an attempt to estimate the total cancer risk (all types of cancer) from urban air pollution in Sweden. They arrived at a most likely figure of at least 700 annual cases, corresponding to an average risk of the order of 10^{-4} per year.

4.2.2 Health effects due to air pollutants in Hungary - violations of air quality guidelines

Health effects on a national scale

The Hungarian Ministry for Environment and Regional Policy (1992) states that the air quality is not satisfying in approximately 11% of the total area of the country, where 44.3% of the population lives. These areas are situated mainly along the western to northeastern axis of the country. However, really critical areas are less frequent in Hungary as compared to other Central and Eastern European countries and only a few "hot spots" can be named, e.g. the Sajo valley, the Transdanubian industrial districts and Budapest. Besides, the difference between these areas and other parts of the country with more typical levels of pollution is less pronounced than in other countries in this area (REC, 1994b).

Health injuries attributable to air pollution have been roughly estimated to cost more than Ft 4 billion each year (Gajzago, 1992, see also Várkonyi and Kiss (1990) for more details). According to the Ministry for Environment and Regional Policy (1992), detrimental effects of air pollutants to health include mainly an increase in acute and chronic upper and lower respiratory diseases. An increase is shown in asthmatic and bronchitis diseases among children and adults. In polluted towns and heavily polluted districts of Budapest, pathological alterations occur in children four times more frequently than average. The occurrence of chronic adult bronchitis is three times the national average. Publications also give accounts of people suffering anaemia - mainly children of school age who suffer both from anaemia and disorder of osteogenesis (bone development).

The emission reductions in many of the main air pollutants (see Chapter 3) have, however, undoubtedly improved the air quality in Hungary in general, even though there still are large areas where the air quality is far from satisfying due to emissions from energy production, industry and/or traffic. A study in Százhalombatta (Tar and Tajthy, 1991), a town just south of Budapest where a refinery and a power plant are situated, indicates a significantly higher level of respiratory diseases, skin allergy, cancer and monthly morbidity as compared to reference levels. However, there are also indications that the situation has improved, i.a. because the power plant sharply reduced the use of residual oil, thus reducing the emissions of heavy metals, sulphur and particles. This is a general feature in Hungary and is due to an increase in cracking and viscosity breakup of residual oil in Hungarian refineries.

Budapest - changes in the concentration levels of the main air pollutants

Two sets of concentration data for Budapest have been available:

Data set I: Monitoring data (manual measurements: discontinous, twice a week) for SO_2, NOx, soot and settling dust for the 22 districts of Budapest are provided by the National Institute of Hygiene. We have used these data to make a preliminary assessment of number of people that live in areas where the concentration levels are above the guidelines (as given by the Hungarian authorities) for shorter or longer periods of the year, see table 4.3. There are large uncertainties in the numbers, i.a. because we have used aggregated numbers for the population in the districts and have not investigated the distribution of the population according to where the measuring stations are situated. Besides there are relatively few measuring stations, and the concentration levels probably fluctuate to a great extent within each district.

Data set II: Continous monitoring data for eight stations in inner Budapest for NO_2, NO, SO_2, CO, TSP and O_3[1] are provided by the Governmental Institute for the Population Health Care (Állami Népegészségügyi és Tisztiorvosi Szolgálat). The data are given as daily means, monthly 30 minutes maxima, monthly 24 hours maxima and monthly means. These data are, however, not available on file, and only preliminary assessments of the main features can be given at present.

There are some discrepancies between the two data sets, especially for particulates (TSP).

Concerning the air quality in Budapest, where 20% of the population live, the composition of the pollution mixture has changed during the last decades. As can be seen from table 4.2, there are large variations in the mean concentration of all components from year to year and from season to season, both due to meteorological factors and variations in the emissions (data set I).

Table 4.2. Six months average concentrations in Budapest 1980-1994 (data set I).

	SO_2 µg/m³	NO_2 µg/m³	TSP µg/m³	Soot µg/m³	Settling dust g/m²/30 days
1980 (whole year)	60	43	n.a.	15	9,1
1984-1985 (winter)	70	n.a.	n.a.	n.a.	6,8
1985 (summer)	14	n.a.	n.a.	n.a.	8,7
1989-1990 (winter)	23	39	n.a.	16,1	5,1
1990 (summer)	5,2	35,2	n.a.	4,5	5,9
1992 (summer)	12,9	50,4	242,5	n.a.	8,1
1992-1993 (winter)	23,8	54,1	294,4	n.a.	4,3
1993(summer)	17,1	48,7	206,2	n.a.	7,0
1993-1994 (winter)	27,1	60,3	251,8	n.a.	5,0

The most distinct changes in this period have been for SO_2: The 6 months average in the heating season in 1984/-85 was 70 µg/m³, while it had decreased to 27 µg/m³ in 1993/-94. The concentration levels are considerable lower in the non-heating season and the reductions in this season are not very pronounced[2]. The main source of SO_2 pollution in Budapest is

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[1] Ozone is monitored at only two stations.

[2] Generally, the total fuel consumption is ca. 40% lower in the summer months than in the winter months. The household sector is the main reason for the seasonal difference.

households (33.5%) and ca. 90% of these emissions comes from use of solid fuel (mainly coal briquettes). (Increasing use of natural gas is now reducing these emissions). Industry contributes to 21.8% of the SO_2 -emissions.

For *NO_2* the pattern seems to be opposite to that for SO_2 although the trend is not as clear: In 1980 the yearly average concentration was 43 $\mu g/m^3$, about 52 $\mu g/m^3$ in 1992. The seasonal differences are only slight for NO_2, due to the fact that transportation is the dominant source (45.3%). The other larger NOx source in Budapest is smaller power plants/heating plants (20.5%).

We have no data for the changes in the concentration of *TSP* in this period, but the emissions from the households, which is the largest source of particulates (50.3% in 1992), were reduced by about 42% in the period 1985-1992. This must obviously have improved the air quality concerning TSP, even though increased emissions from the transportation sector may have counteracted the trend somewhat. In 1992 the transportation sector contributed with about 12.2% of the TSP emissions in Budapest.

An increasing share of district heated flats (heat and hot water supply) and gas heated flats has probably contributed to the improvement of the air quality as regards SO_2 and must also have resulted in lower emissions of particles from the households. In the period 1985-1990 the number of district heated flats increased by 11% (from ca. 204 000 to ca. 226 000) and the number of gas heated flats increased by almost 40% (from ca. 304 000 to ca. 423 000). The number of flats with other types of space heating (probably mainly coal briquettes) was reduced by 53% in the same period (from ca. 282 000 to ca. 134 000).

Violations of air quality guidelines in Budapest

Table 4.3 gives the estimated number of population exposed to concentration levels above guidelines for the two years 1989 and 1990. In annex II to this chapter, the population distributions into concentration classes are shown.

Based on data set I *NOx* seems to be the component that entails the most extensive exposure above guidelines, and as much as 1.85 million people (average for 1989 and 1990) live in districts where the air quality guideline (24 h) is violated at least once a year. The guideline is quite frequently violated in some districts and about half a million of people live in districts where there are more than 20 violations per year (i.e. approximately 20% of the time). The maximum daily mean concentrations recorded at any station was about 400 $\mu g/m^3$ both in 1989 and in 1990. This is more than five times the guideline as given by SFT (1992) (75 $\mu g/m^3$) and the Hungarian authorities (70$\mu g/m^3$ - "extremely protected"). As can be seen from table 4.2 the long-term averageconcentration has been over the guideline (50 $\mu g/m^3$ (SFT, 1992) and 30 $\mu g/m^3$ - Hungarian, "extremely protected") the last years.

In data set II both the 1-hour and the 24-h guideline for NO_2 are violated most of the time at all stations throughout the year, but each of the violations is not so high as in data set I.

According to data set I, the guideline for *soot* is violated to some extent, and about 730 000 people (average for 1989 and 1990) live in the districts where violations occur. However, the guideline is violated very few times per year, indicating that soot is not a very important problem. However, data set II, which provides data for *TSP* and not soot[3], indicates that suspended particulates may be one of the main problems concerning the air quality in Budapest (see fig.4.3). (The Hungarian guideline for yearly average TSP is 50 μg/m^3 - "protection class I"). This observation is supported by the fact that the average 6 months mean for TSP for all districts in Budapest (which has only been measured the last couple of years) is rather high (e.g. 294 μg/m^3 in winter the 1992/93 and 243 μg/m^3 in the summer 1992). As pointed out in paragraph 4.2.1 the finer fraction of the particulates (<10 μm in diameter) is most important as regards health effects. In the winter mechanically generated TSP is likely to be less dominant than in the summer, hence the fraction of smaller, inhalable particulates probably is higher.

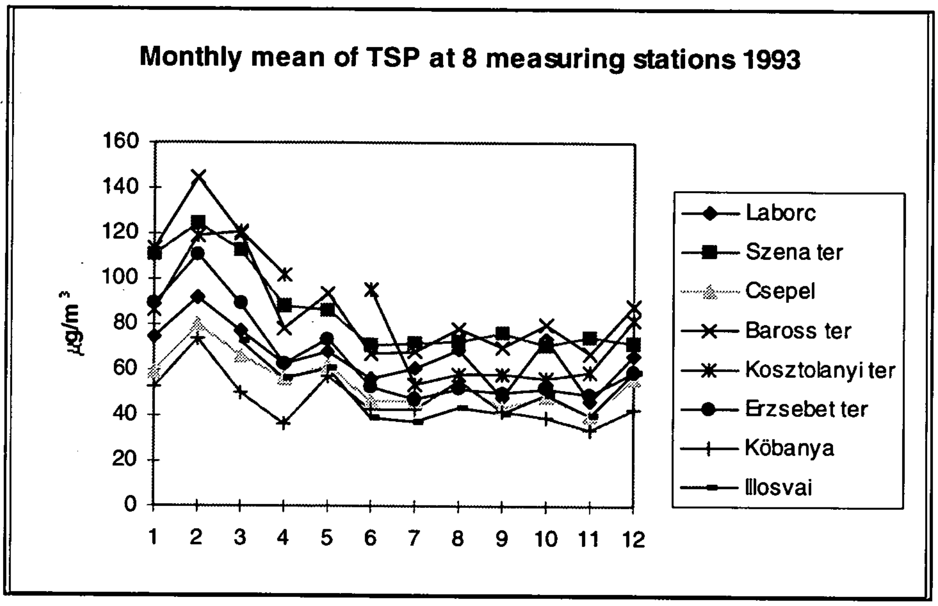

Fig. 4.3. Monthly mean concentrations of TSP in inner Budapest, 1993.

Short-term peak concentrations of TSP may represent a health risk in Budapest. The Hungarian guideline for 30 min. is 200 μg/m^3 - "protection class I". The 30 minutes monthly maxima are often about 400-600 μg/m^3, for some stations the value sometimes gets even higher. During the winter 1993/1994 the 30 min. maximum exceeded 1000 μg/m^3 at two stations, during the winter 1992/1993 the 30 min. maximum was close to or beyond 1000 μg/m^3 at six stations. The monthly 30 minutes maxima of TSP in 1993 are shown in fig. 4.4.

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[3] The measurements for TSP and soot cannot be compared directly, but it is likely that the concentration levels of the two should correlate quite well, especially in this case where the main source of particles is use of coal in households (which gives much soot particles).

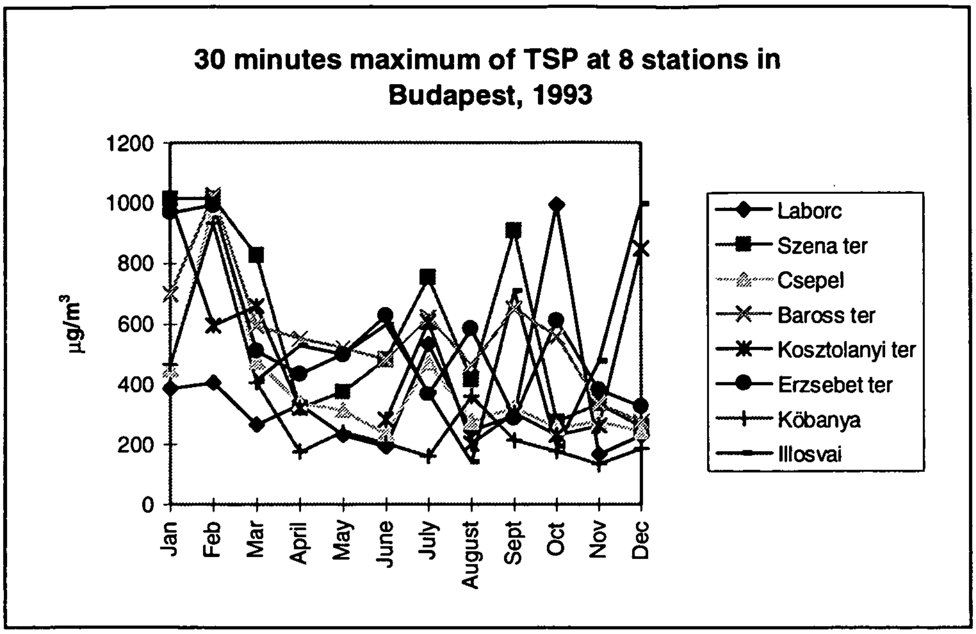

Fig. 4.4. Monthly 30 minutes maxima of TSP in inner Budapest, 1993.

By comparing the 24 h values for TSP given in data set II with the TSP guideline given by WHO (1987), which is 120µg/m^3, it is clear that this guideline is violated frequently the year around. At some stations the 24 h value is sometimes twice the level of the guideline.

The average concentration of TSP in winter in Budapest is about 72µg/m^3 (average for all stations for the two winters 1992 and 1993). The summer average is 65 µg/m^3 and yearly average is 69 µg/m^3. By using the standard US conversion factor between PM_{10} and TSP, which is PM_{10} = 0.55 TSP[4] (CEC/US, 1993), the average concentration of PM_{10} in winter for all stations is calculated to be about 39 µg/m^3, the summer average is 36 µg/m^3 and the yearly average is 38 µg/m^3. The SFT guideline for 6 months mean is 40 µg/m^3. Using the dose-response function as proposed by Schwarz and Dockerey (1992) (see also chapter 4.2.1) of 1.2% increase in daily mortality per 10 µg/m^3 increase in PM_{10} (lower estimate 0.96%, upper estimate 1.44%), this indicates an *5% increase in expected mortality per year in this region of the city* (lower estimate 4%, upper estimate 6% increase). As February seems to be a peak month as regards the concentration of particulates, the expected excess mortality is likely to be highest in this month.

According to data set I about 650 000 people (average for 1989 and 1990) live in districts where the 24 h SO_2 guideline as given by Hungarian authoritues, is violated. However, as for

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[4] There are good reasons to assume that the PM_{10} fraction constitutes a relatively large part of the total suspended particulates in Budapest, because the main sources of particulates are use of coal in households and exhaust from cars, both sources where the small particulate fraction is dominant. On the other hand many other sources, which we have no account of in our emission data, may contribute to TSP, e.g. road dust and other mechanically generated dust from small scale industry, building sites etc. As indicated above the percentage PM_{10} fraction is probably smaller in summer than in winter.

soot, violations are not frequent.

Data set II corresponds quite well to set I with respect to SO_2, but indicates somewhat more frequent violations of the guidelines. The guideline (24 h) for SO_2 is violated to some extent on some stations during winter time (i.a. at "Csepel" in the vicinity of a metallurgic industry plant).

Concentration levels of CO and O_3 are given only in data set II. Concerning *CO* the concentration level (30 min monthly maximum) at the eight different stations attains 10-15 mg/m^3 relatively frequently during the winter months, but is usually well below this in the summer months, except for the stations close to the main roads. The 15 min and 1 h guidelines for CO given by SFT are respectively 80 and 25 mg/m^3, indicating that the CO pollution does not represent a major health problem. However, due to the relatively high percentage of two-stroke engines and the age distribution in the vehicle park, it is likely that elevated CO concentrations to some extent may represent a health risk in the vicinity of the main roads.

By comparing the 30 min monthly maximum for *O_3* with the 1 h guideline as given by SFT, there are frequent violations in the summer period and very few during the winter (O_3 is measured only on two of the stations). Generally, the ozone level is expected to be lower in the city, where there are high NOx emissions, than in the air plume from the city, thus indicating that violations of the O_3 guidelines probably may be rather frequent in summer in the areas affected by this plume (of course, the population density is lower there).

Figure 4.5 shows the monthly average ozone concentrations at the two stations in Budapest where ozone is measured. Generally, the ozone levels were higher in 1993 than in 1992, and August seems to be the month when the concentration generally peaks.

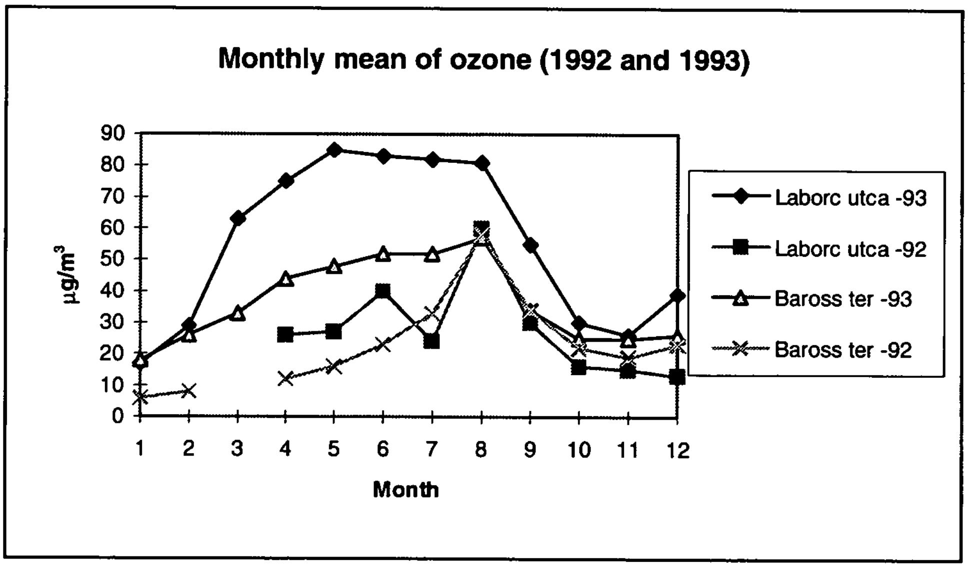

Fig. 4.5. Monthly average concentrations of ozone at two measuring stations in inner Budapest, 1992 and 1993.

The 8 h mean guideline was violated regularly during the summer months[5] in 1993, mainly in August in 1992.

Current knowledge does not provide an adequate foundation for establishing air quality guidelines for long-term exposure to ozone, although experiments in animals indicate that prolonged exposure may induce effects that are irreversible (SFT, 1992). A preliminary risk assessment based on expert judgements of prevalence of mild or moderate lung lesion in children, indicates that the response rate for a seasonal average of about 80 $\mu g/m^3$ (as at Laborc utca station in summer 1993) is in the range *10-20%*[6] (McKee and Rodriguez, 1993).

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[5] Actually, it is the 1 day mean that is above the 8 h guideline.

[6] For numerous species the centriacinar region of the lung has been shown to be the location of maximum delivered O_3 dose and lung injury, and was assumed to be an appropriate indicator of potential chronic lung injury of the experts participating in the referred study.

Table 4.3. Number of days when the air quality guidelines (24 h) are violated at each measuring station in 1989 and 1990. Based on data set I. Measuring is done twice a week, i.e. 104 days a year.*

District	Population	SO_2		NOx		Soot	
		1990	1989	1990	1989	1990	1989
I (1)	33.111	3	1	21	8	1	1
II (2)	100.018			1	43, 4		3, 2
III (6)	148.441	1		1	3, 1		
IV (3)	115.386		1	5	31		4
V (1)	41.126		2	11	24		1
VI (2)	57.555			33	27		
VII (1)	79.574	2		36	30		
VIII (3)	92.854			14, 10	7, 5	1	
IX (2)	76.973	1	2	23, 8	29, 7		1
X (3)	97.696		2	3	6		
XI (3)	168.811			11, 10	15, 6	1	
XII (2)	74.548			1	4	2	
XIII (4)	131.631			27, 10, 1	21, 2, 1		1
XIV (4)	143.884	3, 2	4	17, 13, 12	16, 8, 5	2	1, 1
XV (2)	93.415	2		3	2, 2	3	
XVI (2)	70.457						
XVII (2)	76.404			2	1		
XVIII (2)	102.018		1	64, 12	68, 4	3, 1	1
XIX (1)	69.673				14		
XX (2)	91.182	3			6		
XXI (2)	89.497				3		
XXII (2)	54.291			12	10, 5		2
Total population**	2.008.600	666.600	638.400	1.721.500	1.971.800	708.600	753.500

* In most districts there are more than one station, the number is given in the parenthesis.

** Or population in the districts where the violations occur.

Estimates of population exposure in other Hungarian cities

Based on average local concentrations in the summer and winter season in 1992/-93 in 94 cities/towns in the 19 counties in Hungary plus Budapest a rough estimate of the number of people living in areas where the air quality guidelines (6 months mean) are violated can be made, see table 4.4. The uncertainties in these estimates are, however, very large i.a. because the concentration levels are only measured at a few points in each city. The numbers may, however, give an indication of the order of magnitude for the components included.

The cities/towns included are given in Annex 4.1. The list comprises the majority of the larger and medium sized cities in Hungary and represents totally ca. 5.4 million people, i.e. 52% of the population. According to Central Bureau of Statistics in Hungary, 6.5 million people live in towns while 3.8 million people live in villages and rural areas. To estimate the total population exposed to values above the guidelines we have added respectively 10% and 20% to the number achieved from these 94 cities, representing one low and one high estimate. In doing this we are assuming that violations of 6 month air quality guidelines mainly occur in cities and towns, not in villages and rural areas. Especially for TSP this may imply that we are underestimating the number. TSP was unfortunately only measured in 20 cities and as explained below we have given an extra high estimate in table 4.4. This estimate is of course very uncertain and may still be too low.

Table 4.4. Estimated number of people living in cities where air quality guidelines (6 month) were violated in 1992/-93 (million people). Total population in Hungary is 10.3 mill. (See the text concerning TSP).

	In cities with measuring stations	Total for Hungary	
		Low estimate	High estimate
TSP (> 100 μg/m^3 *)	3.72	4.1	4.5 (5.6)
NOx (> 50 μg/m^3)	2.36	2.6	2.8
SO_2 (> 40 μg/m^3)	0.97	1.1	1.2
Settling dust (> 12,5 g/m^2/30 days)	0.58	0.6	0.7

*TSP was measured only in 20 cities/towns, exceeding 100 μg/m^3 in all of them.

The guidelines that we have used in the estimations are the ones given by SFT, except for TSP and settling dust, where we have used the Hungarian guidelines. As can be seen from table 4.5, the guidelines recommended by SFT lie between the two most strict classes in the Hungarian system. (The Hungarian system for guidelines is also described in Section 5.2.2.)

Table 4.5. Guidelines recommended in Hungary and Norway.*

Authority (guideline class)	Long-term guideline**			
	TSP µg/m^3	SO_2 µg/m^3	NO_2 µg/m^3	Settling dust g/m^2/30 days
SFT (Norway)	-	**40**	**50**	-
Hungarian:	Guideline for yearly mean			
Extremely protected	30	30	30	**12**
Protected I	**50**	70	70	16

*Values used in estimations of number of people exposed to guideline violations in bold
** Norwegian: 6 months average; Hungarian: yearly average

The main features are the same as for Budapest, the TSP being the component causing most violations of the guidelines (see table 4.5). Fig 4.6 shows that some cities have seasonal averages above 300 µg/m^3. The fact that particulates were measured only in some of the cities[7], and that in all these cities at least one of the 6 month averages was above 100 µg/m^3, indicates that the population exposed to TSP levels above the 50 µg/m^3 guideline may be significantly higher than the estimates made by the above method. We have therefore made an extra estimate (adding 50% to the calculated number) which is given in parenthesis in table 4.4.

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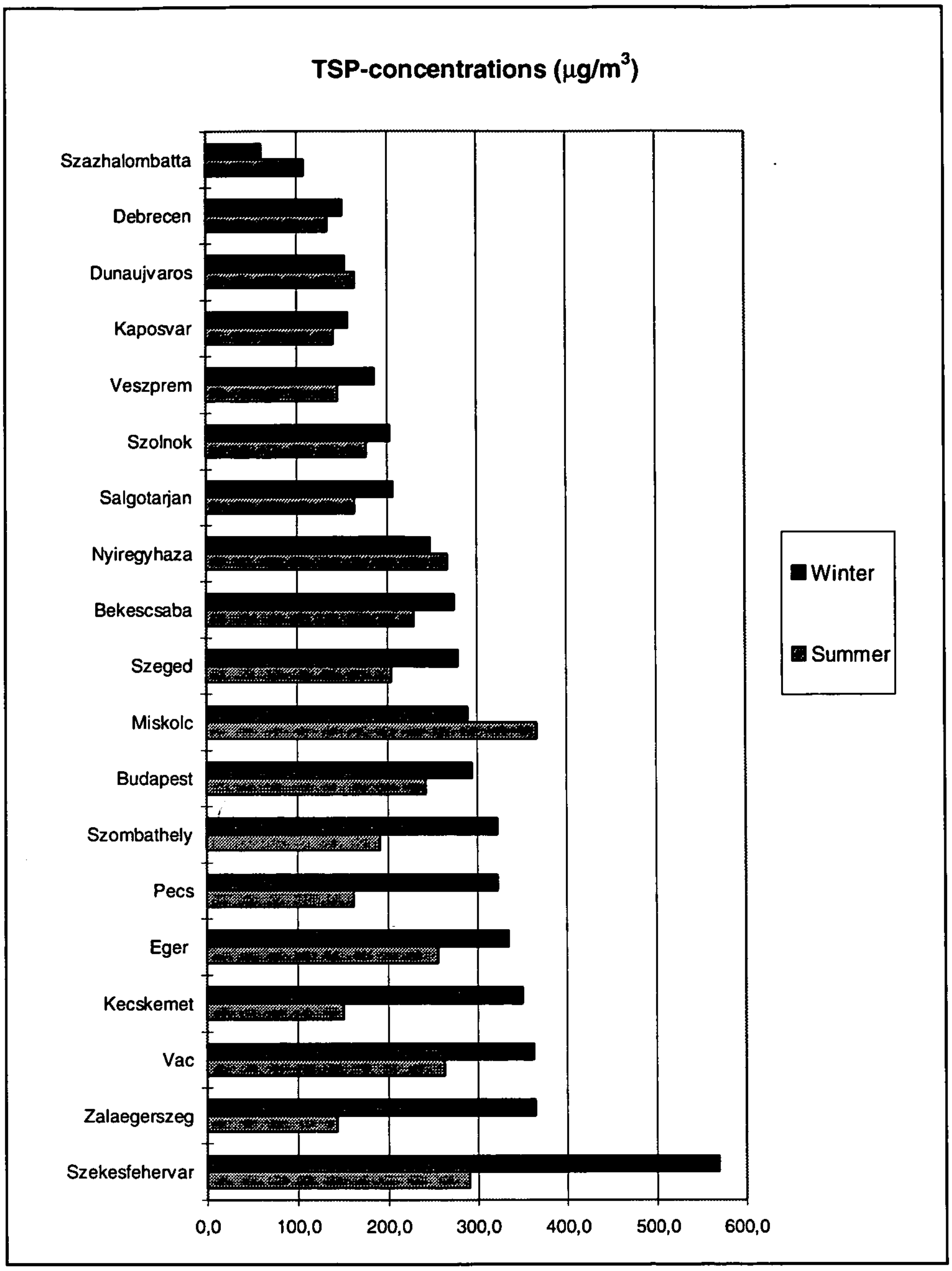
[7] Sopron is not included in fig. 4.6. Here the summer mean was 123 µg/m^3, the winter concentration is not available.

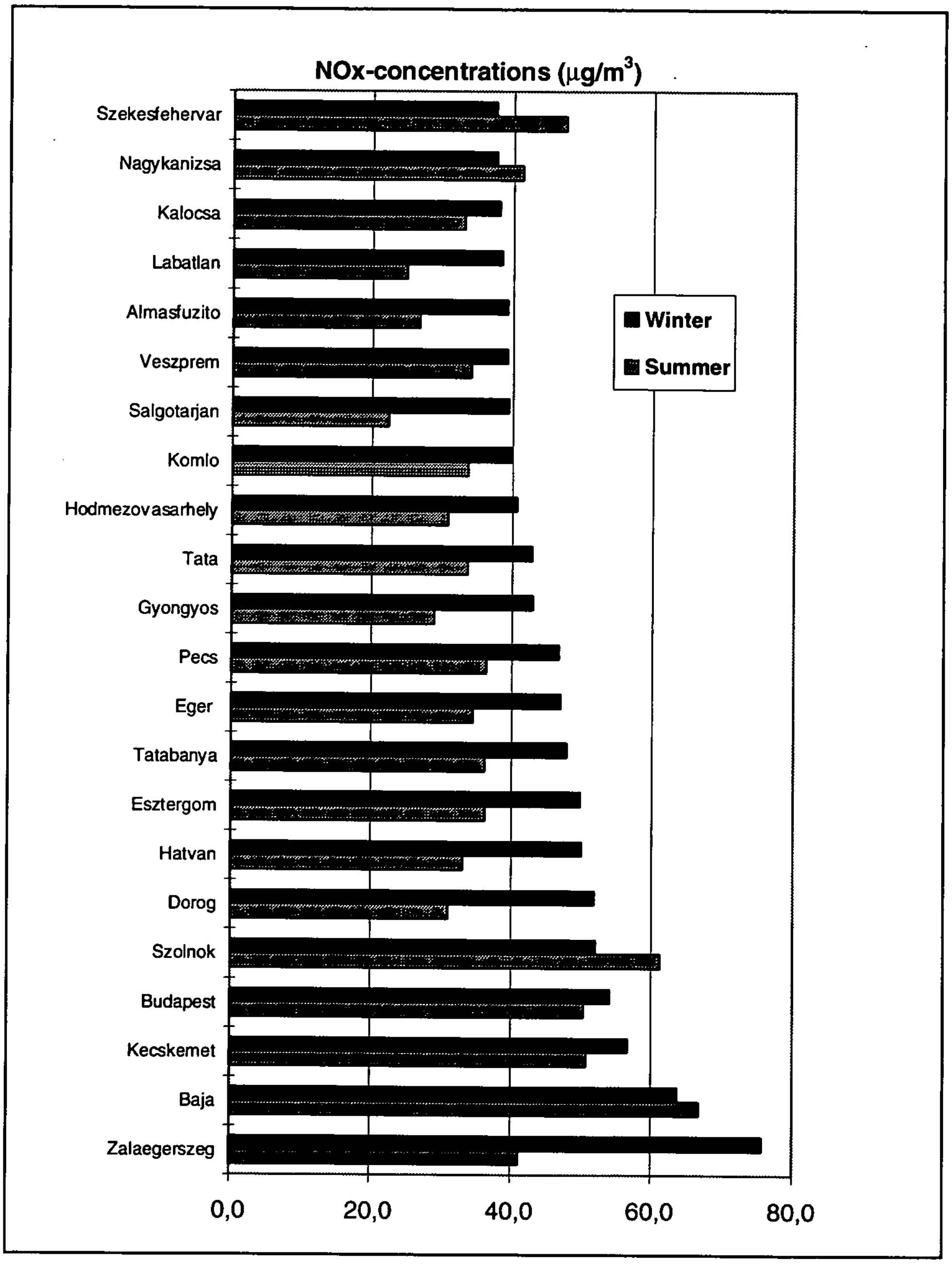


* Long-term guideline: 50 µg/m^3 (Hungarian protection class I).

Fig. 4.6. Seasonal averages of TSP in winter 1992-93 and summer 1992 in some Hungarian cities/towns.*

The levels of mean particulate concentrations that occur in Hungarian cities are in many places far above the levels associated with increased frequency of health effects as impaired lung performance, chronic pulmonary disease and exacerbation of bronchitis (see also chapter 4.2.1).

Concerning NOx relatively few cities[8] have 6 month mean concentrations above the guideline and the violations are not very pronounced. Fig. 4.7 shows concentrations for the cities where the highest NOx levels have been measured.



*The air quality guideline for 6 months mean is 50 µg/m³ (SFT, 1992).

Fig. 4.7. Seasonal averages of NOx in winter 1992-93 and summer 1992 in some Hungarian cities.*

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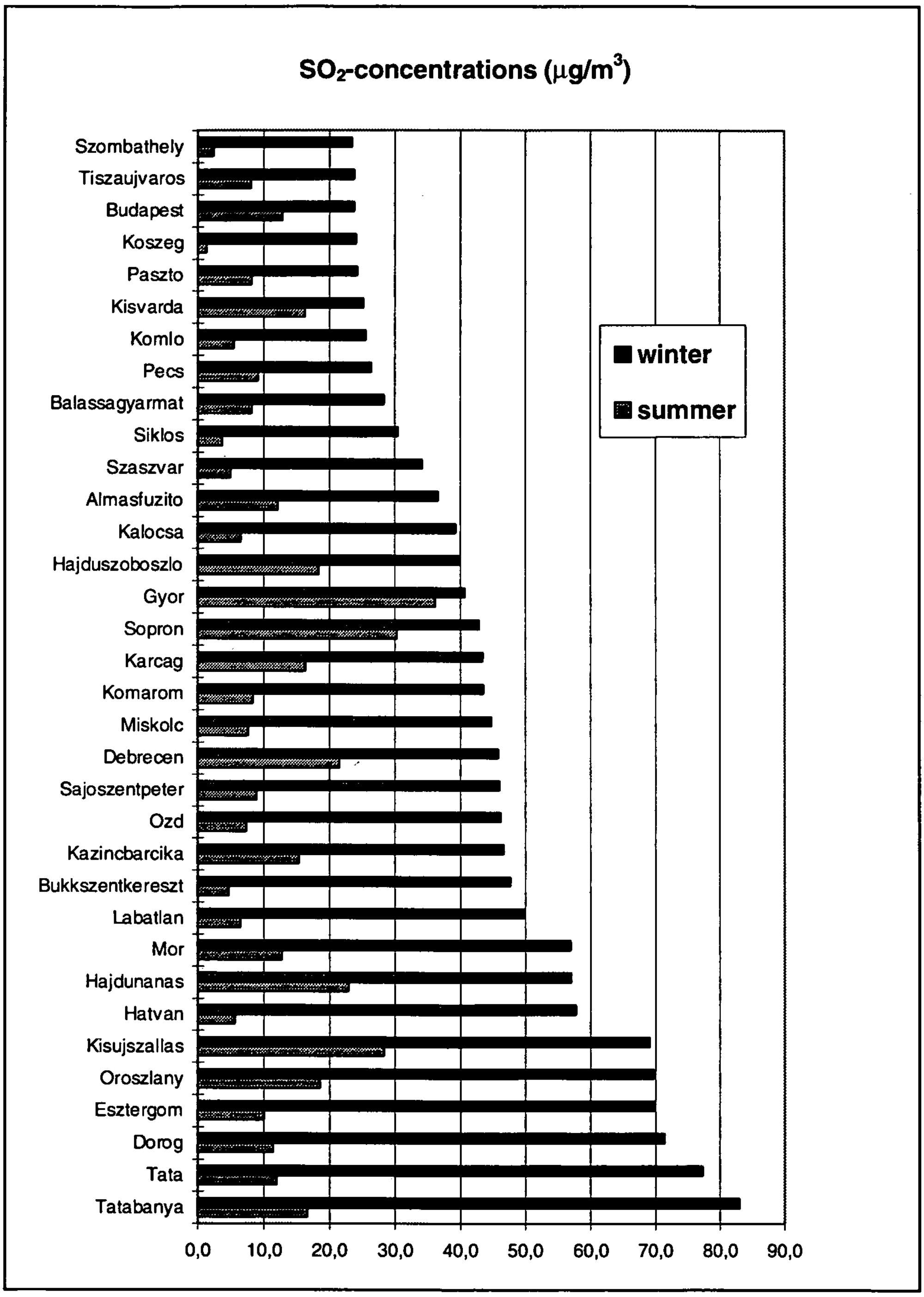
[8] Because Budapest is one of them, the total number of people being exposed to levels above the guideline is high.

The SO_2 guideline is violated in 20 of the cities we have data from (see fig. 4.8), and with few exceptions these cities are situated in two counties, namely Komárom-Esztergom and Borsod-Abauj-Zemplén. The five cities where the concentrations are highest (≥70 µg/m³) are all



*The air quality guideline for 6 months mean is 40 µg/m³ (SFT, 1992).

Fig. 4.8. Seasonal averages of SO_2 in winter 1992-93 and summer 1992 in some Hungarian cities.*

situated in Komárom-Esztergom. Power plants are important air pollution sources in this area.

The seasonal differences in the 6 month means are generally much bigger for SO_2 than for particulates and NOx, and the SO_2 guideline is not violated in the summer period in any city.

The guideline for settling dust is also violated in 20 of the cities represented in our data. Settling dust is first of all a problem of nuisance and enhances the need for cleaning the different kinds of surfaces that are exposed to the dust.

It may be concluded that a large part of the Hungarian population is exposed to air pollutants, in particular suspended particles, in concentrations that may be harmful to human health. Since traffic is a major source of pollutants, it should be mentioned that in the analysis of measures to improve the air quality in Oslo (SFT, 1987; Trønnes and Seip, 1988), better maintenance of buses and diesel vehicles came out with the highest benefit/cost ratio. The largest net benefit was found for reduction in private car usage.

4.3 Effects on vegetation and soil

4.3.1 General

High ozone concentrations seem to reduce the yield of some crops. Thus in the American NAPAP (1991) project an approximate 10% increase was estimated for soybean yield in the most sensitive areas for a 25% reduction in the ambient ozone level (the period 1985-87 was used as basis). Field observations and experiments indicate that SO_2 may decrease the yield of some crops if the average concentration exceeds about $30 \mu g/m^3$ (CEC/US, 1993, Rosenbaum et al., 1994). Concerning forests and natural vegetation the critical level is assumed to be about $20 \mu g/m^3$ (SFT, 1992, Rosenbaum et al., 1994). Effects of rain acidity are uncertain; increases or decreases may be found depending on other factors. The acidification of agricultural soils due to acid deposition is of minor importance campared to other factors and can be neutralized by liming.

The nitrogen compounds in acid rain will have a fertilization effect, since for example pristine forests usually are nitrogen limited. This may affect the species composition of the ecosystem. In large parts of Europe much of the nitrogen deposited is now found in the discharge from the catchment showing that far from all the nitrogen is utilized by the vegetation. It is possible that the level where harmful effects may occur has been reached in some areas.

Effects of acid rain (or related pollutants) on forests have been the focus of much research and debate. A comprehensive monitoring program under the Convention on Long-Range Transboundary Air Pollution has supplied data for defoliation in most European countries for several years, in some countries since 1986. Fig 4.9 gives the percentage of conifers with needle loss greater than 25 % in 1993 (UN-ECE/CEC, 1994). As expected if air pollution plays an important role, we find high percentages of damage in Poland and the Czech and Slovakian republics. The value for Hungary is considerably lower.

A significant, but not very high, correlation has been found between total wet acid deposition and forest damage in Germany (Schulze and Freer-Smith, 1991). There is little doubt that high concentrations of SO_2 cause damage to trees. It has been suggested that such direct effects may occur for mean winter concentrations above 15 - 20 $\mu g/m^3$. It is likely that limited areas with serious tree damage in eastern Europe can be explained as direct effects of SO_2. Also high ozone concentrations may give direct damage. However, in most areas in Europe the concentrations, at least of SO_2, are not so high that direct effects are likely. It is often assumed that there is an indirect effect: acid deposition causes soil acidification which in turn leads to loss of nutrients (e.g. magnesium) and increased soil water concentrations of aluminium. Recent pH declines in soils have been observed in Central Europe, Scandinavia and North America (Johnson et al, 1991). It seems clear that acid deposition has played an important role at least in some areas in Europe. However, other factors, e .g. forestry practice, are also important and it is often difficult to quantify the various contributions (Johnson et al., 1991).

To estimate critical loads for acidifying components, effects on forest are used in all of Europe except Norway (where effects on fish are considered). The values are estimated from models assuming that the concentration of aluminium (or the Al/Ca ratio) is the critical factor (Downing et al., 1993). There are several problems with this approach. First, as stated above, the causes of forest damage are not well understood. It is far from generally accepted that soil-water aluminium is a key factor. Secondly, the mechanisms controlling the aluminium concentrations in soil water are extremely complex. Acidification generally increases the levels, but there is no model today that can give reliable, quantitative estimates of the increase for a certain increase in deposition.

The Forest Condition Report (UN-ECE/CEC, 1994) is rather cautious in the conclusions regarding the role of air pollutants:

> It must be stated that the trend towards the deterioration of forest condition observed in the common trees from 1988 to 1993 continues. It is this trend which cannot be readily explained by site conditions and natural damaging agents. Although there is no direct evidence of this being an effect of air pollution, this phenomenon deserves special attention because a continuous and large scale weakening of forest health by long-range transboundary air pollution is likely to manifest itself in effects like the ones observed.

It follows that dose-response relationships between deposition of acidifying compounds and forest damage will have large uncertainties, except perhaps in the regions with the highest pollutant levels. The critical loads may still be useful for decision makers, since it is likely that they capture differences in sensitivity in a qualitative way. However, there is a tendency to forget the great uncertainties which may be dangerous. Even a prestigious report as "State of the World" from Worldwatch Institute has stated that the annual losses due to forest damage in Europe from sulfur deposition is 30.4 billion dollars (Brown, 1993) without commenting on uncertainties.

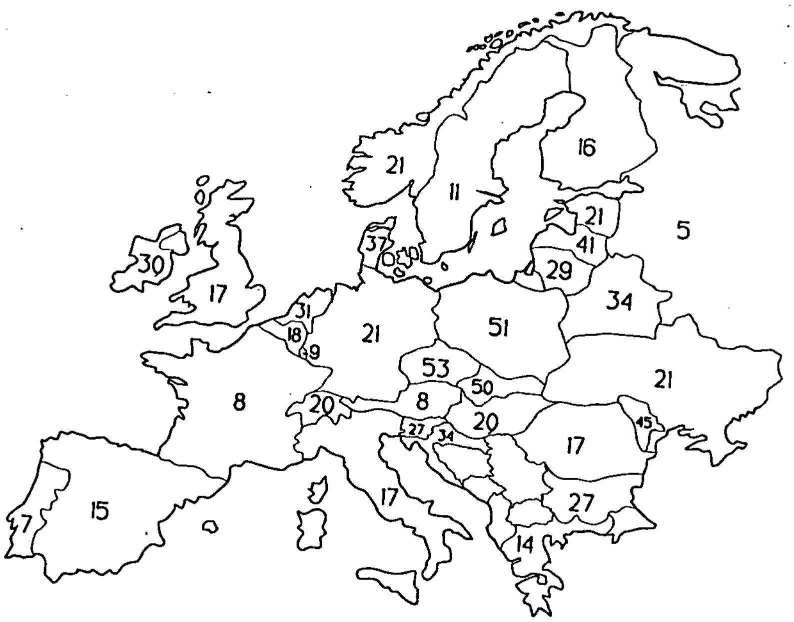


Fig. 4.9 Per cent of conifers with needle loss >25 % in European countries in 1993 (UN/ECE/CEC, 1994).

4.3.2 Effects on vegetation and soil in Hungary

Forest and forest soils

Forests cover an area of ca. 1.70 million hectares in Hungary, which is about 18% of the land area. Hungary is situated in the temperate deciduous-forest zone. The most important and dominant native tree species are sessile oak (*Quercus petraea*)[9], robur oak (*Quercus cerris*), hornbeam (*Carpinus betulus*), beech (*Fagus silvatica*) and ash (*Fraxinus excelsior*). At present about 43% of the forest consists of recently planted stands and contains non-indigenious species as black locust, Scots pine, black pine and Canadian poplar (Jakucs, 1988 and references therein).

The physical state of forests has deteriorated noticeably. Hungarian scientists have observed serious problems in sessile oaks mostly in the North-Eastern mountainous area. Soil acidification induced by air pollution and the gradually disappearance of mycorrhiza fungi has by some researchers been considered as one of the primary causes of deciduous forest decay in these areas. However, the results do not prove unambiguously the primary role of acidic deposition in the initiation of *forest damage.* As mentioned in Section 4.3.1, deterioration can also be attributed to other pollutants (e.g. ozone) animals and pest (over-multiplied big game, insects, fungi), drought and frost etc. It is therefore difficult to assess the role of air pollution.

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[9] About 16% of the total tree stands in Hungary comprise sessile oak.

Fig 4.10 shows defoliation above 25% in percentage of the stock of different tree species. Robur oak, Sessile oak, black locust and Scots pine are some of the most defoliated species.

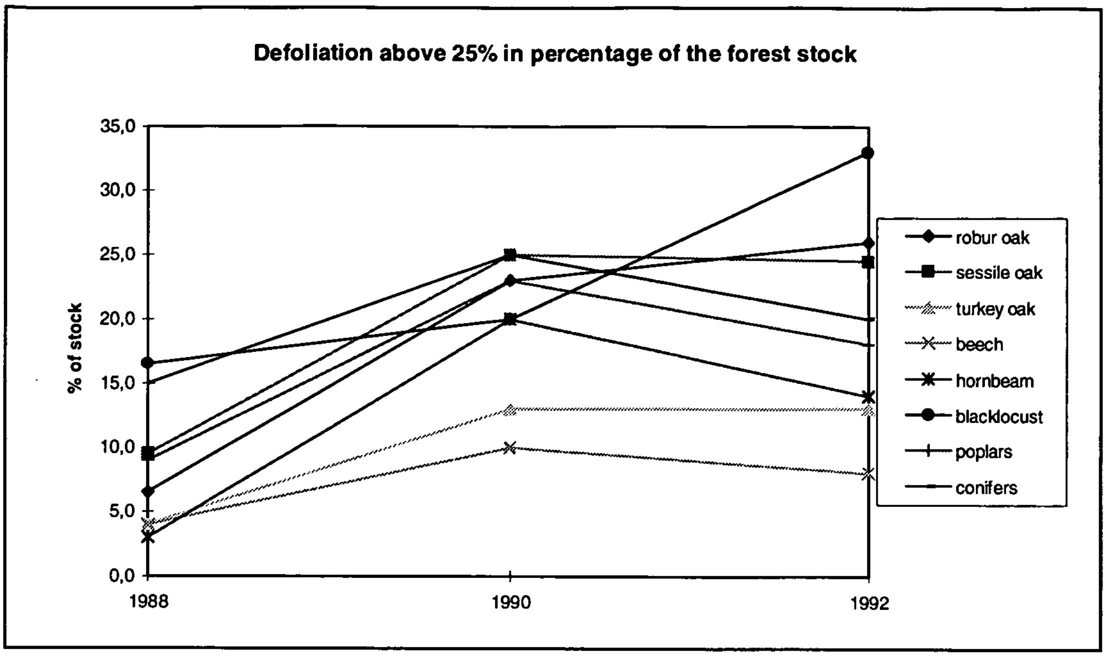

Fig. 4.10. Defoliation above 25% in percentage of the stock of different tree species.

As seen from Fig. 4.9, in 1993 about 20 percent of the conifers in Hungary had a needle loss > 25 %. The corresponding defoliation for broadleaves was 21 %. There have been no significant changes since 1990. The defoliation in Hungary is thus considerably lower than in the Czech and Slovak republics and in Poland.

In some Hungarian forest soils the pH value has decreased during the last decades at least partly due to acid deposition (Pais and Horváth, 1990). This is in agreement with observations from other countries in Central Europe (Johnson et al., 1991). Critical loads for sulphur deposition have been calculated for Europe under the Convention on Long-range Transboundary Air Pollution (Downing et al., 1993). Exceedance of critical loads of sulphur in Europe is shown in Fig. 4.11 (the values are 5 percentiles implying that for 95% of the area damage should not occur.) For most of Hungary the exceedance was (in 1990) in the range 800 - 1600 $mgSm^{-2}yr^{-1}$. However, in parts of Northern Hungary the exceedance was greater (in the range 1600 - 3200 $mgSm^{-2}yr^{-1}$ range). As mentioned earlier, there are many problems related to the estimation of critical loads which must be kept in mind when using the values.

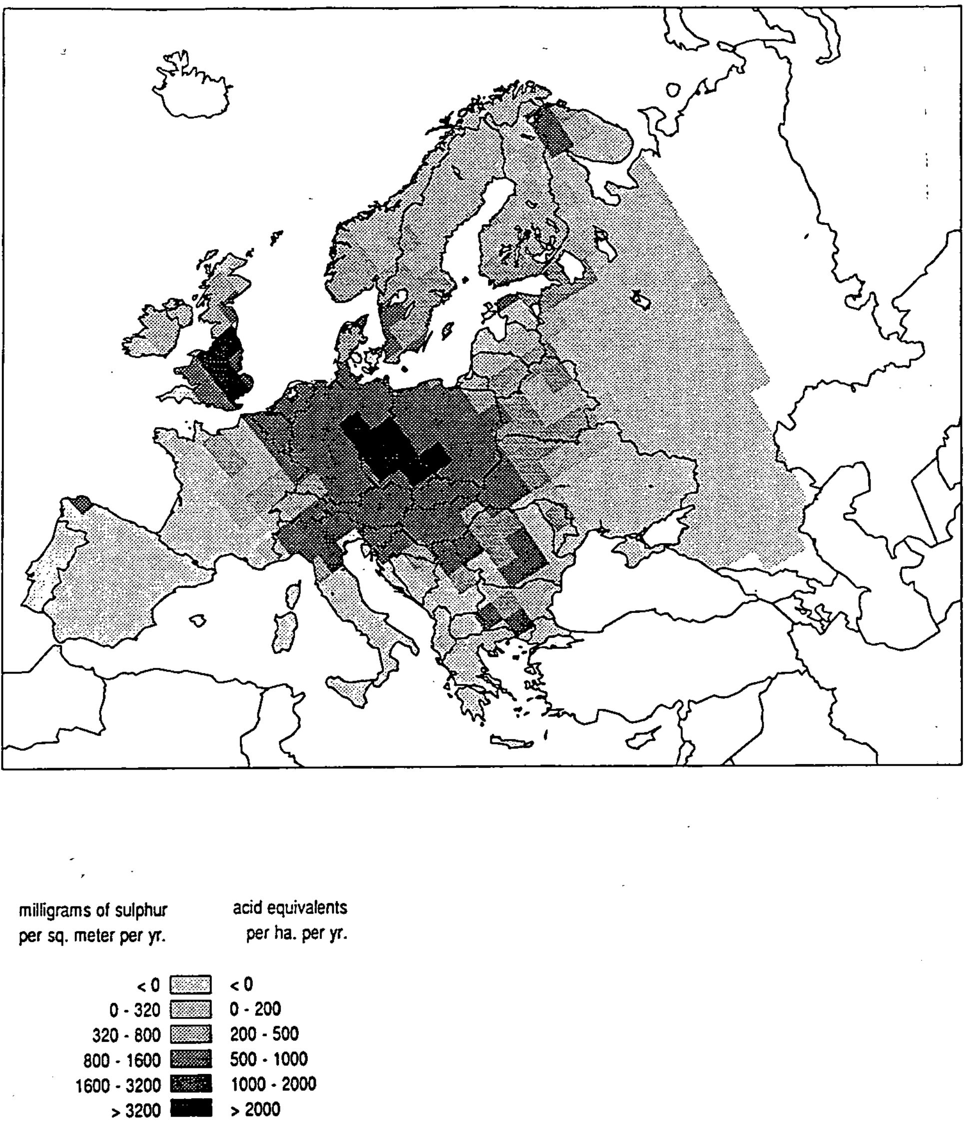

Fig. 4.11. Exceedance of the critical load of sulphur in 1990 (5 percentiles) (Downing et al., 1993).

Agricultural soils

Agricultural land covers 70% of the Hungarian land area, or ca. 6.47 million hectares. The pH value of *agricultural soils* has decreased and is a environmental problem in Hungary. The main reason for the acidification is the non-professional use of fertilizers including nitrogen fertilization in great doses and superphosphate containing considerable amounts of residual acid. However, atmospheric acid deposition also play a role in the increasing of soil acidification.

Direct effects of air pollutants on crops

It is generally assumed that ozone is the component of most concern as regards crop production and it is dispute in the litterature as to whether SO_2 does serious damage to crops at present levels in Europe and the USA (CEC/US, 1993).

Calculated mean of daily maximum concentrations of *ozone* in the growing season April to September in Hungary is 60-70 ppb (ca. 120-140 $\mu g/m^3$) (Simpson, 1993). This indicates that the long term critical level as defined by UN-ECE (1988) is clearly violated. The critical level is 50 $\mu g/m^3$ as average for the growth period of the 7-hour mean (9a.m - 4 p.m.)[10].

For the Netherlands, situated in an area with a long term concentrations of ozone at the same level as Hungary, air pollution is estimated to reduce total crop volume by 5 %, mainly due to ozone and SO_2 (van der Erden et al., 1988). In Sweden, where the mean of daily maximum ozone concentrations in the growth period is 40-60 ppb (ca. 80-120 $\mu g/m^3$), i.e. slightly lower than in Hungary, crop losses due to ozone are estimated to an average of 9% for the most sensitive crops wheat, oats, potatoes and hay (different grass species). In the Central Europe crop losses for wheat are estimated to about 10% (Naturvårdsverket (Swedish EPA), 1990, SFT 1991).

Using 5-10% as a rough estimate for the crop loss for cereals under the prevailing ozone concentrations it is possible to give an indication of the magnitude of the economic consequences of this loss in Hungary. The total production of cereals has fluctuated rather drastically the last years, see Fig. 4.12 (Hungarian Central Statistical Office, 1993b) and we have used the mean production in the period 1990-1992 as basis for the calculation. This implies a total loss in the production of cereals of 0.71-1.42 million tons, of which 290-580 ktons are wheat, 309-617 ktons are maize, 86-172 ktons are barley and the rest is rye and rice. By using the average 1992 production price (the weighted average of procured and market price) for the different crops (OECD, 1994) this gives a *total yearly loss in the order of 5-10 billion Ft.* Using the world reference prices[11] the loss is in the order of 78-155 million US$. These estimates do not take into account demand elasticity (how the price per unit product reacts to a change in production).

Tobacco is one of the most sensitive species to ozone exposure, but this is not a very important crop in Hungary, the yearly production being 13 ktons.

According to model estimates by EMEP (Co-operative Programme for Monitoring and Evaluation of the Long Range Transmission of Air Pollutants in Europe) the annual concentrations of SO_2 are in the range 3-10 $\mu g/m^3$ in background areas in Hungary, being somewhat higher in the north than in the south (Pedersen et al., 1992). Based on these figures

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[10] The 7-hour mean will, of course, be somewhat lower than the mean of daily maximum , but still the critical load is violated here, as in almost entire Europe.

[11] Unit export value for non-rouble trade.

crop damage due to SO_2 on a large scale is unlikely in Hungary in general (see Section 4.3.1), although damage may occur on a smaller scale due to more locally elevated SO_2 levels.

Model estimates of the annual concentration of NO_2 in background areas are in the range 1-2.5$\mu g/m^3$, which is far below the level that is associated with direct effects of NO_2 .

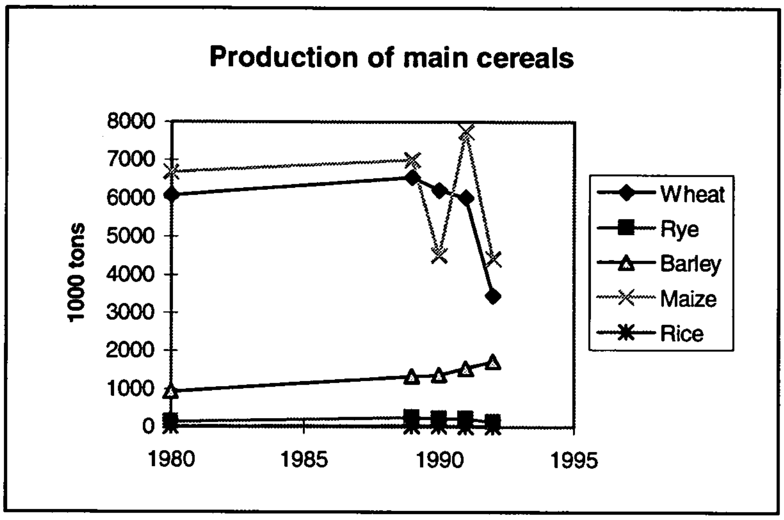


Fig. 4.12. Production of main cereals in Hungary (1000 tons)

Surface waters

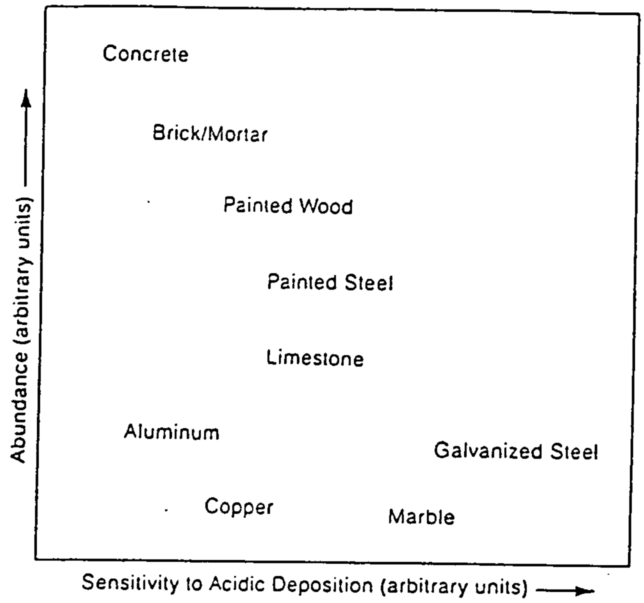
The great majority of Hungarian *surface waters* tolerate the atmospheric acidic inputs well because of their high buffer capacity.

4.4 Effects on materials

4.4.1 General

As regards assessment of damage to materials it is usual to distinguish between general constructions and those of historical/cultural interest. Serious damage to the latter is known from many areas in the world. The greatest problem is how to valuate the damages; we will not discuss this further in this report.

The relative abundance and sensitivity of material in urban settings (in USA) are illustrated in Fig. 4.13.



Note: "Sensitivity" reflects both chemical reactivity to acidity and structural vulnerability in uses typical for the materials.

Fig 4.13. Relative abundance and sensitivity of materials in urban settings in the US (NAPAP. 1991).

For some materials there are fairly good dose-response relationships. The main parameters are the SO_2 concentration and the "time of wetness", often defined as the number of hours per year with humidity > 80% and temperature > 0^0C.

For the temperate climatic zone the following expression has been recommended for unpainted, galvanized steel:

$$V_{corr} = 0.29 + 0.039 \cdot [SO_2]$$

where

V_{corr} = corrosion rate of zinc, µm/yr
$[SO_2]$ = SO_2 concentration, µg/m^3

In a joint Nordic research project the expected reductions in corrosion damage from a reduction in SO_2 emissions were estimated for Sarpsborg, Stockholm and Prague (Tolstoy et al., 1990, Kucera et al., 1993). The main steps in the analysis are given in Fig. 4.14. The SO_2 strata used were:

	SO_2 concentration (µg/m^3)
P_0	< 20
P_1	20 - 60
P_2	60 - 90
P_3	> 90

In the Nordic project mentioned, the following formula was used to estimate the additional costs of corrosion in polluted areas

$$K_a = K*S[1/L_p - 1/L_c]$$

where
K_a = additional costs for maintenance/replacement (kr/year)
K = cost of repair/maintenance (kr/m^2)
S = surface area of material (m^2)
L_p = maintenance interval in polluted areas (years)
L_c = maintenance interval in clean areas (years)

It was then possible to estimate the benefits obtained by, for example, reducing the pollution so that there was a decrease of one category in all areas (I) or to achieve P_0 in all areas (II). The reduced costs per capita in these towns/cities were estimated to (in SEK/year, 1 SEK ~ 0.15 US$):

	I	II
Prague	415	761
Sarpsborg	304	360
Stockholm	118	139

Although there is a discussion about possible sources of errors, no explisit error estimates were given for these values.

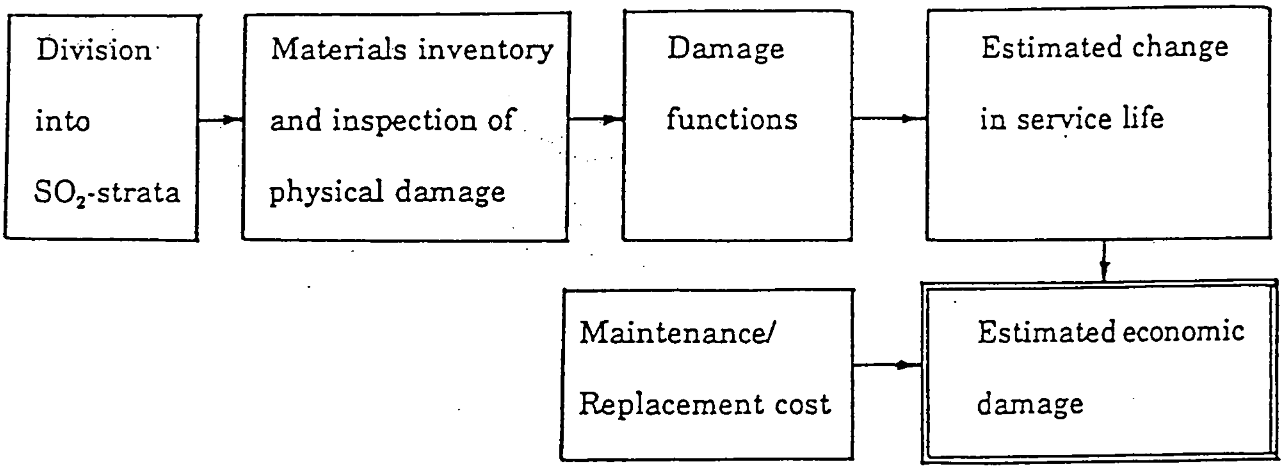


Fig. 4.14. Main steps in a model used for estimating corrosion costs caused by air pollution (Kucera et al., 1993).

4.4.2 Effects on materials in Hungary

The corrosive effect of acidic components on machinery, instruments, buildings and sculpture is a great problem in Hungary. The total cost due to corrosion effects including the expenses of prevention has been estimated to nearly $1 billion a year (Pais and Horváth, 1990). A very rough indication of the economic damage per capita in Budapest is given by the fact that the SO_2 -level in Budapest is about one third of the level in Prague.

4.5 Climate change

According to the Intergovernmental Panel on Climate Change, IPCC, a doubling of CO_2 is likely to cause an increase in the global temperature of 1.5 - 4.5 ^{0}C (Houghton et al.,1992). The relative importance of other greenhouse gases, GHGs, (e.g. methane, halocarbons) has also been estimated (IPCC, 1994). A complicating factor is that some compounds, e.g. methane, have indirect effects because they affect concentrations of other GHGs. The concept of Global Warming Potentials (GWP) has been developed for policymakers as a measure of the possible warming effect arising from the emission of each gas relative to CO_2. However, these values are subject to revisions, partly because their indirect effects are not well known (see also Section 3.2). The GWPs will vary with the time perspective used. Although the concept of GWPs has been criticized, it can probably be used in the context we discuss, since other uncertainties will be more important.

Fig. 4.15 shows the contributions to the greenhouse effect (in terms of radiation) since pre-industrial times for various compounds as given by IPCC (1994). Positive values imply increased temperature. Ranges indicating uncertainties are included. The largest positive contribution comes from carbon dioxide and the estimate is believed to be fairly accurate. Methane (CH_4) is also of considerable importance, but the contribution is more difficult to estimate because of the large indirect effects. The importance of sulphate aerosols (particles) has recently been the subject of much concern. They are the main cause of the haze that reduces visibility over wide areas. Particles may affect climate in several ways, but it seems clear that the overall effect is a cooling.

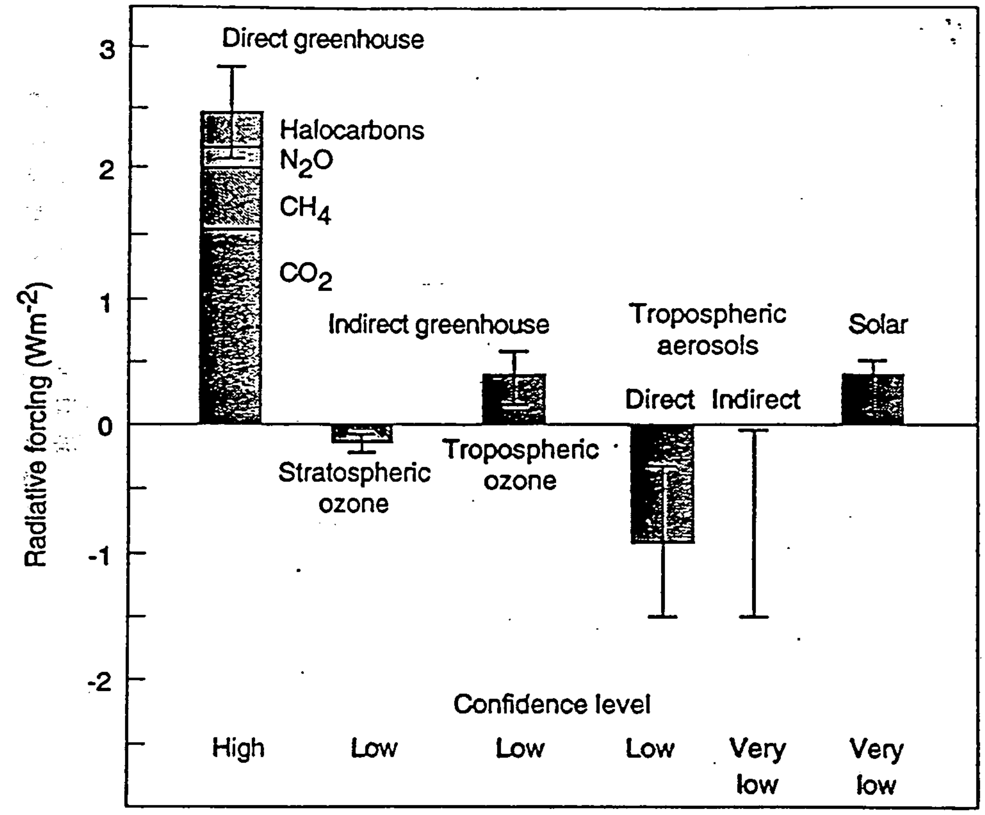


Fig. 4.15. Estimates of the globally averaged radiative forcing due to changes in greenhouse gases and aerosols from pre-industrial times to the present day and changes in solar variability from 1850 to the present day. An indication of relative confidence in the estimate is given below each bar. The contributions of individual GHGs are indicated on the first bar for direct greenhouse gas forcing. The major indirect effects are a depletion of stratospheric ozone (caused by the CFCs and other halocarbones) and an increase in the concentration of tropospheric ozone (from IPCC, 1994).

In a recent paper, Wigley (1994) discusses new results for the importance of aerosols. If they are correct, he concludes:

> They imply that we are still on the upward slope of the climate-change learning curve and that it may take longer than we thought to reduce the uncertainties in climate predictions. In more ways than one, therefore, aerosols add a new dimension to the problem of predicting climate change and providing results that are of use to the policy makers. The outlook may indeed be warmer, but our picture of it has become much hazier.

Some find it reassuring that sulphate aerosols are likely to have a cooling effect, arguing that the effects of greenhouse gases and aerosols may more or less cancel. This seems to be a dangerous attitude. It is very unlikely that the different effects should nearly cancel each other over a long time period in essentially all areas. Strong regional effects of sulphate particles may cause unpredictable weather effects even if the global temperature does not change significantly.

Even though the changes in climate for various deposition scenarios are very uncertain, this should, in our opinion, not be used as an excuse for doing nothing. With respect to monetization, what may be estimated is perhaps the willingness-to-pay to avoid this uncertainty. Not surprisingly, an investigation by Wenstøp et al. (1994) revealed large differences between the weights various groups gave to reduction of greenhouse gas emissions.

Finally, as we have pointed out earlier in this report, the close relationship between emissions of GHGs and air pollutants implies that there are considerable positive effects on local and regional air quality for most of the GHG abatement measures. This is a fact that should be fully harnessed in the process of elaborating optimal abatement strategies.

Annex I to chapter 4. Cities/towns where data on average concentration levels of NOx, SO$_2$, TSP and settling dust have been available.

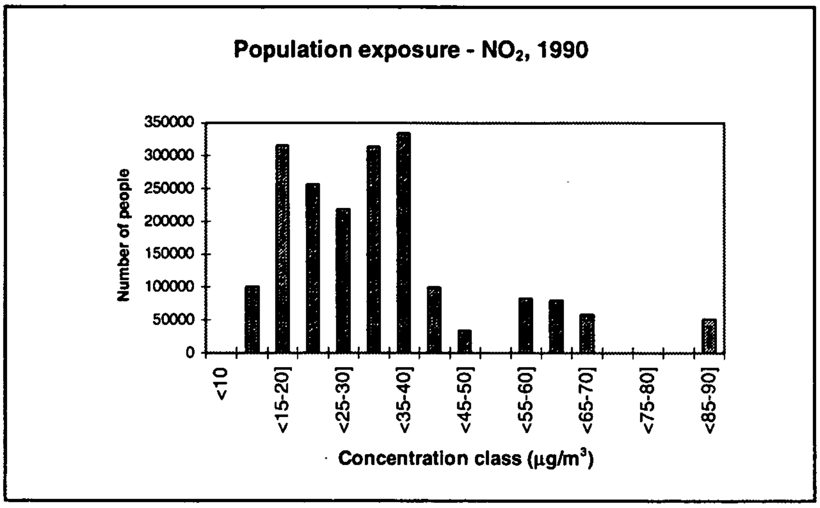
Zalaegerszeg
Keszthely
Nagykanizsa
Lenti
Veszprem
Ajka
Papa
Varpalota
Pet
Szombathely
Koszeg
Szekszard
Bonyhad
Dombovar
Paks
Nagymanyok
Szolnok
Jaszbereny
Karcag
Kisujszallas
Turkeve
Nyiregyhaza
Kisvarda
Mateszalka
Vasarosnameny
Fehergyarmat
Tiszavasvari
Rakamaz
Zahony
Kaposvar
Budaors
Cegled
Szazhalombatta
Szentendre
Vac

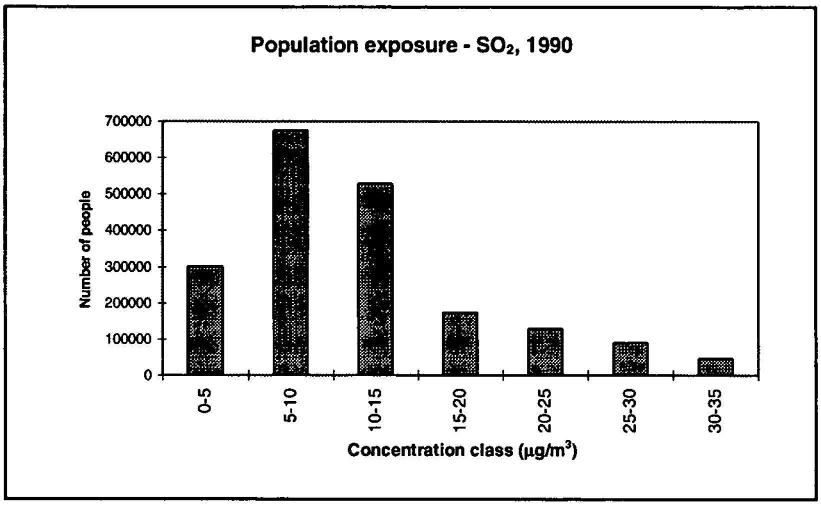
Salgotarjan

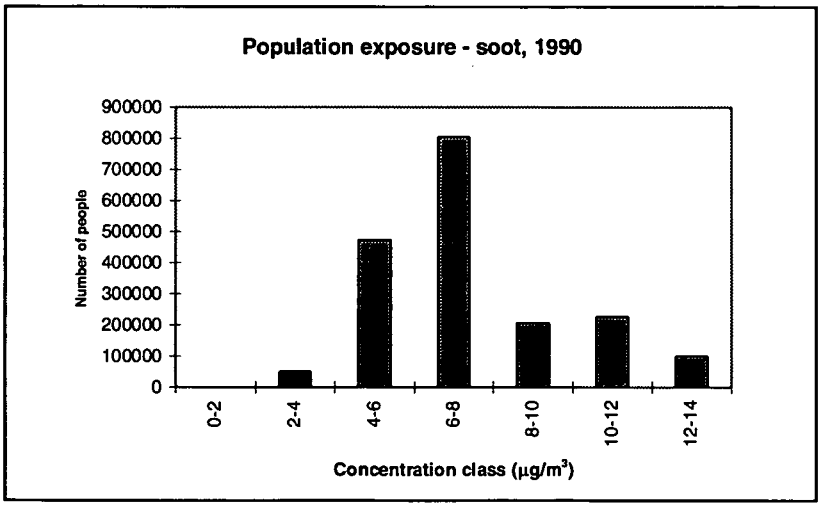
Balassagyarmat
Batonyterenye
Paszto
Szecseny
Tatabanya
Dorog
Esztergom
Komarom
Oroszlany
Tata
Almasfuzito
Labatlan
Eger
Gyongyos
Hatvan
Belapatfalva
Debrecen
Hajduszoboszlo
Hajdunanas
Gyor
Sopron
Szekesfehervar
Dunaujvaros
Mor
Csongrad
Hodmezovasarhely
Mako
Szeged
Szentes
Asotthalom
Maroslele
Szekkutas
Zakanyszek

Miskolc
Kazincbarcika
Ozd
Sajoszentpeter
Tiszaujvaros
Bukkszentkereszt
Pecs
Beremend
Komlo
Mohacs
Siklos
Szigetvar
Sellye
Szaszvar
Bekescsaba
Oroshaza
Bekes
Gyula
Kecskemet
Baja
Kalocsa
Kiskoros
Kiskunfelegyhaza
Kiskunhalas
Dunavecse
Budapest

Annex II to chapter 4. Number of people exposed to different classes of yearly average concentrations of NO_2, SO_2 and soot. Budapest, 1990.







5 POLITICAL TRANSITION: INTERNATIONAL CONSTRAINTS AND OPPORTUNITIES

This chapter discusses the international obligations in the environmental area that Hungary has undertaken. During the period after 1990 Hungary has not developed satisfactory environmental and energy policies, but is in the process of accomplishing this. Apart from being a signatory to international conventions on air pollution and climate, Hungary is a candidate for membership in the European Union (EU) and is obliged to harmonise relevant policy and legislation with those of the EU through the so-called "Europe"-agreement. In this chapter Hungarian energy and environmental policy is compared to the requirements of international obligations, and an assessment is made of the likely development of EU policy towards year 2000.

5.1 The importance of adaptation to international institutions and agreements

Climate policy is rarely made as a separate policy area, but is usually the result of decision-making concerning both energy and the environment. Energy policy is highly relevant in terms of energy saving, efficiency, fuel switching, etc., whereas environmental policy decisions take their goal in the reduction of air pollutants and GHG-stabilization or reductions, and utilize a variety of sectoral policies to this end. Thus one may at the outset agree that climate policy often results from decisions in several policy sectors. Foremost among these is the energy sector.

There are several international actors that are relevant for the development of energy and environmental policies in Hungary, and thereby for future climate policy. Among these are the European Union's (EU) policies and programmes, the financial assistance from the European Bank for Reconstruction and Development (EBRD), the World Bank, as well as Hungary's ratification of international environmental agreements. The conditions for financial aid and access to Western political organizations provide an important constraint and/or opportunity for Hungarian policy formulation in general. Here we will pay special attention to the present and potential role of the EU in the climate policy area, viz. the relevant energy and environmental policies. It is of great importance to provide an assessment of the contents and direction of EU policies in these two fields towards the year 2000, and to analyse how they most likely will impact on the development of Hungarian policy up to and around this time. Attention will also be paid to the role of international environmental conventions.

Since 1989 it has been a major priority issue in Hungarian foreign and economic policy to join the European Union. In September 1994 the Council of Foreign Ministers of the European Union decided to invite their counter-parts in the Visegrad-countries (Hungary, the Chezch Republic, Slovakia, and Poland) to future meetings and in general to expand the consultation procedures between these future members and the EU. This cooperation will increasingly also cover environmental and energy issues (Matláry, 1994).

In the so-called "Europe"-agreements between the Visegrad-countries and the EU (European Union) the former is obliged to adapt to the EU's policies. As of October 1994 the heads of state and ministers for sector policies participate in meetings with their EU counterparts. A so-called 'Task Force' will be established in order to harmonise legislation and policies. One can thus count on an accellerated rate of adaptation to the EU also in Hungary towards the expected accession date of around the turn of the century. In the first inter-ministerial meeting of foreign ministers on October 31, 1994, the role of the environment was stressed: "All sides underlined the importance of harmonising standards throughout the region and converging national policies. The need to take into account the EU's 5th Environmental Action Programme was also noted" (Euro-East, 1994).

At the Essen summit 9-10.12.1994, where also the Hungarian foreign minister was invited, a comprehensive strategy for the adaptation of the Visegrad-countries as well as Bulgaria and Romania in preparation for membership was agreed to. Along with regular consultations between heads of state also environment ministers will meet to ensure that the evolving Hungarian environmental policy is harmonised with that of the EU. Funding for a five-year programme to finance political and legal adaptation in all major policy fields was passed. The annual amount available for this purpose is approximately 1.1. billion ecu. Further, funding was provided for infrastructural developments, including energy, as well as an amount of 3.5 million ecu over the PHARE-programme for the harmonisation of environmental law and policy.

The "Europe"-agreement between the European Union and the Hungarian Republic was enacted as Act No.I.of 1994. Art. 1 of this Act says that the main aim of the agreement is to provide the basis for those future policies, regulations and measures that may serve as guarantees in the process of joining the EU. Art. 79. and 80. of the enacted agreement cover the main environmental objectives, among others the task to undertake the necessary steps for enforcing the climate policy documents and requirements. According to the same articles there are several tools attached to this objective, from the development of information mechanisms to the improvement of legal measures. If we examine not only this agreement, but other legal documents also, we find the same endeavours to take EU legislation into consideration.

When speaking about climate policy in Hungary, energy policy will have a significant impact on the issue. Resolution of the Parliament (1993a) on the Hungarian energy policy requires the Government - in art.6 - to prepare the concept of a framework energy law, which should be in harmony with the EU legal system, covering issues like the implementation of energy policy, energy saving, working conditions of energy sector institutions, etc.

Regarding harmonisation, one should not forget that the simple adaptation of EU regulations is far from being enough. The environmental or any other requirements of the European Union do not provide a system which corresponds to a domestic regulatory system. Thus, environmental requirements should be developed on a country-by-country basis, adding those elements of EU legislation to the domestic system that are missing from it. But harmonisation is a condition in the 'Europe'-agreement.

The methods of how the Government proceeds in the harmonisation process are up to the concrete political and regulatory decisions. In order to create an environmental protection system other conditions must be met, e.g., an efficient administrative and organisational apparatus must be in place. However, since much of both energy and environmental policy developments are rather rudimentary in Hungary, it can be expected that EU standards and instruments will be very influential in the future development of these policy areas.

The major period of adaptation to the EU will take place from the present to the turn of the century, regardless of the exact date of accession, which depends on other, external factors as well. However, it is no doubt the major priority of the government to adapt as fast as possible, as this is the basic condition for membership. In a major survey of environmental policy among Hungarian decision-makers they all agree that adaptation is the strongest incentive for developing Hungarian environmental legislation and policy: "International relations and aspirations, e.g. the strive for EU membership, are a strong incentive for environmental protection. Domestic legal pressure is however weak" (REC-report, 1994). Further, the report estimates that the process of adapting to EU legislation in the areas relevant to climate-policy has both an immediate and a long-term importance: "Revisions to the legal requirements imposed on investors in the CEE countries are being made in order that they be compatible with the regulations of the European Union. This should help eliminate barriers for developing businesses. A common methodology should be adopted while establishing environmental regulations to avoid discrepancies" (Ibid.)

5.1.1 Energy and environmental regulation and policy in Hungary: A general overview

If we examine the environmental protection regulations in Hungary, certain characteristics will appear, most of which have not been changed significantly in the past four years. These characteristics are:

- there is no general environmental policy, strategy, or priority given to environmental interests;
- the method of regulation is not an integrating method, and the movement of pollution between environmental media is not prevented;
- the regulation is based on the use of sanctions, without effective enforcement;
- there is a lack of harmonization of economic and environmental interest, and there is only one example for economic measures: the product fee on petrol prices;
- there is a wide variety of direct instruments both without the explicit obligation to use them and without the regulation of conditions of implementation;
- there are very few high-level, legislative norms;
- there is little access to information and no rules of public participation;
- the division of authority between central, regional and local administration is not clear, and the sharing of responsibility is hampered by a number of reasons, including the lack of a medium level of decision-making.

The development of the draft Hungarian environmental policy paper is based on the Resolution of the Parliament (1993b) which requires the Government to develop an environmental protection and nature conservation policy paper. The draft was adopted by the Government at the end of March 1994. The draft has been published by the Ministry of Environmental Protection and Regional Policy (Nemzeti Kornyezet-es Termeszetpolitikai Konceptio, 1994). Here we do not examine the draft as a whole, but only those references that are made for the short and medium term priorities. The short term priorities up to the year 2000 generally aim at the reduction of air pollution, among others with developing a transport and traffic policy, improving the monitoring capacity and undertaking the tasks of international commitments. The medium term priorities up to 2005 mention in the first place the need to harmonize the Hungarian environmental legal system with the EU environmental legislation. As the air pollution concerns there are no other specific requirements than those mentioned in the set of short-term priorities. The long-term priorities are even more vague.

Looking at energy policy, we likewise find that it is not developed in any full-fledged manner yet: Hungarian energy policy is based on Resolution of the Parliament (1993a) that obliges the Government to develop programmes for energy supply considering also the environmental conditions, to develop energy saving and energy-efficiency policies, to continue the work on the basic power plant concept, to handle the problems of coal mining, and to harmonize the energy laws with EU regulations.

Consequently neither environmental nor energy policy or programmes exist as clear-cut documents with legally binding obligations or very specific policy goals. The most important task for the future in both fields is to develop these policies in an integrated manner.

5.1.2 Political and institutional factors

The mere fact that the last four years did not produce satisfactory environmental and energy policies as pieces of legislation proves that there is limited interest on the side of decision-makers in these problems. The deepest reason for this is the lack of public awareness that requires neither the political parties nor the Government to develop effective strategies for handling environmental problems as well as climate policy. Therefore there was no pressure on political actors to develop and promote environmental programmes. Environmental elements or chapters of party policy papers are usually using vague formulations.

The major priority of parties and state management is the focus on economic growth. Within the state apparatus there does not exist any widespread interest in, or practise of horizontal policy integration. This means that e.g. environmental policy will be made not as a separate sector policy, but as the outcome of a horizontal integration of the various policy sectors that are relevant here. The Ministry for Environment and Regional Affairs remains weak compared to the other ministries. This is also the situation in many other European states, however.

The major structural changes in the economy that led to decreases in living standards and safety could have induced the public to accept the dependency of environmental considerations on economic growth. Different other problems, like unemployment and inflation, have however overshadowed environmental interests. Also the lack of energy policy did not require the public to develop energy saving or energy efficient behaviour. There are some public interest groups (NGOs) that focus on environmental problems, but their impact on the overall public awareness and also on policy making is not considerable.

The potential impact of the international community is greater than ever before since the regime change in 1990, provided that the present government will continue the market liberalisation of the first freely elected government after Communism. The aim to join the European Union is, as discussed, very important in this respect. Most of the international organisations have their specific or general interests in environment or energy, and they use several means and methods to make these interests accepted.

There are several institutions and programmes under the auspices of international organisations that are relevant here: In Budapest as well as in other capitals of the region there are by now so-called EC Energy Centres which work towards improving energy efficiency and management, often through public and managerial education, as well as pilot projects. Further, the EU as well as major OECD countries have established the Regional Environmental Centre for Eastern and Central Europe in Budapest. The main task of this centre is awareness-raising and education through the medium of NGOs about environmental issues. Further, the EU PHARE (PHARE, 1990) and Thermie programmes, to be discussed later, aim at funding energy efficient projects as well as restructuring of the economy in an environmentally friendly way.

However, the prospects for developing a Hungarian climate and environmental policy in terms of political and institutional factors are not promising. At the present time there is no perceived need for a climate policy for the short run, but around and after the year 2000 this will probably be a necessity in Hungary as well as in other countries in the region. There is at present a need for an efficient environmental policy that focusses on the interaction between energy use and emissions at local and regional level, however.

The main impetus for changes will most likely come from abroad, in the form of financial aid, learning and education, conditions for loans and grants for economic restructuring, and institution-building. The most important actor in these various areas is probably the EU.

5.2 Adaptation to the European Union : Consequences for environmental and energy policy

5.2.1 Environmental regulations and policy

The EU has a strong legal basis in the Maastricht-treaty for formulating a common environmental policy, and has developed a major body of legislation in this area.

The EU 5th Environmental Action Programme (EU Commission, 1991) outlines future environmental policy goals, and entered into force as the Commission's instrument on January 1, 1993. Instead of analyzing the whole Programme, we focus only on some basic characteristics that differ from the previous action programmes:

- It focusses on the agents and activities which deplete natural resources and otherwise damage the environment, rather than wait for those problems to emerge;

- It endeavors to initiate changes in current trends and practices which are detrimental to the environment, so as to provide optimal conditions for socio-economic well-being and growth for the present and future generations;

- It aims to achieve such changes in society's patterns of behaviour through the optimum involvement of all sectors of society in a spirit of shared responsibility, including public administration, public and private enterprise, and the general public (as both individual citizens and consumers);

- Responsibility will be shared through a significant broadening of the range of instruments to be applied to the resolution of particular issues or problems.

This programme proposes a broad mix of policy instruments, among which the most important ones for Hungarian environmental legislative development may be:

- fundamental levels of protection for public health and the environment shall be set;

- market based instruments shall be introduced, through the application of economic and fiscal incentives and disincentives, also civil liability, etc., in order to internalize all external costs,

- there shall be increasing commitment to horizontal, supporting instruments, such as those found in connection with research and training, etc.;

- a wider public information and public participation mechanism shall complete the horizontal instruments;

- the financial support mechanism shall be broadened;

- the principle of subsidiarity obtains;

- some legislative measures shall be subject to an "enforceability assessment";

- environmental legislation should incorporate enforcement provisions, etc..

However, EU work in this area is only in its beginning with regard to many of these goals. The present emphasis is on the incorporation of fiscal instruments into other sectors than the environment.

5.2.2 Air pollution legislation in Hungary compared with EU legislation

In the EU, the method of environmental legislation in most of the cases is based upon standardization; thus, limit values are established and the member states will meet these values. The member states must adopt measures to meet the standards, but these measures are not listed in EU regulations. The most important regulatory requirement is to apply the different standards and to use these limit values as basic conditions in permitting procedures. Otherwise, most of the methodological regulations are similar to those in Hungary: for example, member states may designate particularly polluted areas with special protection standards, limitations on the use of polluting substances, obligations to monitor and comply with the requirements. Hungarian air quality measures are less flexible and detailed as related to the different sources of pollution and different products.

The air pollution legal system in Hungary dates back to 1973 and is far less developed than the water protection system. The air regulations were amended in 1986; its final provisions came into force in 1989. Its main problems are the lack of monitoring capacity and the contradictory nature in which authority is distributed.

The basis for air pollution protection in theory is ambient standards; in practice, however, the emission standards divide the country into three types of air quality zones, cf. 4.2. Ambient standards are fixed and controlled by public health authorities, while emission standards fall under the auspices of environment authorities. The air regulation includes general air protection requirements, albeit these are mostly for stationary sources of pollution. These requirements allow the inspectorate to limit or to stop activities if necessary. The air legislation also regulates air pollution by product licensing.

Two kinds of emission standards exist: (1) territorial standards and (2) technological standards. Territorial standards are based upon ambient air quality, and they are divided into three kinds of stationary pollution sources: (1) point sources, such as a chimney; (2) building sources; and (3) surface sources. Established technological standards are based upon available technology and the quantity of the final product. Both standards are general standards. As with water standards, the inspectorates have authority to tailor air standards to individual needs. Moving sources, that is vehicles, require environmental testing, where the emissions are controlled. All the vehicles must have a so called "green card" as a permit for their use in traffic.

Sudden and dangerous pollution situations may require exceptional measures to be taken. These measures include prohibiting the use of automobiles or ordering the use of different energy supply systems. Municipal and county self-governments are required to develop a special action plan for implementing emergency measures. These emergency plans are still absent in Hungary; and in Budapest, the air pollution may exceed the health standards, as discussed in 4.2.2.

Polluters are responsible for monitoring their activities. Point and building stationary sources must report emissions annually, while surface sources must do so upon the request of the authority. The size of the fine is determined by the degree to which pollution exceeded the standard and the danger of the pollutant.[1]

5.2.3 Energy regulations and policy

Since 1988 the EU has developed a so-called internal energy market, seeking to establish common market rules for the production, transport, and sale of energy. It has also attempted

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[1] The dangerousness of a pollutant is categorized on a scale of 1-4, with 1 being the most dangerous. Each category will result in a different index number when imposing a fine.

to develop a full-fledged energy policy in terms of integrating environmental criteria, a policy of supply security, etc.

The EU has several formal political ties to the region of Eastern and Central Europe (Pinder, 1991). The "Group of 24", consisting of the EU and other OECD countries, deal with energy and environmental problems in East-Central Europe in general and the emergency character of the energy supply situation. The Commission coordinates the work of this group. It stresses the need for a medium-term energy strategy on a pan-European scale, proposing that all financial instruments be coordinated; that help be given in diversifying dependence on Russian energy on the part of East-Central Europe; and that assistance in developing alternative gas import sources be provided.

These proposals indicate that the Commission attempts to develop a full-fledged strategy in the energy-environmental area not only for its members, but specifically also for the East-Central European region. In terms of financial policy-instruments, both the EIB and the EBRD are in place. There are in addition programmes that entail direct EU funding, PHARE, SAVE, and Thermie to be mentioned. PHARE aims at the general economic restructuring of the region, while SAVE aims at energy saving and Thermie at energy efficiency through the improvement and modernisation of technology.

However, the most comprehensive plan for improving the energy infrastructure and securing energy supply is the so-called Energy Charter which entails the creation of an international legal regime for the production, transport, and sale of energy, perhaps especially Russian gas. Introduced as an idea to the European Council in June 1990, the legally binding treaty for the charter will be signed on December 17, 1994. Hungary is one of the 50 signatories (Traite de la charte de l'energie europeenne, 1994).

The issue of creating an environmentally sound energy policy came to the fore in the EU during 1990. In May 1990, the Energy Council decided on "Conclusions on energy and environment" which called for energy saving, an incorporation of environmental concerns in future energy policy, and on more debate on the role of nuclear energy. There were however few common policy proposals as of the end of 1994.

The Commission intervenes in the subsidization of coal production in member countries, but is basing this on the rules against state aids in the Rome Treaty and in the European Coal and Steel Community (ECSC) treaty. In the future, coal production and coal use may also be linked to environmental issues, as the Commission has indicated that it will support the enhanced use of natural gas and nuclear energy for power generation. Coal may thus be de-emphasized in future energy policy, and the environmental pressures to curtail industrial emissions will undoubtedly give impetus to the process towards building down coal subsidies. A restructuring programme, RECHAR, has been adopted in order to aid regions and communities that are one-sidedly dependent on coal. The Commission's view of coal subsidies on the part of a member state is that it should not exceed a certain level, but EU coal policy is still in the making.

The EU tries to develop a climate policy that also contains a CO2 tax, but so far the UK has opposed the tax, which requires unanimity to be adopted. Other parts of the EU climate 'package' contain the energy saving programme SAVE, a programme for the promotion of renewables, Thermie which deals with energy efficiency, and an auditing mechanism for monitoring EU member state policies.

In conclusion one may assume that the work on integrating environmental and energy policy in the EU will continue towards the year 2000, and that no aspect of energy policy will be seen in isolation from its environmental consequences at that time. Already there are important developments towards such integration in the EU, and the Commission is under a strong legal obligation to achieve real sectoral integration. This means that funds will increasingly be available for fuel substitution, the development of renewables, etc. both for present and prospective member countries. The coal policy of the EU is under full revision, and the outcome will probably emphasize the need to build down state subsidies but also offer funds for restructuring in coal regions. Hungary's current coal policy will not make it difficult to comply with this policy. Further, of special Hungarian interest is financial aid that is available for the erection of European-wide energy networks through the stuctural funds.

5.3 The Climate Convention and other relevant international agreements

Hungary is a signatory to important international conventions and has met their requirements as planned. The Climate Convention is among these obligations.

(i) The Climate Convention

Instead of examining all the aspects of the Climate Convention, we will emphasise what the Convention understands as commitments on behalf of the Parties. Art.4 of the Convention speaks about the basic commitments, that cover among others:

- developing, updating and publishing national inventories of anthropogenic emissions,
- formulating policies and programmes on mitigating measures,
- developing technologies, practices and processes,
- taking climate change considerations into account when developing social, economic and environmental policies and actions,
- promoting research, information flow, education and public awareness raising.

By far the most important element of the convention is planning and policy making, on the basis of inventories. Climate policy should be a part of environmental policy in a comprehensive sense and should be formulated in order to serve as the basis for relevant actions. Hungary ratified the Convention in 1994 with the year 1985-87 as basis.

(ii) The Geneva Convention on long-range transboundary air pollution

Hungary joined the basic convention in 1980, and has also joined to the EMEP, SO2, NOX Protocols. The conditions of the Convention and Protocols - the limitation of pollution - has been met, due to the economic recession in Hungary.

(iii) The Vienna Convention on the Ozone Layer

Hungary joined the Convention in 1988, then the Montreal and London Protocols and finally the Copenhagen amendments of the protocols. Hungary accepted the limitations of ozone layer depleting substances. Hungary does not produce these materials, and accepted to stop their use. A ministerial order (13/1992.(V.12.) KTM) has a direct effect on the use of these substances and on the phasing out of them. The order describes a fine in case of infringement, and as a consequence of the second offense it is obligatory to stop the polluting activity.

5.4 Concluding remarks

In conclusion, Hungary is increasingly obliged to meet international political goals in the environmental area. The process of adaptation to EU policies takes place towards the year 2000, at which time the EU will have come much further than today in integrating environmental criteria into energy and other policies. The methods that the EU favours are now market instruments. Hungary will, in its economic transition, have an important opportunity in adopting such policy instruments. However, this is a process that will take time. There is as of yet little work going regarding this at the national level. EU funds for energy restructuring and efficiency will be important to the development of Hungarian energy and environmental policy.

6 ENVIRONMENTAL POLICY

The choice of environmental policy measures should aim at achieving the highest possible environmental benefit for a minimum of costs. Major environmental improvements can probably be accomplished without entailing additional macroeconomic costs. A further improvement of the environment at a low cost may be achieved by the use of economic instruments, such as environmental taxes, provided a reasonably well functioning market exists. However, a proper use of economic instruments, attached to economic activity indicators, requires a direct correspondence between the economic activities and the environmental problem, while environmental problems usually are interrelated and depend also on non-economic factors. The choice of policy and policy instruments after the transition to a market economy needs to take this complex reality into account. In addition, Hungary is presently in a difficult economic situation. Therefore, an appropriate choice of policy instruments will include direct measures. Choices which may seem non-optimal in the short run, may yield a net benefit in the long term. This is why there is a strong need for effective and powerful institutions with high competence to take responsibility in the management of environmental concerns.

6.1 What is a cost-effective environmental policy?

Environmental policy making increasingly emphasizes cost efficiency as a criterium for the choice of policy measures. Cost efficiency is achieved when individuals and enterprises pay the real social cost, including the cost of environmental effects, of their activities ("the polluter pays principle") . Moreover, only projects which yield a net social return are carried out. This secures the highest social return for each unit of money spent, or in other terms, the minimum social cost for a given composition of production. The minimization of costs allocated to achive a given environmental target would release the maximum amount of resources for other purposes, and might therefore make it easier to enhance the amibitions with respect to environmental quality.

Alternative policy measures may be ranked according to their economic net cost per unit of e.g. reduction in emissions, as illustrated in Figure 6.1. The ranking provides a priority list over policy measures. It is normally assumed that some alternatives which yield a net economic benefit will also lead to environmental improvements. These are indicated by the part with negative marginal cost in the figure, and corresponds to the so called no regret options. No regret options should be launched regardless of environmental concerns. They may contribute to a substantial part of the cost curve for Hungary. Many of them are likely to be carried out under the transition to a market economy. This may save the country from an expensive environmental policy for the nearest years.

It is likely that many no regret options are presently available in Hungary, but it is difficult to assess the exact number, and their potential benefit. Few, if any, alternatives aim at the same set of social goals. To rank alternatives one therefore needs to compare the different effects.

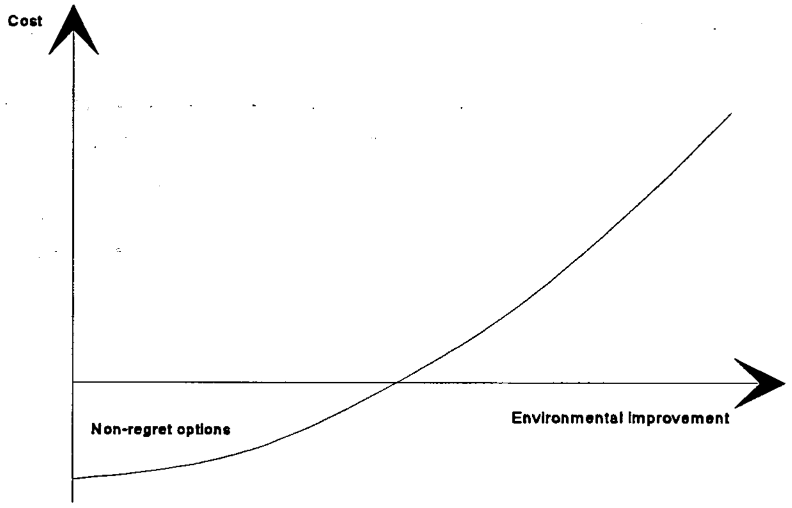

Figure 6.1 Marginal cost curve for emission abatement

Assume for instance that the marginal cost curve in Figure 6.1 displays the economic cost of reducing the emissions of CO_2. The different alternatives ranked may include a close down of some unprofitable CO_2-emitting industry, investments in a better public transport system etc. Observed economic costs and reductions in the emissions constitute only a part of the total social effects of these measures. To carry out a socio-economic evaluation of the projects one therefore needs to assess *all* direct and indirect effects of all the alternatives in terms of values. This includes effects of less time used for transport, substitution from private to public transport, implications for employment etc. Usually, one can only make rough estimates of some of these values. Measures that are expected to yield a net social benefit may therefore be discarded after all.

It is nearly impossible for a central authority to foresee all the implications and assess them correctly in order to rank the alternatives accurately. Indirect policy instruments aims at making individuals behave in such a way that they would select the "best" projects by themselves. The use of indirect instruments thereby faciltates the task for the central authorities. They could concentrate on adjusting the measure to a level needed to achieve their environmental goals. In many cases one can charge the polluters for the social cost of their activities, e.g. by taxation. When the individuals pay for all the social impacts of their activities, their demand for goods and services will correspond exactly to the supply. This makes it impossible to increase the net benefits from one activity without reducing the net benefits of some other activities. Cost efficiency is thereby achieved. There are infinitely many efficient composistions of activities, but there is only one efficient composition for a given set of prices.

By charging polluters for the damage they bring upon the society, one therefore achieves both a reduction in polluting activities and cost efficiency, provided that it is possible to determine the correct tax level. Market behaviour of individuals will in that case determine whether a close-down of the polluting industry or a better public transport system is the most favorable. If there is such a close relationship between the environmental target and the economic activity, environmental policy will aim at sorting out measures that make the market prices reflect all the environmental effects. Market behaviour will "automatically" rank the specific measures, and thereby secure that the economic composition of activities is cost efficient after the environmental policy has been carried out.

In practice, however, the choice of environmental policy instruments is not that simple. First, the policy may aim at different goals. The choice of a climate policy, for instance, will change dramatically depending on whether the policy aims at reducing emissions to a specific level at a certain date, controlling the concentrations of greenhouse gases in the atmosphere or protecting against potential effects of global warming. Edmonds and Richels (1994) have compared the cost of reaching the same concentration of atmospheric greenhouse gases 100 years ahead by two alternative policies. One is to stabilize emissions from now on, and the other is to allow an increase in the first half period, but to *reduce* the emissions in the second half of the period. They show that the cost of the emission target approach is considerably higher than the cost of the latter alternative. A target on emissions requires immediate action under the present technology. A corresponding target on concentrations of greenhouse gases 100 years from now would allow us to postpone heavy investments in abatement measures and to develop new technology which would make abatement less costly. These problems do not affect the advantages of economic instruments, but rather the dose and the timing of them.

There is, however, a second reason why the choice of instruments is more complex which also affects the desirability of indirect economic instruments. This is that "the environment" cannot normally be represented by one variable that has a one to one relationship with some set of economic activities. Anthropogenic emissions of CO_2, being generated from the consumption of fossil fuels, are close to having such a relationship. However, net anthropogenic emissions will also be affected by sinks. If the policy aims at controlling global warming, current emissions of CO_2 constitute only a part of that problem.

In addition, as emphasised in Chapter 1, a cost-efficient policy cannot be achieved by focusing one environmental problem at a time. By reducing the emissions of CO_2, other environmental problems will be affected as well. This also works the other way around: A policy aiming at a control of local pollutants will have an effect on the emissions of greenhouse gases. The effects of local pollutants can seldom be related directly to economic activities and climate policy thereby becomes subject to non-economic processes as well. To require cost efficiency is, therefore, quite ambitious. It calls for an integrated approach for analysing environmental policies in order to assess policy priorities. In an integrated context, it is not sufficient to consider only economic instruments, since direct control of the problem may be more cost effective than controlling some economic activity related to the problem.

In general, the ability to achieve cost efficiency depends on whether the market is well functioning, so that the observed market prices reflect aggregate supply and demand. This is not the case in Hungary at present. For most environmental problems also a detailed knowledge about doses and respones is required in order to assess the correct benefits of a given measure. The latter requirement is generally not satisfied, or at least limited to a great uncertainty. In the short run, therefore, the use of economic instruments in Hungary may fail to have the anticipated effect. The scope of this report is mainly to outline environmental policy options after a transition to a market economy. Thus, we will emphasise a description of economic instruments in this chapter. However, environmental measures will be initiated also in the short term, and we therefore start with an analysis of the transision period.

6.2 Environmental policy instruments under the transition to a market economy

6.2.1 The efficiency gap and means to close it

In the aftermath of the oil price hikes in the 1970s, energy conservation became an important component of energy policy. Technical standards, information and financial incentives contributed to the 20% drop in energy intensities in OECD countries from 1973 to 1985, albeit much less than higher energy prices, see IEA (1987) and Schipper (1987). The massive programmes with substitution of oil by nuclear, coal and natural gas in the power sector further contributed to the collapse in oil prices in 1985-86 which in turn displaced "energy security" as the principal rational for an active energy policy. Hence, energy conservation programmes were gradually scaled down.

Since 1989-90 however, energy conservation has had a renaissance, this time as a tool in environmental policies. In this regard energy conservation measures have been promoted as a win-win option, meaning that appropriate conservation measures will gain the environment and at the same time provide energy consumers, and the society at large, with a net economic benefit. The win-win proposition has its scientific basis from a large number of engineering studies showing that energy consumption theoretically can be reduced by 20% or more at a profit. There should therefore, in principle, exist large opportunities for the provision of energy through investments in conservation at costs that are below the marginal costs of energy supply expansion. The potential for profitable, but not realised, energy efficiency gains is often denoted the efficiency gap, (Grubb,1990).

Whether the efficiency gap actually can be harvested at a net social benefit is a subject of much debate. At the heart of this matter is the controversies over the "top down" versus the "bottom up" approach as the appropriate methodology in estimating the abatement costs in climate policies, see for example Risø (1992). Obviously the simple engineering studies, based on technical data and calculation, and without proper coverage of behavioural features, offer a too narrow approach to the issue. Since energy consumers, by definition, do not by themselves take advantage of the efficiency gap they must be exhorted to capture the opportunities which conceivably are in their own interest. This in turn requires some initiative from public authorities or utilities. Such initiatives entail administrative costs and may produce "side-effects". Typical side-effects are distortive effects on economic efficiency caused by taxes needed to finance the conservation programmes, and "leakages" such as "free riding" and "conservation rebound" which undermine the effectiveness of conservation measures. The validity of the win-win proposition in relation to energy conservation policy, therefore, stands or falls with the magnitude of administrative costs and "side-effects" versus the net monetary and environmental benefits of the investments in energy efficiency.

Most international estimates of the efficiency gap are in the range from 15 to 30% of total energy consumption (see IEA(1987) for an overview of estimates for different OECD countries). If the environmental costs are included the efficiency gap would be substantially larger. A study for the UK for example, indicate a 25% reduction in CO_2 emissions if the efficiency gap was eliminated, (Jackson, 1991).

A study for the European Community estimate the economic potential in industry to be 30%. In Japan and the USA various estimates for the industry are in the range between 20 and 40%

(IEA, 1987). Estimates of the efficiency gap is clearly sensitive to assumptions of future energy prices and economic lifetime of investments. Whatever methods and assumptions are applied, however, it remains a fact that there exist a considerable number of investment projects that have a high rate of return, but which are not pursued by energy consumers. This has forcefully been put forward as an argument for a revitalisation of energy conservation policy.

In principle the causes for the efficiency gap are well known and have extensively been described in the literature, e.g. IEA(1991), Jochem and Gruber(1990) and Grubb (1990). Four set of factors are particularly important:

- Lack of knowledge and technical skills which leads to investments and operational dispositions that are economically sub-optimal and result in high energy use.

- Payback requirements for energy saving investments that generally are higher than comparable discount rates applied for energy supply investments. For low income households required payback has in some surveys been found to be less than one year.

- Separation of expenditure and benefit which, for example, may discourage tenants from renovating buildings if the owner receives the benefit.

- Irrational pricing policies with end-use energy prices set at levels below the social costs of additional supplies.

No doubt, environmental problems may to some extent be due to the behaviour of misinformed individuals: The use of economic instruments in environmental policy making is efficient only if the individuals are fully informed about the environmental consequences of the commodities they trade in the market.

The energy wastage caused by the two latter factors is best rectified through organisational changes whereby the beneficiaries of energy conservation investments also cover the costs and by price reforms. The two former factors (lack of knowledge and high payback requirements) stem from behavioural features that might be adjusted for indirectly by altering the conditions under which energy consumers make their decisions. Three sets of measures are common:

i) Information including large information campaigns, training, energy audits and labelling of energy using machinery and appliances. Information is considered a cornerstone in energy conservation policy in most OECD counties.
ii) Standards covering voluntary and mandatory technical standards on the specific energy efficiency for machinery and appliances and building codes. Building codes are common in most OECD countries. Mandatory standards are used in the USA for motor vehicles and electrical appliances but have been less popular in Europe.
iii) Financial incentives covering a large number of instruments such as grants, soft loans and tax incentives. They are often applied in combination with information. Financial incentives were widely used at the end of the 1970s and the first part of the 1980s, but many of the public programmes were substantially reduced by the mid 1980s. Demand side management (DSM) by utilities, which is growing in the USA, normally

has a component of financial incentives for energy consumers.

The primary aim of information and standards is to overcome the information barriers to energy efficiency improvements. Financial incentives are targeted towards energy consumers who abstain from efficiency investments due to high payback requirements.

The challenge of energy conservation policy is to select and design measures which adjust for the behavioural features mentioned above, but without causing excessive additional costs through unintended side-effects. This requires thorough knowledge of the relative importance of the factors which cause the efficiency gap and of the full effects of various conservation measures. Often the understanding of these issues, prior to implementation of measures, is inadequate.

In Hungary, the efficiency gap is probably much higher than estimated for the OECD countries, the reason being distorted prices. Price reforms are therefore the natural first choice to reduce the gap. However, there may still be a considerable potential for profitable efficiency gains after price changes for the reasons outlined above. Other energy conservation measures can therefore, as noted, be appropriate to achieve further improvements in energy efficiency. But such measures need to be carefully evaluated in order to ensure that they actually offer a net social benefit.

6.2.2 Measues and institutions in the transition period

Apart from closing the efficiency gap, Hungarian authorities may want to take a more active part in environmental control in order to enhance environmental quality before the transition to a market economy is completed. This implies a more direct control over activities than the more indirect control measures discussed in section 6.3. Direct control requires establishment of highly competent institutions. If possible, these should be organized such as to allow for prolongation into a more indirect environmental policy in a market economy.

Institutions

The effectiveness of the environmental management depends highly on institutional aspects. A well organized institutional system is characterized *inter alia* by high competence and clear boundaries between the responsibilities of different institutions. Furthermore, the institutions must be given adequate power to fill their role. Institutional aspects include among others advisory bodies, interest representation, environmental funds, local governments and business corporations.

Advisory bodies are parts of the decision-making system, but are organized outside the Government or the ministries, which are responsible for environmental protection. The advisory bodies have no formal power or authority to make decisions. Generally, they consist of experts, representatives of the environmetnal administration, different interest groups, and the public. The mandates, selection of members and the budget of these bodies should be provided for, based on legal regulations.

Interest representation within institutions outside the environmental administration is a possible element in future management. A model environmental act was drafted by expert consultants for the Council of Europe in 1994. The model proposes how environmental responsibilities may be taken in govermental agencies not primarily occupied with environmental matters. They may serve as a mean to extend the integration of different respects in the government management.

Environmental funds should not limit their responsibility to the raising and distribution of money. They have an even greater function in channelling environmental interests. Other funds that may have the same effect should also be set up, like funds improving energy saving or energy efficiency methods.

The management of state and private owned companies has also environmental responsibilities. Its information about the occurance of environmental effects and response options in their own businesses is clearly better than that of any outsider. In accordance with a recent Hungarian draft environmental act, polluting establishments should have their own environmental management systems. This allows for environmental expertise within the companies.

Elements of direct environmental control

Direct control measures are normally related to standards, given in order to define permissable and acceptable levels of pollution (cfr. Chapter 4). The standards may serve as a reference for prevention activities or as a benchmark for liability or sanctions. They can be expressed in terms of quality objectives, such as the bearing capacity of a recipient, or in terms of limits of discharge. In the latter case, one may refer to product standards or performance standards. By performance standards, the control is directed against a company, for instance a plant. Compared with product standards, it implies that the choice of technology is left open to the company, and it may therefore be regarded as a more implicit measure. Performance standards have the advantage that the company can adapt to the standard in a more flexible manner. However, it may be more difficult to control from the environmental authorities' point of view. The choice between the two is partly a question of monitoring capacity and ability.

Environmental standards will often be related to the so-called best available technology. Product standards are usually given on this background. New technology may, however, be expensive, and especially in transitional economies, such standards should be set with caution. Professional requirements for employees in certain positions may have an environmental aspect and thereby be interpreted as a requriement for environmental standards, for instance by introducing environmental disciplines in the education of professionals.

Permissions and licencing are probably the most important direct control measures within environmental management. A permit is a performance standard, and relates thereby to a company or a plant. Licenses are given on more specific activities, and implies easier, but less flexible control. Allowances, such as permissions and licencing, may implicitly lead to indirect taxation or subsidising of different companies or activities. This may lead to unnecessary social costs, because the allowances do not give agents the right incentives to improve their environmental performance unless the authorities manage to adjust the distribution of allowances e.g. according to introduction of new technology. This is the argument for making permits tradeable. However, tradeable permits require a well functioning market. In the meantime it is vital that permits are given for limited time periods.

Obligations may be given as requirements for further activites, in connection with lincences or as a direct request. The two major sets of obligations are given through juristiction and directly through administrative authorities. The division of responsibility between these two will usually depend on the tradition of the legal system. Examples of obligations include direct obligations to make changes such as to switch energy use or to forbid the use of certain inputs, and to limit or stop some activities. A less drastic alternative is to use fines. A frequent use of obligations and fines is disadvantagous, as it indicates conflicts between economic interests and environmental authorities. A successful implementation of obligations should rather act as a threat that seldom needs to be carried out. Therefore, obligations should in principle be limited to areas where alternatives to harmful activities are known. This would contribute to strengthening the power of the environmental authorities.

Monitoring and information are prequisites for an efficient environmental control, and is particularly important in the period when direct control measures are emphasised. The responsibilities for monitoring may be given to the companies themselves, to public contol agencies, or to local governments. The ability to provide an effective monitoring and sufficient information largely depends on capacity and competence. Furthermore, monitoring tasks and the design of information should be developed and restricted to the explicit requirements of the environmental management authorities. This may restrain collection of data which no one ultimately uses, and compel the authorities to make explicit what they regard the necessary informational basis for environmental decisions to be.

Environmental impact assessment (EIA) should be carried out for all decisions with significant environmental effects. The use of EIA is implemented as a routine in many countries, but has a history of only 2 years in Hungary. A less detailed kind of EIA for some energy and heat producing facilities was introduced in 1992. Slightly different requirements for impact assessments with more general applicability were introduced in 1993. A coordination between the two is needed.

6.3 Market oriented environmental policy instruments

6.3.1 Economic instruments

Economic instruments include

- Charges and subsidies
- Financial incentives (location incentives, "green" funds)
- Creation of environmental markets (marketable permits)
- Pawn and refund systems
- Fines for environmental damage

The aim of economic instruments is to include the external effects, e.g. environmental deterioration, of economic activities into the costs and benefits considered by th decision makers. This creates incentives for economic agents to act in accordance with social goals. The merging of decentralized decision making and the aim of social goals enables in principle cost efficiency. For instance, by charging polluting activities for their environmental damage, the agents receive incentives to substitute from using "dirty" goods to "clean" ones, change the activities from those which place a heavy burden on the environment to activities with less undesired consequences and so on. Enterprises will be encouraged to shift to technologies with lower emissions and perhaps to develop new, "cleaner" technologies in order to reduce costs.

Economic instruments have the advantage that the decisions of what actually to do are left to the individuals: They act in accordance with their own interests. This prevents occurance of "black" markets and other undesired side effects which easily occur if people are told by some central authority what to do. From the point of view of the central authority, far less information is needed to initiate a policy than when direct measures are used. As discussed above, the ranking of measures will partly be a question of individual adaptation to the new situation. The central authority therefore needs not bother too much about the ranking of "projects", only to adjust the dose of the instrument in accordance with their environmental targets.

Charges and subsidies

These imply that the product of a polluting process or the use of a polluting commodity, such as fossil fuels, is taxed according to the pollution it causes. Subsidies may be used for particularly environmental favourable processes and commodities.

In a system of emission charges it is very difficult to determine the level of the charge at which private marginal cost approaches social marginal cost. Galloping inflation may spoil the effect of charges or fines since the economic effects of inflation itself have disorting effects on the preassessed level of the tax.

Environmental taxes should of course be levied the activities which are closest related to the environmental problem. For example, taxes on fuels to reduce the emissions of greenhouse gases should correspond to the amount of CO_2 emitted. This implies that a PJ of gas would be taxed differently from a PJ of coal.

For pollutants, emissions are usually dependent on other factors than the physical quantity of fuel consumed. Emissions of suspended particles depend e.g. on the technology in use and have mainly local effects. Ideally, therefore, a tax on fuels to reduce the emissions of suspended particles should be differentiated across technologies in use and across regions. This lead to practical difficulties which often make systems of emission charges inappropriate.

Some activities may have positive externalities. Then subsidies are appropriate. Afforestation provides an example. Forests serve as a sink for CO_2, and afforestation may thereby counterbalance an increase in emissions. Subsidies should not be used in general to encourage a substitution towards less polluting goods and services. In such cases, the more polluting goods and services should be charged appropriately for their negative external effect. In some cases, however, new knowledge may indicate that action has to be taken rapidly in order to avoid irreversible environmental damage. This may imply that the economic burden on those who will have to pay will cause temporary economic difficulties. Subsidies may be defended in such cases.

Financial incentives

The difficulties in achieving a proper differentiation of emissions charges may favour financial instruments to charges and subsidies. Charging emissions from fossil fuels from transport, for instance, may for some pollutants require geographical differentiation. However, the transporters choose where to buy their fuel, and may drive to regions where the fuel charge is low, and thereby cause an inefficient control of emissions. Financial instruments, such as location incentives, "green" funds etc., may be preferred in such cases. Financial instruments may be used for instance to restrict pollution in heavily polluted areas or be given as a positive incentive according to the same principles as for charges and subsidies.

Creation of markets

The effect of emission charges may be very uncertain. In some cases, the uncertainty may be unacceptable to central authorities, for instance when the cost of re-establishing the environment is very high and the effect of the charge is far less than expected. In that case, it is essential that the environmental target is achieved, and less important what the emissions charge actually turns out to be. As pointed out by Weitzman (1974), it is then more efficient to control the quantity directly than indirectly through charges. Control of the quantity may be done successfully by the creation of environmental markets, that is to make emission rights subject to trade. The central authorities assess a limit on total emissions, distribute emissions allowances between individuals and allow for trading the rights at market prices.

The main problem with marketable permits is to allocate the initial emission rights. In principle this question relates to the income distribution which ideally can be separated from efficiency requirements. In practice, however, it is not easy to separate the two. For example, in most cases it would be unfair to fix the allocation of emission rights for future periods, but perhaps equally difficult to assess guidelines for the future reallocation of rights.

Pawn and refund systems

Pawn and refund systems for environmental damage are economic measures that most often are used in the management of waste problems. However, also in the control of emissions, such measures may be relevant e.g. for controlling the emissions of methane.

Fines

Fines are defined in the context of a given norm system. Polluters above the norm pay fines, 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.

Possible economic means to influence environmental policy in Hungary

As pointed out earlier, economic instruments are not likely to be efficient in Hungary in the short run. However, economic instruments may gradually be introduced as the market economy extends. Some measures may also be realistic alternatives quite soon. In this context, an important aspect of the Hungarian energy and environmental policy is that the Hungarian government plans to raise the prices of energy by at least 30 percent on average in the near future. The effect of such a price rise is very uncertain. Both the price flexibilities and the income flexibilities need to be studied. In the case of a stable economy the demand side will respond with a restructuring of its energy consumption. It will prefer energy saving appliances and substitute towards products with lower energy content. In Hungary, however, energy pricing policy is controversial, especially in the household sector. An increase in the price of energy may lead to collective actions, e.g. refusals of paying the energy bill.

This is why an energy pricing policy in Hungary must be cautious. Furthermore, the environmental effect of it is not its main target. For environmental improvements, tax concession of environmental friendly products may be used as a supplement. Other means, e.g. preferential credits may promote consumption of environmental friendly goods. In addition, environmental awareness and environmental lobbies may together with economic incentives have an influence. Furthermore, tax concessions may add to a company's incentive to save energy if energy saving is important for its image.

In a longer perspective, emission charges may be applied successfully to decrease emissions of for example SO_2, provided that the taxes are differentiated according to the sulphur content of the product (Pigou taxes). This means that coal and heavy oils will be charged for higher amounts than light destillates and gas. This would create incentives to switch towards fuels will lower emissions of SO_2.

Tax differentiation may also be used favourably to reduce lead content in fuels. In Westernt Europe, emission of lead is significantly reduced as a result of technology standards and price differentiation. An alternative is to enforce the use of catalytic converters to reduce emissions of NO_x, as this technology excludes the use of leaded fuel.

As shown in Chapter 3, SO_2 emissions within the energy sector have been reduced in recent years. There are several ways of reducing SO_2. New technologies may reduce the demand for energy within the sector, and switching energy type may reduce the emissions from a given production level. Both emission charges and emission standards, for instance by marketable permits, may be efficient. As noted above, the choice depends on the cost of the environmental damage and the uncertainties involved.

It is more difficult to reduce the emissions of CO_2. Fuel-switching from coal to oil or gas may contribute, and even a switch between different types of coal may affect the emissions of CO_2. Nuclear power provides a solution to the problem of emissions of greenhouse gases, but is highly controversial in other respects. By comparing evironmental problems from fossil fuels with the problems related to the generation of nuclear power one is faced with quite different, but in both cases serious problems. The choice is clearly not only a question of information and knowledge, but involves in addition a number difficult ethical questions (see e.g. Schrader-Frechette, 1991).

In the longer term enhanced use of renewable energy sources may be promising with respect to environmental effects. There are, however, disputes about their importance in the future (WEC Commission, 1993)). The most optimistic scenario estimates that renewable energy sources will constitute 8-10 per cent in the total energy production by 2000. Expectations of increasing energy prices in the future and economic incentives may encourage their development.

Finally, it must be realized that the micro structure in the former socialist countries, including Hungary, is more energy intensive than the OECD average. That is, it takes more energy to produce one unit of the same product in Hungary than the average in OECD. However, structural differences may make the existing macro structures more energy saving and in this way environmental friendly. One example is the transport system. This works with outdated vehicles with high energy demand. On the other hand, the public transport in Hungary contributes to a much higher share of the total of transport services. The energy efficiency of the transport system as a whole is therefore not lower than the OECD average. For environmental reasons it would be advantageous for Hungary to retain its present transport structure. This may require subsidies in a transitional period in order to avoid a close-down of the system which would require considerable costs in the long term.

As subsidies from the overburdened central budget probably are infeasible, one might instead introduce a tariff system which prevents private transport from becoming more economical than collective transport. Additional obstacles for such a policy are clearly present. A sufficient analysis of transport policy options is beyond the scope of this report. However, the importance of reducing the environmental burden from the transport system has recently been emphasised in a British report from the Royal Commission on Environmental Pollution (see Hamer, 1994).

6.3.2 Direct measures

As emphasised earlier, "environmental policy making" in general requires an integrated approach to the choice of measures. By combating greenhouse gas emissions, for instance, several other environmental problems will be affected, such as acid rain and health effects due to changes in the concentrations of particles and NO_x. To estimate the positive effects of climate measures, one has to include these "secondary" effects as well, see Chapters 1 and 4. To assess these effects requires a comprehensive analysis. How much a given reduction in the emissions of greenhouse gases will contribute to reduce other environmental problems, may depend on how and where the reductions take place, on the initial air quality, and the combination of different pollutants etc. In other words, the total benefits from reducing one unit of greenhouse gas emissions may vary considerably according to other environmental effects than those related to climate.

The secondary benefits will often depend upon factors without observable market prices. Therefore, the choice of cost-effective measures becomes more complex than to impose economic measures and leave the valuation of these measures to the decentralized market. Rather than applying economic instruments with a social cost related to the reallocation of resources, it may be more beneficial to initate direct investments, or to impose direct restrictions on emissions in given utilities (see also section 6.2.2). To make evaluations of these effects, however, an integrated approach is required, including a social cost-benefit analysis where the values of the environmental effects are approximated.

In order to attain cost efficiency, direct measures should be implemented according to the traditional decision rule: Impose measures to assure that decision makers on the decentralized level face the real social cost of their actions, based on the net social benefits. The only difference compared to the decision rule for ordinary investments is that net social benefits include a valuation of environmental effects. To attach values to these effects is, however, difficult and there is no consensus about a proper method to apply. Cropper and Oates (1992) provide a survey over the most frequently used methods which range from assessment of implicit market values of environmental qualities of traded goods to direct interviews about peoples willingness to pay (see also Navrud (1994) and Wenstøp (1994)).

A second methodological problem related to the assessment of the value of environmental effects of measures is whether the evaluation should be approached from an overall national point of view ("top-down") or from a micro-oriented point of view ("bottom-up"). The top-down approach accounts in principle for indirect economic effects including changes in relative prices and estimates the effects of structural changes following from policy measures. However, it seldom manages to differentiate between specific technologies which may be important for e.g. the energy intensity, or to make proper estimates of effects of e.g. energy saving. Furthermore, environmental effects which need to be described by an integrated approach may be difficult to incorporate in macro-economic top-down models. In such cases, the bottom-up approach may be the only realistic alternative.

There is a controversy, mainly between engineers and economists, whether the "bottom-up" or "top-down" approach provides the most appropriate basis for environmental policy making. It may be noted that the discussion partly rests on a misunderstanding: To evaluate economic measures, a top-down approach applies in order to see the effects of reallocations in response to the change in relative prices. To evaluate direct measures (which may be analysed as investment projects), one can hardly avoid the bottom-up approach. However, it is possible to make rough approximations of the economic effects of reallocations and values of environmental changes from an integrated top-down model and apply these values in a bottom-up assessment. In that case, the two approches are not competing, but complementary.

Figure 6.2 displays a schematic view over environmental policy instruments (dashed lines) and their relations to economic activities (solid lines). Regulations may be imposed prior to an activity to prevent negative externalities. This applies to environmental regulations, such as product standards and information to households. It may also aim at an efficient use of natural and environmental resources, by for instance requiring charges for access. In this context, charges cover *inter alia* royalty and the value of marketable permits. Charges may also be applied to regulate the supply and demand for activities with externalities ("internalizing the externalities"). Finally, environmental policy instruments may be used to control emissions/waste directly, for instance by standards and quotas or by the creation of pawn systems in order to encourage recycling.

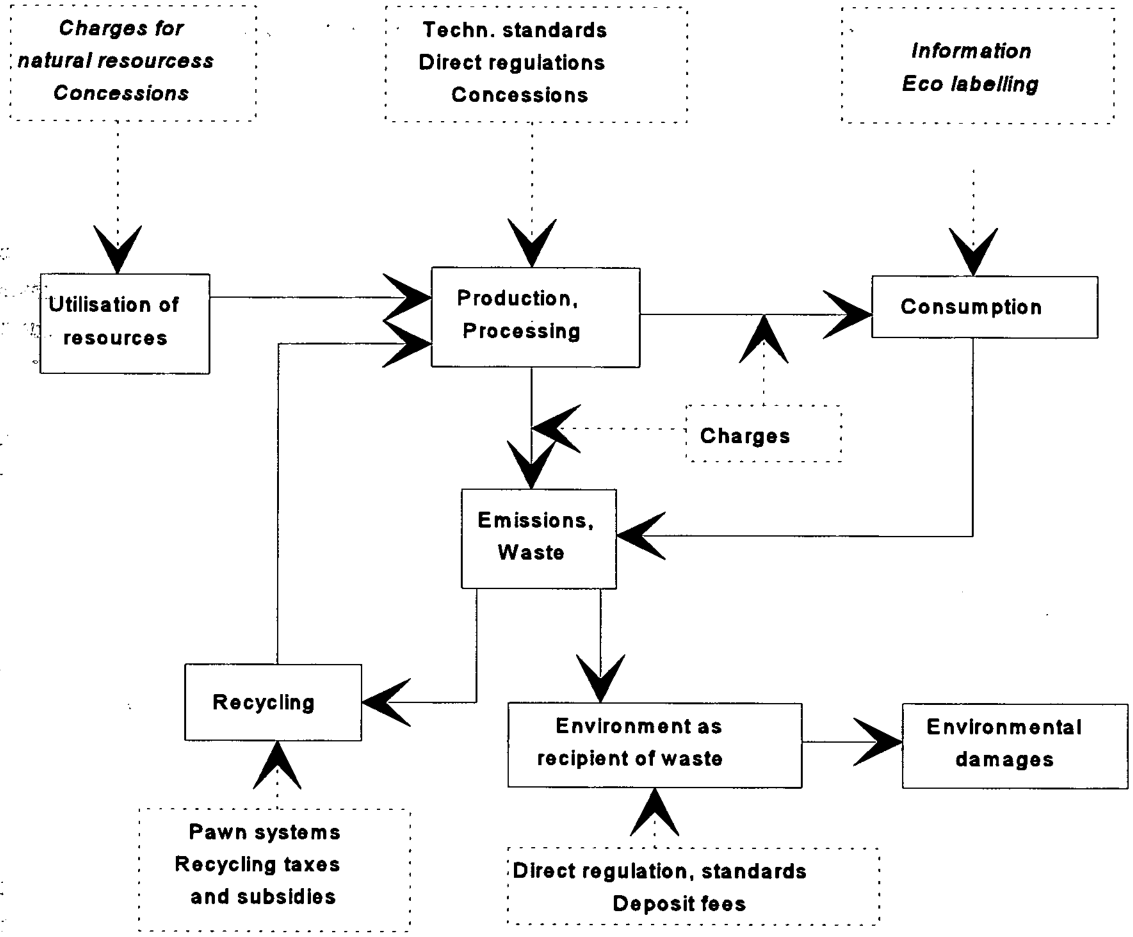

Figure 6.2 Relations between environmental policy instruments and the economy

6.3.3 Sectoral integration of environmental policy in the EU and selected Western European coutries

It has become widely recognised in Western European countries that an effective environmental policy needs to be fully integrated with other sectoral policies within the state apparatus in a horizontal manner in order to be most effective. This work, which is difficult, is in its beginning in both the European Union and in various Western European countries. Below we refer to the most relevant of these experiences as a basis for exploring a similar policy development in Hungary.

The drawbacks of the lack of such integration is evident. Environmental policy tends to become viewed as oppositional to e.g. economic policy when it is not integrated with it. This is mentioned as a problem in Hungary, where this opposition is especially clear. Environmental policy tends to be seen as detrimental to economic growth. The Regional Environmental Center for Central and Eastern Europe report concludes for example that "as decision-makers see the environment as an externality to the economy, there is not much incentive for the integration of environmental costs and benefits in the governmental decision-making." (REC report, 1994).

Sectoral integration was first advanced in the Brundtland report (World Commission on Environment and Development, 1987), and has been a policy goal in the EU since 1983. However, perhaps the most advanced country in this regard is the Netherlands.

In Norway the government adopted sectoral integration in 1988 (Storting report no. 46, 1988-89). The experience so far is that one needs even further integration so that the Ministry of Environment ceases to be seen as a watch-dog and such that all sectors assume real responsibility for the environmental consequences of their activity.

In the 80s, this work was started by identifying environmental goals and strategies for the various sector policies after having studied the environmental impact of the same sectors. However, there was a tendency for the sectors to interpret their role as defenders of the same sectors against environmental policies. It therefore became increasingly more important for the sectors to assume full responsibility for reaching the environmental goals of their policies.

This first phase of sector integration, already implemented in Norway, resulted in the development of environmental goals and political strategies for each sector. The second phase will consist of making the sectors themselves responsible for carrying through these policies. The role of the Ministry of the Environment will then be to control whether this has happened, having a kind of overseer function.

A central stimulus for this work lies in the importance of international agreements and conventions. Much of the driving force for the development of sectoral integration stems from the need to comply with international obligations, conclude Norwegian policy-makers. This is a general phenomenon, and since an international - level obligation demands a common national response, it presupposes some degree of coordination and integration of sectoral policies. This will certainly be the case with the development of climate policy, which by its very nature is cross-sectoral, involving first and foremost energy policy, but also industrial policy, transport policy, financial policy and agricultural policy.

In Norway the experience of sectoral integration varies from policy field to policy field. It has been easiest to integrate with the energy sector, and most difficult with the transport sector. One has implemented a CO_2-tax for energy use and there are legal requirements for Environmental Impact Assessments for all new oil and gas field developments in the North Sea. In general one has managed to make the energy sector responsive to the need for environmental policy.

There are similar developments and experiences in the other Nordic countries. Also in the regional cooperation between them, the Nordic Council, a common strategy for sectoral integration is being developed and will be presented by March, 1995.

In the EU one has not come very far in the area of sectoral integration, but the 5th Environmental Action Programme, discussed in Chapter 5, focusses on such integration as the major way ahead. The stress on the need for integration is especially pronounced in the Maastricht-treaty, which obliges the Commission to publish its rules for such integration and to press on with this work. There are five sectors that are singled out as being in particular need of such integration: Energy, transport, agriculture, tourism, and industry. In EU climate policy, one has e.g. attempted to agree to a CO_2-energy tax, however, so far without success. This proposal is the result of such integration.

It must be underlined that the work on sectoral integration of environmental policy is in its beginning in most countries, but that this step is found to be of the utmost importance as a better way of achieving policy with in-built environmental criteria.

Perhaps the most remarkable development in this regard so far has taken place in the Netherlands. Here one has developed two national plans, National Environmental Policy Plan (NEEP I) for the period 1989-93 and NEPP II for 1994-1998. These specify environmental strategies for the various sectors in great detail and assign responsibilities to the various decision-makers for reaching those goals. In this way they try to develop an incentive structure for implementing the policies. The final goal is to reach what is defined as a condition of sustainable development for all of society by the year 2010. One has managed to quantify the targets to be reached to a great extent.

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