Economic Transformation and the Environment

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Abstrakt:

Příspěvek analyzuje dopady ekonomické reformy na kvalitativní parametry životního prostředí České republiky. Po charakteristice stavu životního prostředí v předtransformačním období a rozboru hlavních příčin a faktorů jeho degradace, je podán krátký přehled změn ekologické legislativy, ke kterým došlo po roce 1991.

Vzhledem k odlišným problémum v ochraně jednotlivých složek životního prostředí jsou v příspěvku relativně autonomně analyzovány problémy znečištění vod a problémy znečištění ovzduší. V obou případech klade analýza důraz na dopady snížení průmyslové výroby v prvních letech ekonomické transformace na kvalitu těchto složek, na investice do jejich ochrany a na úlohu ekonomických nástrojů v jejich financování v období redukce dotací ze státního rozpočtu.

Mimo to je v analýze vodního hospodářství diskutována otázka průběhu a specifik privatizace a hodnoceny dopady liberalizace uživatelských poplatků na spotřebu pitné vody.

Analýza znečištění ovzduší se soustřeďuje na změny ve struktuře primárních energetických zdrojů a na nezbytné podmínky pro efektivní realizaci strategie energetických úspor.

Vybrané souvislosti v obou částech analýzy jsou kvantifikovány pomocí jednoduchého ekonometrického modelu.

Analýza ústí do závěrů, orientovaných na ekologickou politiku.

Abstract:

This paper analyzes the impact of economic reform on the qualitative parameters of the Czech environment. After delineating the pre-transformation enviromental situation and identifying the main causes and factors of its degradation, an overview of legal changes in the environmental protection laws enacted since 1991 is carried out.

There is a relatively autonomous analysis of water quality management and air pollution development viewed as individual aspects of the enviromental issue. The focus is on the consequences of the decline in industrial production during the initial years of transformation on air and water quality, on investment in their protection and on the role of economic instruments in their financing during this period of reduced budgetary subsidies.

In addition to water management, this analysis discusses the record of privatization in this regard and evaluates the impact of user charges liberalization on drinking water consumption.

The air pollution analysis is focused on the changes in the primary energy resources structure and on the necessary conditions for effective implementation of an energy conservation strategy.

The chosen connections in both parts of this analysis are quantified using the simple econometric model.

Policy oriented conclusions follow as a result of this analysis.

CONTENTS

1.INTRODUCTION

The economic transformation in the Czech Republic, particularly its forms on rapid development of entrepreneurial activity and property rights enforcement, has frequently been interpreted as environmentally unfriendly, especially by radical, non-government environmental organizations.

This paper used available data to analyze the impact of the economic reform on principle environmental variables. We will begin our analysis with an overview of the enviromental situation prior to the economic transformation, identifying the main causes and factors involved in its degradation. The following analysis of the transformation begins with an overview of the legal changes in environmental protection since 1991, which forms the legal basis for environmental protection in market conditions.

With respect to protecting the various environmental components, we have provided herein a relatively autonomous analysis of two of the most important of them: water quality management and air pollution development. Particular attention is paid to the consequences of the decline in industrial production on air and water quality during the initial transformation period, and to investment in and financing of protecting them despite decreasing subsidies from the State Budget.

In addition to water management in general, specific aspects of this issue are discussed with respect to the transfer of property rights and the course of the privatization of public drinking water delivery and sewege systems are analyzed in details. The impact of price liberalization stemming from deregulation is assessed and is followed by a breakdown differentiation of water rates and sewage charges in separate regions.This new arrangement is connected with the remarkable decline in drinking water consumption. The price elasticity of water consumption is expressed in short, simple econometric models.

The air pollution analysis focuses on the on-going changes in the structure of the primary energy resources that represent a long-term stable contribution towards environmental quality. Energy savings represent both a significant factor in environmental burden and a decrease in air pollution.Therefore, the necessary conditions for the effective realization of an energy conservation strategy in the Czech Republic are analyzed and the initial contributions of the saving program for the environment - supported for the first time by the state -are evaluated. The relationship between air pollution development and the chosen economic figures are quantified through simple econometric models.

The analysis mentioned above leads to policy oriented conclusions.

2.THE ENVIRONMENT IN THE PRE-TRANSFORMATION PERIOD

2.1 The State of the Environment

The degradation of the quality of the Czech environment represents a long term barrier to social as well as economic development. More time will probably be required to overcome the environmental devastation than it will take to transform centrally-planned economy into a market economy.

From the early 1950's until the early 1980's, environmental pollution and environmental damage in the CR was continuously increasing. Despite a decrease in pollutant discharge already during the pre-transformation period, the present state of contamination of air, water, and soil is still extensive. Our forests, the genetic potential of plants and animals and the ecological stability of the landscape are threatened.

Social and economic damage and losses, due to environmental pollution and devastation are readily visible in the deterioration of human health, as evidenced by our high mortality rate and our shorter average life expectancy than in developed countries.[1] Economically expressible damage and losses, are not limited to deterioration of human health, but also include our forests, the productive use of forests and agricultural land and their new productive ecological) function, our historical and cultural architectural monuments, increased corrosion of machines and buildings,etc. In total they have been estimated at aproximately 5-7% of Czech GDP in 1990.[2]

The highest level of **air pollution** in the CR was recorded between 1982-1983, following the completion of thermal power stations burning domestic brown coal of the worst quality (with a high content of sulphur and ash), and without flue gas desulphurization technology. A decrease in the total volume of air emissions began in 1984-1985. This was the result of various measures which were implemented in order to fulfill an international commitment to decrease sulphur dioxide emissions by 30% from 1980 to 1993-1995.

By volume sulphur dioxide, nitrogen oxides and particulates (solid emissions) constitute the majority of air polluting emissions.[3] They are harmful

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[1] The average life expectancy of both sexes varies in the long run about 70,4 years in the CR. It comes close to the limit of 70 years set by the U.N. to distinguish between the developing and developed countries. Source: The Environment in Czechoslovakia,Federal Committee for the Environment, Prague 1990.

[2] Source: The environment in Czechoslovakia (1990).

[3] Fly dust emissions contain a series of harmful substances, e.g.asbestos,lead compounds,mercury,cadmium,arsenic,as well as radioactive elements.Air pollution also

pollutants for both ecosystems and human health. Air pollution has led to an increase in the destruction of forests in the CR with some estimates suggesting that as much as one-third of forests may have already been lost or irreversibly damaged.

The environment is one of the external factors which influence health to a decisive degree. A direct affect can be seen on developed structures and the functions of organisms or in an influence on the genetic apparatus.

In the CR, the influence of solid emission air pollution on respiratory ilnesses has been proven particularly in children.[4] A correlation between fly ash concentration (imission level) and the mortality of new-born children due to respiration diseases has been proven. Sulphur dioxide increases the death rate of children by 1 per cent for every 0,7 micrograms per cubic metre present in the air.[5] Cases of retarded skeleton maturation (by 5-8 months), lowered activity of some blood enzymes and the lowered levels of different classes of immunoglobulin are remarkable in polluted areas. The influence of air pollution on the environment and immunity are the best documented of a wide and complex range of relationships. Solid emissions are an important factor causing respiratory system allergies. At present 30% of children have some kind of allergy in the CR.[6] New studies have ascertained the influence of sulphur dioxide emissions as well as other harmful and toxic substances in the atmosphere on the increased rate of miscarriages (spontaneous abortions),on genetic structure, congenital anomalies, premature babies,etc.[7]

There is growing concern regarding the risks of global climate change, caused by the increased emissions and atmospheric concentrations of greenhouse gases,particularly carbon dioxide. Although there is still a considerable degree of uncertainty regarding the resulting increases in global mean temperatures, scientists fear the occurence of economic, environmental and geophysical effects of the forecasted increase in temperatures, which include rising sea levels,increased intensity of storms,extinction of certain plants and animal

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includes electromagnetic waves,noise,vibration and heat pollution.

[4] The influence of the environment on children is not complicated by as many influences as it is in the case of the adult population, and the results are indisputable.

[5] Kriz,J.: Vesmir, No.12, 1989.

[6] Zakoutska,A.: Allergy and the Environment.(Qualification Work),Prague 1989.

[7] Studies of Program "Teplice". Investigators:Regional Hygienical Station Teplice in cooperation with the Czech research institutions and abroad institutions,including USA EPA.Sources:Report on the Environment in the CR, Yearbook 1992; The State Environmental Policy of the CR,Ministry of the Environment,Prague,December 1993.

species and disrupted agriculture.[8] The CR, with the amount of carbon dioxide emission per capita at about 3,6 t (in carbon;see Table 1), contributes approximately 1% to the total volume of global carbon dioxide emissions.This represents a relatively significant contribution to the greenhouse effect.

Organic compound air pollutants, including carbon dioxide and toxic carbon monoxide, along with nitrogen oxides constitute the most important precursors for the formation of photooxidantes (especially ozone) and are thus primarily responsible for city "summersmog".[9] Ozone along with fly dust and sulphur dioxide, in greater concentrations, also have a damaging effect on the photosynthetic and transpiration processes of plants.

Specific air pollution emissions (per capita) in the CR,especially sulphur dioxide emission, are very high compared to developed countries in the early 1990's (see Table 1). Only carbon monoxide emissions per capita are lower. This is partially due to the lower number of vehicles. Motorized transportion plays an important role in carbon monoxide air pollution. For example,while in the Federal Republic of Germany, traffic and heavy duty vehicles accounted for a share of the total emissions of 76% of carbon monoxide in 1987[10],in the CR that figure was about 23% in 1990,according to the Air Pollution Sources Register. It is also specified that the present official data on nitrogen oxides emissions, as well as of carbon monoxide from car traffic is underestimated.[11]

Sulphur dioxide emission per square km amounted to about 26 tons in 1988, 24 in 1990. This was the second worst showing after the former East Germany's with 46,1 tons (Great Britain reached 15,6 t, Hungary 15,3 t, Poland 13,8 t, the former West Germany 7,7 t, Austria 1,7 t in 1988)[12].

In the Northern Bohemian District territory and in Prague, the territorial sulphur dioxide emission's rates exceed 100 tons per square km annually.[13]

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[8] The Climate Challenge.European Economy, No.51, May 1992.

[9] Angrick,M.: Reduction of Organic Substances.Federal Environmental Agency.Federal Republic of Germany. A selection of recent publications, Vol.3, Berlin 1992.

[10] Gorissen,N.: Measures for a More Environmentally Friendly Freight Traffic. Federal Environmental Agency (1992).

[11] Environment of the Czech Republic. Ministry of the Environment of the CR,Academia,1990.

[12] According to European Monitoring Air Pollution, 1990.

[13] The Environment in Czechoslovakia (1990). Statistical Yearbook of the CR 1993.Czech Statistical Office Prague,1993.

Table 1

Air Pollution Emissions (per capita)

Country	Sulphur Dioxide kg	Nitrogen Oxides kg	Particu-lates kg	Carbon Monoxide kg	Carbon Dioxide t /1/
CR	162,1	62,1	55,3	97,1	3,62
Hungary	100,8	69,8	.	.	1,49
former East Germany	308,0	91,8	.	.	5,05
Poland	90,0	64,5	.	.	2,60
former West Germany	14,9	41,2	7,1	129,3	2,94
France	24,0	31,8	5,0	97,7	1,74
Italy	34,6	34,7	8,7	114,6	1,82
United Kingdom	62,1	47,9	8,7	117,4	2,65
USA	84,3	78,3	29,8	238,9	5,26

Notes:Figures for the latest available year./1/In tons of net weights of carbon.
Sources: OECD in Figures.Statistics on the Member Countries.Supplement to the OECD Observer.No.182,June-July 1993;Statistical yearbook,UN 1990/91 (Issue Thirty-eight); Air Pollution Sources Register,Prague 1992;Report on the Environment in the CR.Ministry of the Environment, May 1993;Statistical Yearbook of the CR 1993.

The continual underestimation of **water** as an important component of the environment and a constituent of food, resulted in a preference for the quantitative aspects of water management in the past.Despite the fact that water quality has been regularly tested since the 1960's in a field network of control profiles, and periodically evaluated the CR is currently facing serious surface and ground water pollution that has already made some bodies of water entirely unusable for economic use.

It is generally known that nearly 60% of Czech waterways are heavily polluted and more than 23% of the major river lengths have been classified in the worst IV.pollution category, i.e. incapable of sustaining fish (see Table 2).

The rule for bidding the establishement of new housing complexes and industrial plants without adequate provisions for the disposal of waste water has

been violated quite regularly. More than 5,000 sources of surface water pollution have been registered (see Table 2), their waste water output is only partially compensated for by the construction of the waste water treatment plants. There are a significant number of cities and industrial enterprises that discharge their untreated or insufficiently treated effluent directly into waterways. The worst situation is in the Labe basin. For example 31.3% of Czech inhabitants in cities of over 50,000 inhabitants on the Labe live without any waste water treatment (compared to 6.5% in Germany).[14] Only approximately 40% of currently operating waste water treatment plants achieve satisfactory effectiveness.

In addition to uncontrolled industrial and municipal discharge, water pollution has resulted from the large-scale application of fertilizers and other agrochemicals, as well as from small dispersed sources. This so called "planar pollution" makes up a 50% of total surface water contamination.Their influence has increased by about 25% during the last 10-15 years. These factors are the main cause of ground water contamination as well. The average nitrate content in ground water has increased 2 to 4 times over the past 30 years. Ground water contamination, due in large part to oil based substances, is the legacy of Soviet troop presence. Another of the important causes of surface and underground water pollution are numerous accidents (more than 500 per year) which are mostly connected to the oil products.

The Czech economy produced large amounts of **waste** . According to a study of Federal Statistical Office the total of 626,7 million tons of waste of varying unhygienic and noxious levels were produced in 1987 (of which the surface mining wastes were 81% and hazardous wastes 2.3%). The quantity of municipal waste reached 287 kg per capita (it is 73% of the European OECD average). Waste management was virtually nonexistent in the past. There were a lot of uncontrolled dumps that meant danger for proximate settlements.

[14] See "Project Labe", The Environment of the Czech Republic, Yearbook 1992, p.167.

Table 2

Waterways Pollution in the Czech Republic
(in the water way administration)

The waterways basins in total	1985	1986	1987	1988	1989
The number of registered sources	4958	4969	5005	5101	5092
Length of the waterways	17523	17810	17796	17810	17676
The length of polluted waterways in III. and IV.class of water quality:					
- in km	4316	4301	4289	4323	3962
- in %	24,6	24,1	24,1	24,3	22,4
The quantity of the discharged wastewater into waterways - mil cubic m	2039	2160	2264	2222	2106
The amount of water pollution charges - mil CSK	668	709	713	689	1595
Pollution Produced in thousands of tons					
BOD5	391	388	443	448	424
ID	1224	1167	1200	1116	1009
CHOD	660	661	768	775	739
The discharged pollution					
BOD_5	162	157	175	176	165
ID	206	190	199	215	186
CHOD	325	322	365	380	354

BOD_5 - biochemical consumption of oxygen, necessary for the natural decomposition of the pollution
ID - insoluble substances
CHOD - chemical consumption of oxygen for the oxidation of chemical substances in water

Sources: The Water Management Plan of the CR,publication No 39, Research Institute of Water Management, Prague 1992,p.51 and Sbornik SVP CR 1990,publication SVP No 38,Prague 1991.

Remark: The difference between indicator "produced" and "discharged" water pollution is due to the effect of waste water treatment plants.

End-of-pipe treatment, the manufacturing industry and households generate so much solid waste that our disposal and incineration capacity has become insufficient. The problem is compounded by the giant garbage incinerators that produce their own set of significant environmental hazards. On the other hand, there is great potential for reducing the production of toxic waste in the Czech Republic through improved environmental facility control. (43,8 mill.t of waste were reused in 1987).

Land productivity is being impaired by water and wind erosion (56.6% of total area of arable soil was endangered by erosion in 1985), undesirable soil compaction (from heavy agricultural mechanization) and by waterlogging (from improper agricultural practices). Physical, chemical, biological and agronomical soil degradation has been the inevitable consequence of soil use based on reckless large-scale exploitation.

2.2 The Main Causes and Factors of Environmental Degradation

The critical state of the environment in the CR at the beginning of the 1990's is a consequence of the centrally planned economy, the pattern of economic growth, economic structure, and long-term disregard for the environment care.

Centrally Planned Management is characterized by state ownership of assets which made it unable to internalize the environmental externalities into individual polluter's costs The main reason for this was that the State created the environmental legislation and was responsible for its compliance, checking and enforcement, while, at the same time, the State also represented, through state enterprises, the main polluters. The State was also the main source of financing for environmental protection through the state budget. System is seen in the large number of "exceptional permission" exclusions for enterprises and municipalities that were unable to meet the environmental measures.

Another feature of Centrally Planned Management is an administered pricing policy which placed no value on scarce natural resources and was

accompanied by a soft budget policy in respect to enterprises. Unrealistic pricing combined with production quotas rise to an unrealistic allocation of resources and to wasteful production processes. Additionally public participation was actively discouraged and state environmental data was often kept secret. The responsibility for environmental protection was divided among ministries according to their economic interests which were often indifferent to environmental concerns.

Economic growth in the centrally planned Czech economy was predominantly based on the dissemination of energy and material inputs.[15] Extensive economic growth together with environmentally unfriendly technology and a high share of heavy industry has given rise to excessive generation of solid, gas,liquid, and energy waste.

The chief culprits for the **air pollution** generated from stationary sources has been heat and power generation facilities, and the production of iron and other metals. Other culprits have been engineering, the chemical industries, and the construction-materials industry. Local heating installations also warrant attention due to their local environmental impacts. Among mobile sources of air pollution, transportation has been the most important.

The energy industry accounted for greatest share of air pollution by solid, sulphur dioxide and nitrogen oxides emissions at the end of the 1980's. The total sulphur dioxide emissions of power plants (using brown coal) accounted for about 60%, central and local heating 12%, the metallurgy industry 7%, the chemical industry 10%, other industries 5%, and transportation 6%[16] (See Table 3).

[15] On average the consumption of raw materials and energy per unit GDP was twice as much in former Czechoslovakia as in comparable market economies at the end of the 1980's. The average yearly rate of resources productivity measured by GDP per resource unit went down while in OECD countries it has increased continually since 1979. See: Prokop,L.: Trend of development in economy of primary material resources in CSFR. Working Paper No. 237. The Economics Institute of the Czechoslovak Academy of Sciences. Prague 1990.

[16] See: National Report of the CSFR. United Nations Conference on Environment and Development, Brazil, June 1992.The Czechoslovak Academy of Sciences and the Federal Committee for the Environment. Prague, March 1992.

Table 3

Sources of Total Emission Pollution in Czechoslovakia in the 1980's

Emissions, % of the total

	solid	SO_2	NOx	CO	CxHy	other gases
Power industry	51	60	56			
Metallurgy Industry	12	7	5			
Chemical Industry	-	10	7	20	50	75
Construction Material Production	7	-	3			
Other industries	8	5	-			
Central and Local heating	11	12	7	40	17	
Transportation	11	6	22	40	33	25

Source: National Report of the CSFR.UN Conference on Environment and Development.Brazil,June 1992.

The high consumption of poor-quality domestic brown coal for energy (65% in 1990),[17] the combustion of coal using inadequate equipment lacking both devices for removing particles and desulphurization technology, and less efficient use of energy under the Czech centrally planned economy were the main factors in the extremely high level of air pollution emissions per unit GDP. There were in former CSFR three times higher level of energy consumption per unit of GDP in comparison with OECD countries and five times higher level of specific emission of sulphur dioxide per USD GDP than in Great Britain, four times higher than in USA and even 24 times higher than

[17] This share is approximately twice as much figure in comparison with developed countries. See: Vazac,V.: Czechoslovakia's Power-Engineering Economy at the Beginning of the 1990's.Energetics, No.5,1993.

in Sweden, France and the former West Germany at the end of the 1990's.[18]

The greatest **polluters of waterways** in the CR are the water management organizations, especially municipal ones. Their share, expressed by the indicator BOD_5 (biochemical consumption of oxygen necessary for the natural decomposition of pollution) accounted for between 60-70%, the chemical industry and agriculture are following closely. On the other hand, the chemical industry, including cellulose and paper production, bears the most responsibility for water pollution by insoluble substances (50-60%), dissolved substances (more than 70%), oil substances and other special pollutants.[19]

The **financial means** released for environmental protection has not been adequate for the scope and the seriousness of the environmental degradation in Czechoslovakia.It should be noted that for the last twenty years the volume of funds committed to environmental protection was, though not negligible, but still, insufficient.Expenditures of enterprises and of the State budget to environmental protection were limited particularly to the environmental investment focused on reduction of pollution by construction of end-of-pipe technologies and waste water treatment plants.

The share of **environmental investment** as a part of total investment in both the Czech and Slovak Republics has accounted for less than 2% over the period of the 1970-1988.

Despite the fact that the volume of investment in the environment in CSFR had been increasing, the total investment share trend had been declining until 1985 (see Table 4).

Table 4

Investment in the environment in Czechoslovakia

	1971-1975	1976-1980	1981-1985	1986-1990
Volume (bill. current CSK)	8.2	9.7	8.9	25.8
Share of the total inv. [%]	1.35	1.27	1.14	2.81

Sources:Černá,A.-Lamser,Z.-Tošovská,E.: What Does Environmental Protection Cost? Svoboda, Prague 1987; Palas,S.: Investment in Environmental Protection. Statistics (Economic-Statistical Journal), No.10, Prague 1992.

[18] See Vazac,V.: Analysis of the Development of Power Demand in the Creation of the GDP by Method of an International Comparison with OECD Countries. Journal of Energetics, No.3,1993;The Economic News, August 31,1993.

[19] According to figures from Yearbook of State water management inspection, Prague 1991.

Environmental investment between 1981-85 and 1986-90 increased by 188% (nearly three times) and only in this latter period did its share of total investment exceed 2%, for the first time.

However, neither this share nor the absolute volume of environment investment is sufficient due to the great extent of environmental damage and insufficient equipment to provide pollution control and prevention in the CR. The urgent need to reach a comparable level of environmental quality with the EU countries, as well as to fulfil international commitments, will create pressure to increase environmental investment and its share of total investment.

The increase in environmental investment share in the CR will not be a special phenomena. In the developed countries its average share of total investment amounted to about 4-8% during the long period of pollution control technology installation through the 1970's and the first half of the 1980's. The further development of environmental investment in the CR during the transition will predominantly depend on the creation of favourable conditions for the introduction of cleaner production methods. This is a technological and socio-economic concept corresponding to the modern phase of environmental protection. It is based on the pollution prevention principle, which is achieving not only environmental, but also economic effects.

The greatest share (60%) of total environmental investment over the period of 1970-1990 was placed in clean water protection projects. The share of investment in clean air protection accounted for only about 18%, in waste recycling, disposal projects and land reclamation projects about 20%. Only between 1986-1990 did the share of clean air protection investment increase. In 1990 it reached 28% (see Table 5).

Table 5

Structure of Environmental Investment in CR in 1986-1990.

	1986	1987	1988	1989	1990	1986-90
Total (bill. current CSK)	2.2	2.5	3.0	3.6	6.0	17.3
Water protection projects	54.6	53.8	61.5	63.0	54.0	57.2
Air protection projects	25.2	25.8	19.7	19.0	28.0	24.0
Waste recycling, disposal and land reclamation proj.	20.2	20.4	18.8	17.8	18.0	18.8
Total [%]	100.0	100.0	100.0	100.0	100.0	100.0

Source: Palas, S. (1992).

Clean air protection was underfunded over a long period in relation to the high level of air pollution in the CR. It seems that the volume and share it reached in 1990 is still to low with respect to an expansive target of air emissions reduction. We can expect that the further growth of the share of investment in clean air protection projects will be encouraged both by the fulfilment of international commitments and by the measures of the new Clean Air Act (see part 3.1 and 3.3 of this paper). Air pollution reduction is the key target in environmental quality improvement. Therefore, an increasing air protection investment share represents a positive trend in the environmental policy of the CR.

Under collective ownership in the Czech centrally planned economy both the selection of environmental protection projects, and their territory allocation, as well as their realization had a low-rate of effectiveness. The absence of efficient environmental policy, particularly the lack of economic incentives, as well as the lack of specialized construction and machine equipment and pollution control technologies also diminished the polluter's interest in respecting and enforcing the legal environmental protection measures.

3. THE ENVIRONMENTAL CONSEQUENCES OF ECONOMIC REFORM

3.1. The Legal Changes in Environmental Protection Since 1991

In the past, the legal basis of environmental protection was contained in a large number of legal regulations that did not present a comprehensive system. Frequently these regulations were more rigorous than those in Western European countries. However, in practice there was a large discrepancy between strong laws and highly ineffective implementation because many enterprises and municipalities were unable to meet these environmental measures and received "exceptional permission".

In the first years of the economic transformation it has been necessary to introduce a set of generally valid legal environmental regulations corresponding to legal regulations valid abroad, especially in the EU countries.

Firstly, we can mentioned "Act on the Environment" /Act No. 17/1992/ establishes the basic principles of environmental protection and the obligations of legal and natural persons in the process of protecting and improving the environment and in the utilization of natural resources. This act is based on the principle of sustainable development.

From a prevention point of view it is very relevant the Czech National Council "Act on Environmental Impact Assessment" /EIA/ that regulates the

EIA of planned constructions, activities, technologies, development concepts and programs as well as products. The Act determines the bodies of State Administration that are competent in EIA. /Act No. 244/1992 S.B./

The "Act on the State Environment Fund of the Czech Republic" /Act No.388/1991 S.B./ which is substantial for financing of environmental measures has established a state organization, which is administered by the Ministry of the Environment, and states the rules for the management of this fund.

The legal changes regarding the main environmental component has been carried out on a different scale.

In 1991 the first legal waste management regulation was approved in the Czech Republic. "The Waste Management Act" /Act No. 238/1991 S.B./ establishes the rights and obligations of state administrative bodies and the obligations of legal and natural persons in the handling of waste (including payment of charges and penalties). The wastes have been categorized and catalogued and the state administration of waste management has been established /Act No. 311/1991 S.B./

The new "Clean Air Act" /Act No. 309/1991 S.B./ that came into legal force on October 1991, decharges the rights and obligations of all legal and natural persons in the protection of external /outdoor/ air and the method of limiting the causes and mitigating the effects of pollution. This Act decharges pollution limits, the permissible level of air pollution and states the charges and penalties for polluting the air. It has been supplemented by a list of pollutants, the categorization of the sources of pollution and emission limits /vol. 84/1991 S.B. and vol. 84/1992 S.B./ on the basis of the corresponding EC regulations and recommendations by the World Health Organization. The State Administration of Air Protection and charges for air pollution were established in Act No. 389/1991 S.B. The decree establishing principles for the creation and operation of smog regulation systems was the last legal act in the air protection sphere.

Unlike air and waste, the fundamental arrangement in the water protection management sphere is still under preparation and only partial legal changes have been carried out. The network of state administration of water management has been clarified /Act No. 458/1992 S.B./, indices for admissible water pollution have been established according to the new methods /decree No.171/1992 S.B./ and payments in water management have been reformulated in harmony with price movement /Act No. 281/1992 S.B./.

3.2. Water Quality Management

This part of the paper will analyze how the changes in economic and management policy during the economic transformation are reflected in water quality management. Water quality is the socio-economic category that is both the final social and economic target. On one hand, water quality is a significant cause of human health problems in the Czech Republic (together with air and soil pollution). On the other hand, water quality is also currently a potential barrier to further economic development because the surface and ground water pollution has already made some water entirely unusable for the production of drinking water, irrigation and other economic uses.

3.2.1. Surface Water Quality Development

The relevancy of this parameter is stressed by the fact, that currently more than 60 % of drinking water is produced by the transformation of water from surface sources. Therefore the indices for an acceptable degree of water pollution, especially the indicators of amounts of substances in surface water are promulgated [20] both for water-works, water courses and for other surface waters. Nevertheless, these indices are overlooked at many stations, namely those downstream from the chemical industry on the river Labe and downstream from the coal mining and briquette plants on the river Odra.

Generally, the changes of surface water quality with regard to the variation of flows, the self-purifying capacity of streams, water temperature etc. can only be characterized over the long run. The evaluation of this parameter is based on State Standards /CSN 757221/ and the physical, chemical, biological and microbiological indicators are systematically monitored in the network of almost 300 designated stations.

In view of the fact that a disassociation of production quantity from pollution level did not occur in the Czech Republic /as it did in the Western developed countries during their structural environmentally friendly changes/, one could expect that the total industrial production decline in the first years of economic transformation [21] will result in a remarkable reduction of water pollution.However, the development of the surface water quality does not fully confirm this hypothesis. The produced pollution, expressed through the indicator BOD_5, on the contrary, has increased slightly /see Table 6/.

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[20]1/ See "Decree of the Government of the Czech Republic Establishing Indices for an Acceptable Degree of Water Pollution", No. 171/1992 S.B.

[21]1/ Industrial production declined from 1990 to 1991 by 24%, from 1991 to 1992 by 14%.

The decline of the other two main indicators is not too expressive and can be ascribed partly to measurements in production technology and partly to reduction of production, namely in the chemical industry.

Table 6

The Produced and Discharged Pollution
(in the waterway administration) in the Czech republic.

Produced pollution in thousands of tons	Year				
	1990	1991	1992	1993	93/90
BOD_5	319	388	395	373	106.2
ID	1010	975	975	971	96.1
CHOD	617	637	540	516	83.6
Discharged pollution in thousands of tons					
BOD_5	148	132	118	101	68.2
ID	160	165	142	123	76.8
CHOD	298	254	239	198	66.4

Source: Czech Statistical Office, report VHP5B01, former VH201

The positive tendency is reported only with regard to the discharge of pollution into surface water. This indicator declined in 1992, compared to 1989, on the average by about 32%. Because the difference between produced and discharged water pollution is affected by waste water treatment plants, it is necessary to ascribe this positive result to new plants introduced into operation in recent years /41 in 1992/.

Despite the fact that the discharged pollution decreased by about a third, the quality of surface water has not substantially improved due to the particularly dry period of 1990 to 1992. The climatic conditions have modified the expected results. Nevertheless, provided that the precipitation deficit will decrease in the coming years, the experts expect a long overdue positive effect of the discharged pollution decline on surface water quality.

3.2.2. Investment in Water Protection

The self-purifying capacity of Czech waterways is no longer enough to maintain acceptable quality levels - as we mentioned earlier - the investment in water protection and technological production measures play a decisive role in surface water quality improvement.

The restrictive macroeconomic policy in the first years of the economic transformation and the decline of GNP did not result in any decrease in environmental investment. Despite of the fact that the price of capital construction works increased by 50 %, and total investment has declined by 37 % from 1990 to 1991 and has grown slightly in 1992 compared to 1991 [22] , investors' interest in environmental investments has been fully maintained. The total environmental investment has increased up by 55 % in 1991 compared to 1990 and by 280 % in 1992 compared to 1990.[23]

Table 7 details the position of water protection investment.

Table 7

Investment in Clean Water Protection Projects

Indicator	1990	1991	1992	1993	index 1990=100
1.Total (bill. current CSK)	3.3	4.6	7.2	6.8[x]	206
of which:					
2.Projects 5mill. or more	1.7	4.5	6.4	6.0	353
3.Share of 1. in total inv. in the environment, in %	55.0	49.0	42.3	42.5	-
4.Share of 2. in total envir. projects 5mill.CSK or more	70.8	56.2	51.0	50.4	-

[x]) estimated figure

Sources:

Statistical Yearbook of the CR 1993, Environment of the Czech Republic, Yearbook 1992, Investment in the Environment, Report and Analysis 1993, Czech Statistical Office 1994.

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[22]1/ especially in firms fully or partly owned by foreign capital and in the private sector

[23] 2/ "The Environment of the Czech Republic, Yearbook 1992",MZP and CEU, Prague, p. 219.

The reported growth of water protection investment can be ascribed partly to the considerable extent of work under construction from previous years and partly to pressure from the more strict water protection laws.

The investment in water protection of over 5 mil.CSK are, for the most part, waste water treatment facilities /WWTF/. In 1992 41 WWTF in the Czech Republic were completed and 68 were under construction. It is possible to expect their impact on the improvement of surface water quality after 1995. While in 1989 the WWTF cleaned cca 45 % of the total amount of water pollution /expressed by the BOD_5 indicator/, in 1992 the cleaning effect of WWTF reached 69,4 %.[24]

As we can see from table 7, the water protection investment share of total environmental investment is the highest. The relative decline of this share since 1991 is related to the legal enforcement of the Waste Management Act /August 1991/ and the acceleration of investment in the waste management sphere.

With regard to the extremely high pollution of waterways in the Czech Republic, the acceleration of investment in water protection is a positive tendency namely in the municipal area. Nevertheless, the investment in water protection in industry has traditionally assumed the form of an "end-of-pipe technology" /i.e. waste water treatment facilities/. There is strong necessity to shift attention in the industrial sector from a focus on pollution control through technological measures to pro-active pollution prevention through an integrated approach to the entire production process. This approach demands a change of attitude from a sole emphasis upon technological measures to a broader perspective to one which also encompasses non-technological factors such as attitudal, motivational and ethical factors. The most developed conceptual approach is found for example in the Cleaner Production Concept. [25]

3.2.3. The Financing of Water Protection

We can distinguish two main tendencies in the financing of water protection in the first years of economic transformation. The first general tendency takes the direction of a decrease in direct subsidies from the state budget and a shift in the responsibility for financing the investment in water protection to economic subjects and municipalities and other sources outside the state budget.

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[24] 3/ See "The State Environmental Policy of the Czech Republic", the proposal of the Ministry of the Environment, Prague, December 1993, annex p.9.

[25] See "Time for Clean Production, Protection of the North Sea", Erasmus Centre for Environmental Studies, Erasmus Universiteit 1990, No.11, Rotterdam 1991.

For example, in 1993 the State budget only provides 1.9 bill. CSK for the completion of the specified registered water protection construction. This represents approximately 31 % of the total works invoiced on 294 water protection projects. The next state budget's contributions to water protection cannot be predicted. The share of direct investment of total invoiced work has been cca 27 %, credits 12 %.

The emphasis on water protection financing and other environmental measures through economic instrument revenues [26] represents the second tendency. Charges in water management include charges to cover the costs connected with the administration of water courses, charges for the discharge of waste water into surface or ground water /"water pollution charges"/, chargess for the withdrawal of ground water and other charges. User charges /water rates and sewage charges/ are determined in accordance with price regulation as we shall analyze later.

Water pollution charges are the most important issue from the water quality point of view. Their economic sense is to establish an economic balance between organizations treating their effluent and organizations discharging their untreated or insufficiently treated effluent directly into waterways. The basic charges is therefore fixed minimally on the basis of operational costs of waste water treatment facilities, or higher. The actual economic stimulus is an additional charge added to the basic charges in relation to the waterways quality deterioration due to waste water discharges.

The urgent problem facing water management authorities is to maintain the incentive function of water pollution charges and simultaneously to increase their revenue raising role. This means making charges correspond to the gradual increase in operational costs in waste water treatment facilities due to price fluctuations in the first years of the economic transformation. Therefore, according to an act of the Czech National Council /from May 1992/ the basic payment is to be multiplied by the coefficient 2.0. The results have shown that the increasing water pollution charge rates have not met with opposition from industrial polluters and they are acceptable with regards to inflation.

The decreasing volume of water pollution charges in the past three years of the economic transformation reflects the decline in discharged pollution and the associated decline of pollution that is the subject of those charges /1317,2 mil.CSK in 1990, 1119,1 mil.CSK in 1991 and 1026,7 mil.CSK in 1992/.

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[26] Generally the role of economic instruments in the Czech environmental policy is more significant than in other countries including EU Member States. The Czech Republic traditionally makes use of air and water pollution charges. Recently the new waste charges and set of environmental taxes - as part of the tax reform package - were added. The main problem of past arrangement was that charges rates were below abatement costs and in practice, when accompanied by soft budget policy, they had no impact on polluters behavior.

The revenue generated from water pollution charges /and charges for ground water withdrawal/ is earmarked for the State Environmental Fund of the Czech Republic or to municipal budgets. The total incomes of the State Environmental Fund in 1992 amounted to 2,4 bill.CSK /3,67 bill.CSK in 1993/ in which the revenues from water pollution charges amounted to 42,5 % /42 % in 1993/. See Table 8.

Table 8

The Charges' Share of the State Environmental Fund - 1992
(in mill. CZK, current prices)

	Water	Soil	Air	Waste	Total
The real income in which	1320.0	208.6	845.8	48.1	2422.5
the pollution charges	1026.7	208.6	782.8	48.1	2066.2

Source: the Environment of the Czech Republic, Yearbook 1992, p. 294

The Fund files the incomes and expenditures separately with respect to environmental components and follows the rule that 60 % of resources are directed back to the affected region.

The State Environmental Fund, that is a state organization administered by the Ministry of the Environment, begins to play an important role as a stable direct financing source for new environmental investment and non investment measurements independent of bank deposits and valid interest rates.

The Fund's contribution to the realization of water protection measures was 957,4 mill.CSK in 1992 and approximately 1,3 bill. CSK in 1993. The Fund's contribution to the total invoiced work for water protection construction in 1993 represented an approximately 22 % share.

Currently, the Fund is moving from subsidies as the predominant form of environmental financing to a more progressive form, particularly loans (bearing no interest or interest to 10 %.)

New environmental legislation makes possible indirect water management financing resources, provided that the polluter demonstrably began work on construction of a waste water treatment plant or other equipment of an investment character to decrease the pollution of waste water to at least the index of acceptable water pollution in discharged waters, then the payment of

60 % of the established sum is to be deferred. [27]

As previously discussed, the role of widely dispersed waste discharges is very significant in water pollution /for example the run-off of farm waste containing concentrations of fertiliser nitrates etc./. If the relationship between the input and the pollution output is fairly stable, input charges can be placed in many countries /for example on fertilisers containing nitrates etc./ The Czech environmental policy doesn't use any of these types of instruments for non-point source pollution regulation. Nonetheless, fertiliser consumption has declined in the past few years almost by 60 %. It is not yet possible to distinguish whether or not this trend toward fertiliser conservation will continue or it stems from a still unstable situation in the agriculture sphere (the privatization of cooperatives, land restitutions etc.).

3.2.4. The Course of Privatization in Water Management

The transformation of property rights in the water management sphere is a relatively complicated process with regard to its subject. Water courses and natural stocks of ground water are excluded from privatization and they are fully state owned. The liberalisation of property rights regarding water courses beds lands is under discussion.

Nevertheless waterworks may be the subject to privatization which are not connected with water courses, particularly water-supply systems and waterworks buildings including waste water treatment plants. Small water power plants, which are not necessary for the regulation of water courses, might be subject to privatization also. The rules for the property of network irrigation and the drainage of lands remain problems which can be tied to the property rights of many owners. This issue calls for a clear distribution of competencies between the Ministry of Agriculture and the Ministry of the Environment within the framework of the Water Act, currently under preparation.

Rising public attention has been devoted to the privatization of public drinking water piping and sewege systems /so called VAK enterprises/.With respect to VAK enterprises property we can distinguish the infrastructural assets /water and sewage pipes, water treatment facilities etc./ and the operational assets /administrative buildings, warehouses etc./.

Practically, the transformation of VAK's enterprises have been

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[27] See "The Act of the Czech National Council amending and extending Decree of the Government of the Czechoslovak Republic " No. 35/1979 S.B. /Act No.1992 S.B./. It occurs that a construction approbation decision made by the responsible construction office came into legal force prior to the termination of the permitted construction period, then the water course administrator is to communicate to the polluter the fact that he has fulfilled the conditions for deferral of payment and the deferred part need not be made.

promulgated in three ways:[28]

1. the operational assets remaining after the transfer of infrastructure on municipalities will be privatized by direct sales to limited companies or by the creation of operational joint-stock companies that will be privatized by the voucher method;
2. the transfer of almost all VAK's assets /cca 90 % of account values/ to the mixed joint-stock companies, where municipalities hold the majority share. The remaining 10 % of assets will be privatized by the voucher method in the second privatization wave;
3. the transfer of all of VAK's assets to municipalities or unions of municipalities. The municipalities are obliged to pay the operational assets account value of previous VAK enterprises.

We can see that in all the above mentioned cases the infrastructural assets were transferred to municipalities. The position of municipalities were thus, reinforced.

Since 1990, uncontrolled disintegration of VAK enterprises has occurred in the Czech Republic. This tendency is opposite those in the Western countries. Unlike the previous figure of 9 VAK enterprises, currently there are cca 27 mixed joint-stock companies, 25 operational companies (limited companies or joint-stock companies) and 2 individually held companies of owners. [29] The largest is "North Bohemia's Water Supply Companies" that unites 450 towns and villages in this region. Generally, it is to be expected that the larger companies will be more successful /both mixed and operational enterprises/ with long-term contracts with municipalities.

Initially, the public privatization of VAK enterprises took place in the NorthernMoravian region and in Brno. Many former state organizations in the water management sphere /for example Hydroproject, Water Resources etc./ were privatized in the first wave of privatization as well. However, a large part of the property of VAK enterprises will be privatized in the second wave.

The scale of changes in public water piping and sewege system enterprises management calls for the new legal arrangement of this sphere in harmony with another environmental legislation being prepared. Simultaneously, permission for the establishment of public water piping and sewege systems would be required, including the establishment of operational rules. This arrangement would ensure the professional operation of these systems (including a high level of effectiveness) and would create a guarantee that the health of the inhabitants will not be threatened.

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[28] See Act No. 619/1993 S.B.

[29] data from the Ministry of Agriculture of the Czech Republic, see: Ekonom, No. 4, 1994 /Adamkova, A.: "The liquid Certainty", p. 37 - 38/.

Privatization can result in water protection investment, made not only by industrial or other private polluters, but also by water protection service providers that perceive a market for their services that is sufficient to warrant their investment. In water protection such investment will be stimulated by the new water protection legislation (for example the water protection standard-setting etc.). The potential private environmental services investment in water management includes, for example, investment in water monitoring services in industrial water pre-treatment and waste water treatment.

3.2.5. The Impact of Price Liberalization on Water Management

Price liberalization, as a fundamental step in the Czech reform process, has a beneficial impact on water protection. Fully cost-based pricing (including the environmental costs) will eliminate the tendency to overuse water resources, reducing the degradation associated with such overuse and will represent the necessary condition for the beginning of structural water protection changes in the Czech economy. Water pollution and user charges may be, to some extent, considered as a "price" to be paid for pollution and for the costs of public treatment of effluent. "Water prices" must better reflect the long-run marginal costs for the full life-cycle of the water and services associated with it. This "price" enters into private cost-benefit calculations at least in some part.

We have already mentioned the increase of water pollution charges due to price movement in the first years of economic transformation. Now the focus will be on user charges (water rates and sewage charges).

In the pre-transformation period the water rates and sewage charges for industry and households were subsidised by the State budget. They were generally below the operating and maintenance costs of the water utilities and had remained so for a long time. They were set uniformly for the whole country, therefore the rate structure did not reflect geographically determined conditions of water quality and availability. This has resulted in a relatively high demand for water in households, industry and the public sector. For example in Prague, the specific consumption of drinking water in the past has been two times higher than in Vienna or Munich and in the whole Czech Republic has been two times higher than that in Bavaria.[30]

Since the initial years of the economic transformation, the reduction of budgetary support for the operation of public water piping and sewage system enterprises has continued. Nevertheless, the price policy was influenced largely by the state. The price fluctuations are depicted in the following table.

[30] See: Dejmal,I.: The water rates and sewage charges issue", EKO, No.l/1994, page 3.

Table 9

Household and Wholesaler Water Rate and Sewage Charges

	Household Prices			Wholesale Prices		
	water rate	sewage charges	type of price	water rate	sewage charges	type of price
to 31.12.1990	0.60	0.20	fixed	3.70	2.35	fixed
1.1.91-30.6.92	1.50	1.50	maximal	4.50	3.50	maximal
1.7.92-31.8.92	1.50	1.50	maximal	contracting prices		
1.9.92-14.5.93	5.00	5.00	maximal	contracting prices		
since 14.5.1993	substance based prices			substance based prices		

Note: All figures are expressed in terms of CZK/m^3
(substance based prices=věcně usměrňované ceny)
Source: Drinking Water Supply, Sewage Systems, CR 1992, Yearbook 1992 - First Draft, p. 13.

Since May 1993, the maximum prices for households and price liberalization for wholesalers were dissolved and the water prices have been regulated on the basis of real costs and reasonable profit in different waterworks areas. The water charge rates differ according to geography so as to reflect the local conditions and therefore be consistent with the regional environmental program adopted by the taxpayers of that region. This significant decentralization means that decisions about the level at which the rates are established will be transferred to local authorities.

Simultaneously, this type of regulation makes it possible to redistribute water rates and sewage charges in favour of households. It means that these household prices are sufficiently lower than the prices for other wholesalers, which is relevant from a social perspective.

Generally, it is to be supposed that this new arrangement will increase the total price level of water rates and sewage charges by approximately 20 %.

Based on consultations with the local responsible authorities, the current situation is as follows:

In the Plzen region the water rate and sewage charges will be increased by 15 % for households and by 50 % for industry from 1.1.1994. There are several reasons for this: the rise in electricity costs, and the high charges for the discharge of waste water into surface water.The development of water prices will function as a source of financing for investment activities in the water management sphere.

In the Karlovy Vary region, the water rate will be 8,10 CZK/m3 for households and 11,20 CZK for firms and the sewage charges will be 5,30 CZK for households and 9,80 CZK for firms. The reasons are practically the same as mentioned before.

In the Prostejov region there is no consideration of an increase in household water prices, only for firms.

In the Southern Bohemian region the water prices will be determined by negotiations between local authorities and the Water Supply Stations Union.

One of the lowest water rate is in the Northern Moravian region: 4,95 CZK for households and 5,41 CZK for wholesalers.

In Prague, the implementation of two-component water and sewage rates are currently under discussion. The requirement of the Prague Water Supply Stations on high share of fix part /lump-sum part/, that is not affected by consumption behaviour, on the whole price is not, in my opinion, acceptable for the long term. Firstly, the "lump-sum" would remove the motivation for a further decrease in drinking water consumption, that is desirable from both an environmental and economic point of view. Simultaneously, it would not stimulate the enterprises to decrease operational costs through investment in advanced technologies etc.

During the last several years drinking water consumption per capita/per diem in Prague has decreased from 500 litres to 160 litres. There is a prognosis of a further 10 % decrease in the coming years and later it is to be supposed that consumption will stabilize itself.

It should be considered that water rates will increase minimally in the future unlike the sewage charges. In developed market economies the sewage charges are approximately three times higher than water rates. This differentiation is still not apparent in the Czech Republic.

The water price differentiation between regions and price negotiation between local authorities and the Water Supply Stations Union is a new concept in water management; unlike the previous situation where water rates were unique to the whole republic and set centrally. This arrangement will mitigate the risk of over- or under-charging and will result in the conservation of water resources.

The first results indicate that the consumption of drinking water has declined by approximately 20 % from 1989 to 1993 See table 10/.

Table 10

The Consumption of Drinking Water (...)

Year	Drinking Water Invoiced 93/89	Index 93/89	of which Households	index 93/89
1989	929.4	100.0	532.4	100
1990	936.5	100.7	546.2	102.6
1991	867.0	93.3	509.4	95.6
1992	845.0	90.9	506.3	95.1
1993	745.9	80.2	430.4	80.8

Note: numbers are in mill. cubic meters/year
Source:

Yearbook of VAK enterprises, Prague 1992
CSU, The selected indicators of VAK enterprises, Prague 1994 (13- water management).

Besides the impact of increasing water prices, other factors probably play a certain role, for example: the increasing number of water meters installed that lead to water saving /index number in %: 1980 = 100, 1992 = 135/ [31] and the increasing per capita consumption of mineral water / index number in %: 1980 = 100, 1991 = 142/. Nevertheless, the really expansion of the production and distribution of bottled water occurred since 1992 /for example the most popular "Good Water" in production since September 1992 had sold 17 mill. litres by the end of 1992).[32] The share of piping network water losses in total water produced for consumption were high, but almost stable /1980: 23 %, 1990: 22 %, 1992: 24,9 %./.

Analogously, withdrawals of surface water /surpassing 15 000 m^3 in one year/ for industry have declined by 8 %, and by more than 10 % in the energy sector. There is no doubt that the beginning of the transformation process associated with price fluctuations has manifested itself in declining demand for drinking water and declining surface water withdrawals. There is an apparent inclination to save the water resources.

[31] See Statistical Yearbook of the Czech Republic, Czech Statistical Office, Prague 1993, p.85.

[32] See "Environment in the Czech Republic, Yearbook 1992,", MZP and CEU, Prague 1992, p.171.

More detailed analysis is involved in part 3.2.5.1. "Price Elasticity of Water Consumption".

That water prices are connected with the quality of drinking water currently remains a crucial issue in the Czech Republic. In the past, about 57 % of drinking water produced did not meet the Czechoslovak State Standard [33] which was, however, old fashioned, unreflective of current demand for (e.g.) organic compounds. In addition to the poor quality of surface water, the lack of appropriate technological solutions for transforming surface water to drinking water has not proven economically viable. Czech technologies don't remove most of the toxic components such as pesticides, nitrates, viruses and radionuclides. Therefore carcinogenic substances have been found in drinking water.

Currently, it is possible to achieve the desirable water quality improvement both through more advanced water treatment technology and a systematic increase of surface and ground water quality.

The recent check-up of risk water treatments samples /106/ have shown, that almost 40 % of them demonstrated serious problems with drinking water quality. The estimates say that 6,2 bill. CZK would make it possible to meet all required State Standard indicators from the present 62,5 % volume of treated water to 88 %. The most important State Standard hygienic indicator would make it possible to improve from the present 95,6 % to cca 99 % of treated water volume with a 4,5 bill.CZK investment. [34]

[33] Since 1.1.1991 there has been a State Standard for drinking water that comes from the criterion of the World Health Organization. This standard delineates the maximum concentrations of pollutants with regard to the "average consumer's health". The optimal way to supply the vulnerable groups of inhabitants /small children, allergic people/ with drinking water of acceptable quality is the growth of the bottled water industry. The volume of produced drinking water itself was only 1 % in the years 1989 - 1990, currently we see a significant increase in the production and distribution of bottled water.

[34] See: The Environment of the Czech Republic, Yearbook 1992, p.171.

3.2.5.1 Price Elasticity of Water Consumption

In this short and simple econometrical part of our paper we have tried to set a very simple model of water demand (or consumption if you prefer) and then to estimate the price elasticity of this demand. We used the data for the transitionary period to analyze this issue (more specifically from the first quarter of 1990 to the second quarter of 1993). The sources for this data were the Czech Statistical Office and the Czech Ministry of the Environment. A printout of these data is attached it the end of this section. If you care to have a look at this data set, you will understand why we could not afford the luxury of building more sophisticated models. We have only 14 observations to work with, not to mention the dynamics.

Taking into account this handicap we can only build two simple models. The first is

$$\log y = \beta_0 + \beta_1 \log p + \beta_2 \log GDPi + u \qquad (1)$$

The second is even simpler

$$\log y = \beta_0 + \beta_1 \log p + u \qquad (2)$$

The first model regresses the water consumption (log y) on the price (log p) and on the GDP index (log GDPi) as a proxy for income. The second model puts all the weight on price, not bothering with other possible variables that might influence water consumption.

Logarithmic specifications are used for the sake of simplicity. Demand price elasticity is simply the regression coefficient β_1, since the price elasticity is defined as

$$E_p = \frac{\partial \log y}{\partial \log p}$$

Running OLS regression on our data set we obtained

MODEL 1

$$\log y = \underset{(0.59)}{9.87} - \underset{(0.03)}{0.043} \log p + \underset{(0.131)}{0.41} \log GDPi + u$$

$$adj.\ R^2 = 0.61$$

MODEL 2

$$\log y = \underset{(0.02)}{11.7} - \underset{(0.03)}{0.094}\log p + u$$

$$adj.\ R^2 = 0.34$$

Looking at the results of our regressions one sees that water demand is extremely inelastic with regards to price changes: **E_p =-0.043 for model 1 and E_p =-0.1 for model 2**, which is in accordance with the basic economic concept of price inelasticity of basic needs.

Our preference is MODEL 1 since it is superior according to all of the common choice statistics like R^2 or Schwarz-Bayes information criterium; we also think that Model 1 is more intuitive than Model 2.

DATA SET USED FOR THE REGRESSION

quarter	cdef	wage	GDPi	RPW	RW	CW
3/90	106.5	3629	113.549	0.56338	3407.512	130064.4
6/90	109.6	3044	108.217	0.547445	2777.372	135910.2
9/90	114.5	3096	110.397	0.524017	2703.93	131062.6
12/90	123.8	3567	114.569	0.484653	2881.26	139052.1
3/91	165.8	3981	105.351	0.904704	2401.086	135264.7
6/91	176.9	4147	84.323	0.847937	2344.262	121708.9
9/91	176.9	3946	86.130	0.847937	2230.639	125171
12/91	181.2	4755	81.256	0.827815	2624.172	113220.6
3/92	185.2	4636	84.309	0.809935	2503.24	124496.4
6/92	188.0	4669	77.608	0.797872	2483.511	113662
9/92	194.8	4610	91.154	2.566735	2366.53	131011.6
12/92	204.2	5684	88.845	2.44858	2783.546	113184.7
3/93	225.8	5734	88.760	2.214349	2539.415	105525.2
6/93	228.9	6340	78.175	2.18436	2769.768	106971.1

cdef=consumer’s price index

GDPi=GDP index
(1989=100%)

CW =household water consumption (in 1000’s of cubic meters)

RPW =real price of water (norm. to 1989 prices)

RW =real wage (norm. to 1989 prices)

3.3 Air Pollution Development

Air pollution development in the first years of the economic transformation is a result of both the long-term trend continuation, which started before 1989, and of changes due to the realization of economic reform measures.

Herein, we attempt to analyze of the main factors, which achieved a reduction of the air pollution after starting of the economic reform in 1991.

From 1990 to 1992 there were decreases in solid emission by 9,7%, sulphur dioxide by 11%, and nitrogen oxides by 13,8%.[35] The average annual percentage decrease in the period of 1991-1992 was different from pre-transformation period of 1985-1990 (see Table 11).

Table 11

Average Rate of Air Emission Decrease in the Czech Republic (in % per year).

Indicator	1985-1990	1989-1990	1991-1992
Solid emissions	8.8	13.0	4.9
Sulphur dioxide	2.8	4.7	5.6
Nitrogen oxides	0.8	6.0	7.0

Source: Figures accounted from the data of the Register of Emissions and Air Pollutants, 1985-1992.

In the pre-transformation period, particularly between 1989 and 1990,there was a higher average rate of decrease only in solid emission. This was the result of the completion of particulate removal devices (separators) according to the clean air protection program of the Czech energy enterprises for the period of the 1985-1990.

A decrease in sulphur dioxide and nitrogen oxides in 1985-1990 was carried out mainly by the lower exploitation of the steam power plants capacity, which was substituted with energy from a newly completed nuclear power plant

[35] But specific emission levels of these pollutants (per sq.km and per capita) are still much higher in the CR than in developed countries. Specific emission of sulphur dioxide amounted in the CR 21,2 tons per sq.km in 1992, in Great Britain 15,6, in the former West Germany 7,7, in the Netherlands 8,0, and in Austria 1,7 in 1988. (Specific emission per capita see Table 1 of this paper.)

(with capacity to 880 MW,in 1987). An increase in gaseous fuel and a decrease of solid fuel in the Czech energy balance also contributed to the decline of air pollution up to 1990. This trend was made necessary in order to fulfil international commitments to decrease sulphur dioxide (by 30% from 1980 to 1993-1995) and nitrogen oxides conservation to 1987 levels.

The higher percentage decrease in sulphur dioxide and nitrogen oxides in 1991-1992 was probably not only a result of the international commitments, but also due to a more active environmental policy[36] in transition and by the economic reform realization. With respect to the fact that the energy industry is the greatest environmental polluter in the CR, we can assume closer correlations between the development of air pollution and supply and demand for energy, structural changes in primary energy resources, as well as adopted measures within the framework of energy and environmental policy in 1991-1992.

3.3.1 Slump in Industrial Production and Energy Use

The 24% industrial production slump from 1990 to 1991, (14% from 1991 to 1992, and 5% from 1992 to 1993 [37]) is unfavourable but an unavoidable byproduct of the first three years of economic transformation to a market economy. This decrease, and probably the increase in energy prices between 1991 and 1993, affected domestic demand for energy and brought about a decrease in both primary energy resources use (here-after referred to as PER) use, particularly solid fuel, and the production of electricity (see Table 12).

[36]Carried out not only by the Czech parliament and government through a new environmental legislation, but also by non-governmental organizations in the developing democracy of the CR.

[37] Sources: Statistical Yearbook of the Czech Republic 1993 and preliminary data for 1993 of the Czech Statistical Office.

Table 12

Development of Air Pollution, Use of PER and Production of Electricity in the Czech Republic (indexes in %, 1990=100%)

Indicator	1991	1992	1993
1. Air pollution [1]	95.2	88.6	80.0 [2]
2. Use of PER [3]	93.3	86.5	83.0
of which solid fuel constitutes	92.7	81.3	75.6
3. Production of electricity	96.8	94.5	94.1
of which steam power plants constitute	97.3	93.4	92.4

1) Expressed by total solid emissions, sulphur dioxide and nitrogen oxides.
2) Figure arrived by estimate; decrease in SO_2 by 21% from 1990 to 1993 is expected due to a decline in brown coal combustion.
3) Including solid fuel, liquid fuel, gaseous fuel, water and nuclear power.

Sources: Register of Emissions and Air Polluters; Fulfilment of the Energy Policy Goals. The Economic News, June 10, 1993; Preliminary energy balance of the CR in 1993, Czech Statistical Office, March 1994.

With respect to the absence of insufficient with end-of-pipe technological equippment it is reasonable to take into account the relatively close linkage between industrial output, GDP and air pollution in the CR, in contrast to the developed European countries. But statistical data show a much lower percentage decrease in air pollution compared to the total decline of the industrial output in 1991-1993. This results from the fact that a part of energy consumption is constant and independent of the production decline,[38] and from the uneven participation of the different industrial sectors both in total air pollution generation and in total production decrease.

The lowest production decline was recorded in fuels and energy (by 3-4%), which also represent major resources of environmental pollution and degradation. In contrast to this, there has been a more than 40% decline in

[38] It is also necessary to take into account an increase in household electricity consumption in the CR in 1991-1993.

production in the relatively "cleaner" branches, for instance, electrical engineering production, and textile and clothing production.[39]

Therefore a closer correlation is seen between the development of air pollution and energy, particularly solid fuel consumption.

The above mentioned uneven decline of production in the individual branches implied structural changes in industrial output, which have given rise to an increase of energy intensity of GDP (i.e.,to an increase of the total consumption of PER per unit GDP). This indicator increased by 9 percentage points between 1990 and 1992,[40] and it was stabilized at that higher level in 1993.

Growth of energy intensity of GDP represents an environmentally unfavourable development,mainly from the point of view of long term economic growth. A short term increase of that indicator in 1991-1993 due to total decrease in the productivity of the Czech economy, expressed by GDP per capita, didn't directly affect the already overtaxed Czech environment.

Nevertheless specific indicators of air pollution - emissions per unit GDP - increased during the 1991-1992 period in comparison with the 1985-1990 period (see Table 13). This ratio increased approximately by 13 percentage points for solid emissions, by 12 percentage points for sulphur dioxide, and by 8 percentage points for nitrogen oxides from 1990 to 1992.[41]

Table 13

Specific Emission Per Unit GDP in the CR (index numbers).

Emission type	solid	sulphur dioxide	nitrogen oxides
1990/1985	57.5	80.2	86.3
1992/1985	65.1	89.6	93.4
1992/1990	113.3	111.7	108.2

GDP in 1984 prices

Sources: Tabulated according to data from the Statistical Yearbook of the CSFR and CR, and the Register of Emissions and Air Pollutants in the CR.

[39] Fuel and energy production amounted to about 10% of total industrial output, manufacturing production to about 85% in 1992.Source:Statistical Yearbook of the Czech Republic 1993.

[40] Provided that a calculation of GDP in the CR is corresponding to objective reality.

[41] See the footnote 40.

The increase in this indicator was a result of a higher GDP decline and slower decrease in air emissions between 1991 and 1992. With respect to this fact, development of this indicator has probably recorded only a temporary increase. It should not be combined with environmentally incorrect energy policy in the CR. Changes in the PER structure and the goals and results of the energy saving program give evidence about environmentally friendly orientation to energy policy in transition.

3.3.1.1 A Simple Model of Pollution

We will herein set up a very simple model of the pollution situation in the Czech lands. Unfortunately the systematic monitoring of this area began only in 1980's which is a constraint to our study. As you can see from the enclosed data table we worked with, it consisted of 13 observations (1980-1992) regarding the total amount of polluting substances from which we focused on sulphur dioxide, nitrogenium oxides and solid particles (ash). We have also included the total yearly sums of investment to air protection in this period.

Because of the lack of a sufficiently long time series, we worked with two very simple specifications. The first concerns the pollutants (SO_2, NO_x, solid particles), GDP and the time trend

$$pollutant = \alpha GDP + \beta TIME + u$$

The second one concerns the pollutant, GDP and air protection investment

$$pollutant = \alpha GDP + \beta INV + u$$

As our work proceeded we preferred the first specification (the one with the time trend), since the air protection investment specification showed somewhat weird results, namely a positive correlation between the total amount of pollution and the level of investment. This contra-intuitive result can be explained in two ways. First, the investment in air protection programs was absolutely insufficient in the 1980's (and as a matter of fact it remains to be) and thus their impact was negligible (the t-statistic for SO_2 regression was only 0.15 for the investment coefficient) and the effect of today's investment will clearly be seen, say, two years later. We can of course include this fact in our model, but doing so we lose the next of the scarce observations.

Now let us present the results of the study.

SULPHUR DIOXIDE

Sulphur dioxide is probably the most prevalent polluter, at least as a matter of public concern. That is why we are going to begin with it and why the case of sulphur dioxide is the only one in which we are going to present the results of both of our setups.

First, we ran the OLS regression on both specifications, but the results showed an autocorrelation of the errors according to the Durbin-Watson autocorrelation test (actually the autocorrelation was also present in the analysis of NO_x and solid particles analysis). In order to get efficient estimates of the regression coefficients we had to use the Cochrane-Orcut data transformation, assuming the time series would follow the AR 1 process. The results of the analysis are as follows.

MODEL 1

$$SO_2 = \underset{(0.18)}{2.18\ GDP} - \underset{(20.8)}{19.03\ time} + u$$

$$adj.\ R^2 = 0.77$$

$$autoregr.coefficient\ \ \rho = .6$$

MODEL 2

$$SO_2 = \underset{(0.2)}{1.94\ GDP} + \underset{(0.08)}{0.15\ INV} + u$$

standard errors in the brackets.

SO_2 -sulphur dioxide emissions in kilotons per year
GDP -gross domestic product in billions of 1984 CSK
time -time in years (time= zero for 1980)
inv -real investment in air protection in 1984 prices

As can be seen from the above results, the Model 2 specification seems to be a bit contra-intuitive. The reasons for this were established in the introduction to this part of the paper so we will not make any other comments on them. We will point out that the t-statistics for the inv coefficient in Model 2 would be only 0.15, and since this fact was similar in the NO_x and the solid particles analysis we will no longer discuss Model 2.

What we were interested in, wether or not there was a structural break after 1990, or if the decreased pollution after this date was simply due to the sharp

decrease in GDP (approximately 30% to date). To solve this problem we have decided to use the Chow predictive test for the coefficient's stability. We used 1990 as the break year, so the resulting Chow statistic has the $F_{3,8}$ distribution, which for the 5% confidence level has the critical value $\mathbf{F_{3,8}=4.07}$.

The value of the Chow test statistic we obtained from our test was $\mathbf{3.71<F_{crit.}}$ **and thus we accepted** the hypothesis that there was no structural break after the 1990 and all the improvement in SO_2 pollution was simply due to the decrease in GDP.

SOLID PARTICLES

In the case of the solid particles and NO_x we are simply going to present the results of the regression and Chow predictive test for the coefficient's stability. The numbers in the brackets will again be the standard errors; the units of exogenous parameters are the same as in the SO_2 regression.
Regression equation

$$\underset{\quad}{Solid} = \underset{(0.13)}{1.2}\ GDP - \underset{(15.3)}{41.5}\ time + u$$

$$adj.\ R^2 = 0.75$$

$$autoregr.coefficient\ \rho = 0.73$$

Chow statistics= 9.5 > $\mathbf{F_{crit.}}$ and thus we rejected the H_0 hypothesis of no structural change in solid particle pollution after 1990. The explanation for this can be seen in the fact that the filters for solid particles are easier to build and that there was finished but not fully utilized equipment, that were simply not well maintained in the period before 1990. Another possible explanation could be in the fact that a large part of solid pollution comes from heavy industry plants that experienced a major reduction after 1990.

NITROGENIUM OXIDES (NO_x)

Regression equation

$$NO_x = 0.82\ GDP - 4.42\ time + u$$
$$\quad\quad (.017) \quad\quad (2.2)$$

$$adj.\ R^2 = 0.94$$

$$autoregr.\ coefficient\ \rho = -0.46$$

Chow statistics= 4.38 > $F_{crit.}$, so we have once again rejected the H_0 hypothesis that there was no structural change after 1990.

3.3.2 Changes in the Structure of Primary Energy Resources Use

Generally speaking, the total decrease in energy production and consumption from 1990 to 1993 has resulted in a positive impact on the environment, but only in the shortterm. One determinative factor for this decrease was related to the decline in industrial production without any significant energy saving technological changes. On the contrary, the changes in the structure of PER represent a long term stable contribution to the improvement of environmental quality.

As a result of energy policy, and also as a result of a lower demand for coal there was a reduction in the mining of coal and decline in its energy use from 1990 to 1992 by 20%, and to 1993 by 25% (by estimate). The decreasingtrend in the domestic mining and consumption of coal is accompanied by structural changes in PER in favour of less-polluting substitutes, mainly natural gas (see Table 14).

The share of natural gas in total PER has been increasing slowly, but continuously, since the beginning of the 1970's. It amounted to 11% in 1990 , to 14 % in 1992 and will comprise approximately 15% in 1993. The percentage of coal use decreased by 12 between 1985 and 1990 and by nearly 25 percentage points from 1990 to 1993. The share of coal in total PER use in 1993 amounted to approximately 59%. That is still a relatively high share compared to developed countries (see Table 15).

Table 14

Structure of Gross Consumption of PER.

Resource	Unit	1990	1991	1992	1993[1]	index 1993/90
Solid fuel	PJ	1348	1251	1096	1020	75.6
share from total PER	%	65	65	61	59	
Liquid fuel	PJ	356	299	317	317	89.0
share from total PER	%	17	15	18	18	
Gaseous fuel	PJ	226	255	252	255	112.8
share from total PER	%	11	13	14	15	
Primary heat and el.	PJ	146	132	131	131	89.7
share form total PER	%	7	7	7	8	
Total PER	PJ	2076	1937	1796	1723	83.0

[1]) Preliminary figures

Sources: Statistical Yearbook of the Czech Republic 1993.
Preliminary energy balance of the Czech Statistical Office, March 1994.

Table 15

Simple Energy Balance of Some EU and OECD Countries and the Czech Republic

Indicator	CR	EU	OECD	A	B	F	G	GB	USA
PER[1](GJ /capita)	180	145	199	134	201	164	184	153	317
of which (in %)									
Solid fuel	59	21	24	27	21	11	27	31	27
Liquid fuel	18	45	43	43	39	40	41	39	40
Gaseous fuel	15	18	19	19	17	11	17	22	23
Water power	0.2	1	2	11	-	2	0.5	-	1
Nuclear power	7.8	14	11	-	23	36	14	8	8

[1]) Gross consumption of PER in 1990; the CR in 1992.

Source: Vazac,V.: Czechoslovakia's power- Engineering Economy at the Beginning of The 1990's. Energetics, No.5, 1993.

In the near future the speed of the solid fuel consumption decline in the enduser power consumption sphere, and the consequent major reduction in

1992/1989 for industrial producers amounted to 192% in total, of which fuel was 181%, energy was 272%, and total consumer prices amounted to 191%, of which fuel was 296%, heat (from sources more than 6 MW in output) was 381%, electricity was 148%, natural gas was 233%.[44]

While producer prices for electricity and heat cover the production, transmission and distribution cotss of these energy products, the level of their consumer prices is still substantially lower. Therefore these consumer prices have to be increased by approximately 70%(in part through internalization of the environmental costs), probably in two or three steps (in 1994 and 1995).

The main **institutional measures** to manage and support energy savings were also created in 1991 - 1993. A first program on energy savings in the CR was adopted by the Czech government in 1991 under the title "Principles of State Participation in Fuels and Energy Conservation in Buildings and Flats".[45] A significant institutional measure to administer the energy conservation environmental policy which also includes the above mentioned program, was realized by the establishment of the Energy Agency of the CR in 1993.[46]

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to their lower electrification.

[44] Figures according to Statistical Yearbook of the CR 1993.

[45] The total subsidies to production, transmission and distribution of electricity, heat, gaseous fuel and water from the State Budget in 1992 amounted to about 1%, of which the subsidy on this energy savings program about 12%.
State support is realized by the defrayment of interest on credit for technical equipment used for measuring and regulating heat consumption, and for insulation for buildings, by a direct subsidy up to 50% for comprehensive insulation an up to 70% of costs of demonstration projects on complete technical measures to achieve energy savings, by a direct subsidy to support an energy consultation service network, and by returned non-interest-bearing loans for construction and reconstruction of alternative resources of energy. The widening of energy conservation initiation in industry employing demonstration projects and a modernization of heating plants, development of the alternative resources of energy, light savings, etc is under consideration.

[46] The Energy Agency is also aimed at finding and utilization of non budget means to enforce energy savings. The energy saving strategy is enforced by the Energy Agency through the implementation of various technical systems and projects such as a combining electrical and heat production, centralizing the supply of heat, comprehensive control system for power engineering,etc. Along with the EA other, non-state, institutions focused on energy savings operate in the CR, e.g. The Centre for Effective Use of Energy supported by Battelle Pacific North-West Laboratories, or Energy Centre of EU, based in the EU THERMIE program.

According to the Energy Agency Report[47], the realization of the energy savings program contributed to a decrease in PER use by 0,25%, sulphur dioxide emissions by 1,4%, solid emissions by 3,5%, and nitrogen oxides by 0,5% between 1991 to 1993.

The environmental target of this program is the most effective factor in lowering air pollution. The use of budget resources for the realization of this program will be also more effective in comparison with direct heat price subsidies for citiziens. Energy savings achieved, expressed in monetary terms, will overlap the total amount of the state subsidy between the fourth and fifth year implementation of the program. This program will likely make a financial contribution to the State budget after 1995.[48]

Results of the savings program are comparable with similar programs in developed countries.[49] However, conditions for introducing energy saving technologies in the CR are still less favourable, in comparison with developed countries. This reality reflects the specific situation of the transition (e.g. the privatization is yet not finished, there is an economic recession, insufficient incentive towards investment, limited capital and credit resources, an insufficiently developed market for energy savings commodities and services, incomplete legislation, and insufficient information among other contributing factors.

3.3.4 Investment in Clean Air Protection

According to the Clean Air Act (see 3.1 of this paper) the existing pollution sources must reach the established emission limits of air pollution by the end of 1998 at the latest. With respect to this obligation, the energy industry has planned the decommissioning of obsolete steam power plants (by 2400 MW of installed capacity, which will be substituted by the 2000 MW capacity of Temelin nuclear power plant) and realization of desulphurization projects (at the

[47] Energy savings program realization in 1991-1993. Energy Agency of the CR, October, 1993.

[48] Due to the realization of the program the heating subsidy for inhabitants will decrease by approximately 15-20% in 1994. The program brings about a decrease of heat consumption by 20-40% per flat annually. Source: Report by the Energy Agency, October, 1993.

[49] Returnability of the state subsidy is expected by measurement and regulation of heat consumption and partial insulation of buildings to 0,9-2,6 years, by demonstration projects to 4,4-8,5 years, by complete heating isolation to 12,6-22,4 years.

steam power plants by total capacity 500 MW by 1997).[50] Abatement of sulphur dioxide emissions by about 60% from 1992 to 1997 (and by about 70% from 1992 to 2000) is predicted as a result of these measures.

The implementation of desulphurization technology will require great financial resources and will result in significant economic burden. It is estimated that necessary desulphurization investment would approximately equal investment costs to finish Temelin, including the entire nuclear cycle.[51]

There are also further technical and economic problems associated with desulphurization technology construction at existing steam power plants. The first technical problem is the installation of modern equipment in obsolete energy facilities. The second problem concerns the amortization of the old power plants versus the new desulphurization investment. Also with respect to the necessary decrease of coal in the energy balance, the early amortization of expensive desulphurization equipment seems to be possible.

The period after 1990, is characterized by higher investment activity in clean air protection. The total investment in clean air protection projects was increased (in current prices) by 240% from 1990 to 1992, and by 270% (by estimate) from 1990 to 1993 (see Table 16).Its share in total environmental investment increased from 28% in 1990 to 34% in 1992, and reached 39% in 1993 (by estimate). Consequently clean air protection projects, both under construction and completed, recorded a more progressive trend in 1990-1993 than before 1989.

[50] See: State environmental policy in the CR. Design of the Ministry of the Environment of the CR, December, 1993.

[51] Costs of 1 MW generation at Temelin should amount to only 58% of these costs in an integrated coal/gasification-combined cycle and 48% in a modernized and desulphurized steam power plant. According to Analytical Study of the Czech Energy Enterprises,S.C.,Prague,1993.

Table 16

Investment in Clean Air Protection Projects.

Indicator	1990	1991	1992	1993	index 1990=100%
1.Total (in bill. CSK, c.p.)	1.7	3.2	5.8	6.3[x]	370.6
of which:					
2.Projects 5mill.CSK or more	0.4	2.1	3.6	4.1	976.0
3.Share of 1. in total inv. to the environment in %	28.3	34.0	34.1	39.4	-
4.Share of 2. in total env. proj. of 5mill. CSK or more	16.7	26.2	28.8	34.4	-

[x]) estimated figure

Sources:

Statistical Yearbook of the CR 1993; Environment of the CR, Yearbook 1992: Investment in the Environment, Report and Analysis 1993, Czech Statistical Office, 1994.

Most of investment in clean air protection in the period from 1991 to 1993 was represented by gasification and electrification projects in the local heating, by modernization of heating boilers, desulphurization of cokeoven gas, construction and renovation of separators, etc. Selected desulphurization steam power plant projects were also started in this period.

Many investigations show that investment in medium and small pollution sources emissions reduction from local heating plants and from household coal combustion have several times higher the social and economic effectiveness than desulphurization projects including big steam power plant with high chimneys.[52] These desulphurization projects will have no decisive effects in the improvement of environmental quality in the territory of the CR and the quality of life and health of its inhabitants.

The structure of environmental investment projects in 1993 (over 5 mill.CZK) according to the origin of its financial resources is represented as follows:

[52] World Bank investigations show that SO2 and NOx emissions from local heating plants with lower chimnies burning coal chimney) are about 2.5 times higher, solid emissions even 12 times, producing greater social-economic damage than emissions from large pollution sources with high chimneys.Source: Planeta,No.3,1994.

Financial resources	Total environmental projects (%)	clean air protection projects (%)
Direct investment	40.5	52.2
Credit means	10.0	6.6
Grants and subsidies	39.0	24.3
Foreign help	5.8	16.5
Other resources	4.7	0.4

Source: Investment in the environment. Report and Analysis 1993, Czech Statistical Office 1994.

The structure of the financial resources used for environmental investment should gradually change, in accordance with the privatization process and the "polluters pays"principle, in favour of direct investment and credit means.

3.3.5 Instruments of Environmental Policy

Air emission limits and emission charges are considered as two main instruments of environmental policy in the CR.

Emission limits for industry secttors are imposed for solid pollutants, sulphur dioxide, nitrogen oxides, carbon monoxide, and for other organic and inorganic substances.

The emission limits established for new pollution sources attain values corresponding to those for the best achievable means. The emission limits established for existing pollution sources are derived from the lowest attainable emission of the given technical facilities while meeting the conditions set for their operation. The air protection authorities specified these limits and determined a deadline within which the level emissions must be met (on December 31,1998 at the latest).

While emission limits represent a direct regulatory measure, emission charges are an economic instrument.Theoretically, the economic efficiency of emission charges is higher in many aspects. A single price sets marginal abatement costs equal for all possible sources of emission reduction and offers incentives to develop better and cheaper technologies. If precise environmental targeting of the emissions charges is required, targeting is not possible without incurring relatively high information costs.

According to the Clean Air Act (No.309/1991 Sb.) and Act on Administration Protection (No.389/1991 Sb.) medium and large pollution source

charges per year depend on the amount and kind of pollutants emitted. The final charges represents the total of the charges for individual pollutants. During 1992-1993, only 30% of the actual charges must be paid, 60% in 1994-1995, 80% in 1996, and 100% in 1997. If emissions will exceed set limitations, a surcharge of 50% is added.[53]

The annual charge for one small pollution source is a fixed amount of up to 10 thousand CZK proportional to the size of the source and the harmfulness of the pollution produced.

The payment rates for pollutants are established as follows:[54]

1. Principal pollutant	Rate (CZK/t)	2. Other pollutant	Rate (CZK/t)
solid emisson	3000	Class I	20 000
sulphure dioxide	1000	Class II	10 000
nitrogen oxides	800	Class III	1000
carbon monoxide	600		
hydrocarbons	200		

Despite the fact that pre 1989 charge rates were increased 8-10 times, a comparison present charge rates and anticipated costs reduce air emissions will give rise to the conclusion that the responsiveness of polluter firms will be insufficient. For example specific costs to reduce sulphur dioxide unit emissions are 5-7 times higher than the charges.[55] The extremely low charges can not encourage polluters to take protection measures.

Also impact the of these low charges on the economic results of polluters can not be significant. An investigation of a relatively representative set of firms showed that annual fine payment didn't exceed 1% of their total operation costs, gross profit or total financial payments in the majority (60%)

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[53] Penalties for violation of air protection laws range from 500 to 10 mill.CSK. In the case of a repeat violation, penalty amounts may be doubled.

[54] If the operator of a pollution source has demonstrably started work on the reduction of emissions, 40% of his charge payment is deferred for the time he is carring out this remedy. If the operator finished this work in conformity with established conditions, the air protection authority will issue a decision on the remittance of the remaining amount.

[55] Sources: Ministry of the Environment Analysis on Level of the Air Emission Charges,1991; Payments for Fuel Resources in Relation to the Economic Reform. Working paper, VUPEK, Prague 1991.

of investigated firms, and only 5% by the rest of the firms (40%).[56]

It seems that air emission charges in 1991-1993 fulfilled a function of centralizing of the financial means. Nearly 40% of the total charges paid represent income to the State Environmental Fund.(The rest is income going to municipal budgets). The share of air emission charges in the total Fund resources amounted to 24% in 1992 and 31% in 1993.

Fund resources are used to support investment and also non investment protection projects. Air protection accounted for about a 34% share of expenditures.

The majority of the Fund's expenditure (97%) are used for investment projects such as grants, subsidies and loans. This amounts only to about 9% oftotal investments in the air protection.

The total contribution of air protection projects completed in 1992 and supported by the Fund has accounted for only a 0.3% reduction of emissions from 1991 to 1992.[57] The support of the Fund has been oriented to medium polluters.

In conclusion we can state that polluters are motivated, in practice, by administrative, non economic instruments to achieve the deadline for complying with emission limits by 1998. The implementation of the adopted legal and policy measures to reduce air pollution in the CR will be very expensive. Consequently, fulfilment of emission limits, especially by the old sources of pollution, merits continued study.

4. CONCLUSIONS

The judgemental analysis in this report of the impacts of the economic reform on the environment attempts to take into account both direct and indirect effects of the transformation. While the main steps of the economic reform, such as privatization and price liberalization, appear to account for direct effect in water management, the analysis suggests that water and air pollution development are better shown as indirect effects. Likewise, legal, economic and institutional environmental policy measures carried out in 1991 - 1993, and the continuation of long-term trends began during the pre-transformation period

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[56] See Cerna,A.,Ritschelova,I.: Impact of Emission Fines on the Economy of Enterprises.Working paper.Ministry of the Environment of the CR,1991.

[57] Figures from: Statistical Yearbook of the CR 1993; Environment of the CR, Yearbook 1992;Nevyjel,J.: The State Environmental Fund as an Instrument of Environmental Policy. Planeta, No.3,1994; Report on the Environment in the CR by Ministry of the Environment, May, 1993.

appear to have been important in explaining water and air pollution development.

Despite the fact that the industrial production decline in the initial years of economic transformation has not resulted in improvement in surface water quality(due to the particularly dry period of 1990 - 1992), the analysis indicates that the fundamental system changes in the water protection mechanism has already been launched.

In view of the rapid on-going movement towards private ownership and the de-regulation process based on the new legislation, the previous practice connected with the "exclusion permission" from the Water Act for enterprises and municipalities that were unable to meet the water protection measures, has been discarded. The state administration of water management has been firmly established and anpowered, namely the jurisdiction of the municipal authorities, the district offices and the Environment Inspection Office. Proceedings and water management records have been developed, including a system of penalties. The shift from water protection within the administrative units or industrial branches in favour of water protection within the hydrological units /waterway basins/is also of great importance.

As far as direct and indirect water policy instruments are concerned, the indices for acceptable degrees of water pollution have been established and water pollution charges have been increased due to price fluctuations. These charges continue to perform a primarily revenue generating function, that is very important in the initial years of economic reform when is the trend is to decrease direct water protection subsidies from the state budget /and to cut it down in the future/. Attention must be paid to extend the list of pollutants subject to charges /especially heavy metals, chlorofluorcarbons, etc./.

The transformation of property rights in the water management sphere is a relatively complicated process with regard to its subject. The privatization of the piping of the public’s drinking water and sewege systems has experienced the most development. Since 1990, uncontrolled disintegration of these enterprises has occurred in the Czech Republic. It is to be expected that the larger companies will be more successful /both mixed ones and operational ones/ with long-term municipal contracts.

The relevant impact of price liberalization in the water management sphere is the decentralization and subsequent differentiation of user charges /water rates and sewege charges/. Such "water prices" better reflect the local conditions and are consistent with regional environmental investment programs adopted by the taxpayers of those regions. This approach has resulted in remarkable conservation of water resources as we have shown on the basis of the available data.

We suppose that the overhaul of the Water Act, that is currently being elaborated, will reinforce all positive tendencies in water management towards sustainable resource utilization.

The slump in industrial production as a consequence of the economic reform realization implies a decrease in the supply and demand for electricity and primary energy resources use as well as a continuation of structural changes in PER, by decreasing brown coal in favour of less polluting substitutes, have contributed by a decisive share to the decline in air pollution emission in 1991 - 1992.

The commencement of an energy conservation program supported by the state, dynamic investment in clean air protection and emission limits targets, in accordance with the new Clean Air Act, represent significant measures realized in 1991 - 1993, which will affect stronger air pollution decrease in the coming mid to long-term period.

It should be emphasized that the unfinished privatization, particularly in the energy industry, insufficient incentive to invest, high interest rates level, or relatively cheap energy together with the low level of air pollution charges don't induce producers and consumers to generate and introduce new technologies both in the production process and in pollution prevention to adequate energy saving and the abatement of pollutants.

Energy prices don't include environmental externalities and their average level includes neither the level of energy production costs nor the price level of equipment /technology/ and other products required for energy conservation. Under these energy pricing conditions producers and consumers are not sufficiently motivated to conserve energy, to use alternative energy resources, nor to implement environmentally friendly behaviour.

Therefore, in order to strengthen the effectiveness of the political measures and instruments to clean air protection it will be necessary to provide:
- an increase in energy prices commensurate with marginal costs including environmental protection costs; price regulation with the maximum price set so as to change the system of substance based energy prices;
- an increase in the level of air emission charges matching clean air protection costs;
- the utilization of tax and credit policy to stimulate energy saving technological introduction.

With respect to the need more rapidly decrease the coal share in the energy balance and to integrate countries in CO2 emission limitation agreements it will also be useful to undertake a discussion of the introduction of a CO2/ energy tax in the Czech Republic.

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