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ENVIRONMENT FOR EUROPE
UN ENVIRONNEMENT POUR L'EUROPE
UN AMBIENTE PER L'EUROPA
ОКРУЖАЮЩАЯ СРЕДА ДЛЯ ЕВРОПЫ
LUZERN, 28.-30. APRIL 1993

Environmental Action Programme for Central and Eastern Europe

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BASIC FIGURES FOR COUNTRIES IN CENTRAL AND EASTERN EUROPE [1]

	Area (000s sq km)	*Area relative to France*	*1990 Population[2] (000s)*	*Population density per sq km*	*Percent urban*	*Cars[3]*	*Telephones[4]*	*Physicians[5]*	*Infant mortality[6]*
Albania	29.0	0.05	3,200	113.0	35	n.a.	n.a.	n.a.	25.4
Armenia	29.8	0.05	3,300	110.7	68	n.a.	n.a.	n.a.	18.2
Azerbaijan	86.6	0.16	7,100	82.0	54	n.a.	n.a.	n.a.	23.3
Belarus	207.6	0.38	10,300	49.6	65	n.a.	110	41	11.8
Bulgaria	111.0	0.20	8,800	79.3	68	142	290	36	13.1
Croatia	56.5	0.10	4,760	84.0	51	167	259	24	10.4
Czech Republic[9]	78.9	0.14	10,360	131.0	78	207	270	36	12.1
Estonia	45.2	0.08	1,570	34.8	72	154	230	46	12.0
Georgia	70.0	0.13	5,400	78.3	50	n.a.	n.a.	n.a.	19.6
Hungary	93.0	0.16	10,600	114.0	61	184	180	33	15.4
Latvia	64.6	0.11	2,680	42.1	71	110	280	50	10.2
Lithuania	65.2	0.12	3,750	57.1	69	128	220	40	9.8
Moldova	33.7	0.06	4,340	128.8	47	n.a.	n.a.	n.a.	18.6
Poland	313.9	0.57	38,180	122.0	62	138	137	21	15.9
Romania	238.0	0.43	22,760	95.8	54	61	130	22	22.7
Russia (European)[7]	4,253.0	7.71	115,050	27.1	74	60	n.a.	47	17.4
Slovak Republic[9]	49.0	0.09	5,310	108.0	78	200	270	36	12.1
Slovenia[8]	20.3	0.04	2,000	98.7	56	289	328	19	8.2
Ukraine	604.0	1.09	51,700	85.6	67	60	n.a.	44	13.0
France	552.0	1.00	56,400	102	74	410	610	31	7.4
Netherlands	37.0	0.07	14,900	403	89	360	650	22	7.3

1/ Refers to most recent year (in most cases 1990) for which data are available.
2/ Population figures for Albania and Ukraine are for 1989; Croatia, Romania and Slovenia for 1991.
3/ Passenger cars per 1,000 inhabitants.
4/ Per 1,000 inhabitants.
5/ Per 10,000 inhabitants.
6/ Number of deaths before age one per 1,000 live births.
7/ Figures for cars, telephones, physicians, and infant mortality are for Russia as a whole, not just European Russia.
8/ Figures for urbanization are for Yugoslavia.
9/ Figures for urbanization, cars, telephones, physicians, and infant mortality are for Czechoslovakia.

The metric system is used throughout the text.

A list of Abbreviations is provided inside the back cover.

A summary of proposed actions is in Annex 12.

ENVIRONMENT FOR EUROPE

ENVIRONMENTAL ACTION PROGRAMME FOR CENTRAL AND EASTERN EUROPE

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ECONOMIC INDICATORS FOR COUNTRIES IN CENTRAL AND EASTERN EUROPE

	GDP[1]			*Industrial production*[1]			*Agricultural production*[1]			*Unemployment rate (%)*			*Gross foreign debt (billion $)*		
	90	91	92	90	91	92	90	91	92	90	91	92	90	91	92
Albania	-13.1	-30.0	-11.0[5]	-7.5	. .	. .	-7.4	. .	. .	8.6	50.0	70.0[9]	0.35	0.55	. .
Bulgaria	-11.8	-22.9	. .	-16.3	-27.5	-17.5[2]	-6.7	-13.2	. .	1.7	10.2	12.5[8]	10.0	11.4	12.0[7]
CSFR	0	-16.0	-15.0[2]	-4.0	-21.0	-22.0[4]	-2.0	-14.0	. .	1.0	7.0	5.0[10]	8.1	9.3	9.1[2]
Croatia	-8.5	-15.0[12]	-20.0[12]	-11.3	-28.5	-14.6	-3.5	-8.2	-19.8[13]	9.8	14.2	17.5[5]	. .	. .	2.6[11]
Estonia	-3.6	-10.8	-30.0[2]	-5.6	. .	-38.0[2]	-3.2	. .	. .	. .	. .	0.7[10]	. .	0.4	. .
Hungary	-5.0	-10.2	. .	-10.5	-19.1	-18.9[3]	-4.0	-3.0	. .	1.7	8.5	10.1[9]	21.3	22.7	21.6[7]
Latvia	-0.2	-7.9	-30.9[5]	7.4	0	. .	-17.2	-3.6	. .	. .	. .	1.6[9]	. .	0.8	. .
Lithuania	-5.0	-12.8	-35.0[5]	0.3	-1.3	-41.0[5]	-11.5	-8.0	-18.0[5]	. .	. .	1.1[8]	. .	1.0	. .
Poland	-11.6	-7.0	1.0	-24.2	-12.9	4.2	-2.2	-2.0	-11.0	6.3	11.8	13.6[9]	46.6	46.9	47.0
Romania	-7.4	-13.0	. .	-17.4	-18.7	-17.6[4]	-3.0	-5.0	. .	. .	2.9	5.4[8]	0.3	1.9	3.2
Russia	0.4	-9.0	-14[2]	-0.1	-8.0	-13.5[5]	-3.6	-4.7	. .	. .	0.1	0.2[6]	38.0	40.1	43.4[8]
Slovenia	3.4	-9.3	-6.5	-10.1	-11.6	-13.0	1.0	-3.3	-17.0	4.7	8.1	11.3	19.5	18.7	17.3
Ukraine	-3.0	-10.0	-18.0[2]	-1.0	-13.0	-15.0[2]	-7.0	-4.0	-20.0[2]	0	0	0[2]	. .	. .	. .

1/ Percentage change over the (same period of the) previous year.

Latest period for which data are available:

2/	January-March	7/	April
3/	January-April	8/	May
4/	January-May	9/	June
5/	January-June	10/	July
6/	March	11/	December

12/ Estimated data based on current prices
13/ *Preliminary data*

Sources: Commission of the European Communities, Directorate-General for Economic and Financial Affairs. 1992. *European Economy*, Supplement A (8/9). Croatia Ministry of the Environment. Slovenia Ministry of Economic Affairs and Development.

ENVIRONMENT FOR EUROPE

ENVIRONMENTAL ACTION PROGRAMME FOR CENTRAL AND EASTERN EUROPE

Conference Document[1]
29 March 1993

Contents

The resources available for environmental improvement in the countries of Central and Eastern Europe (CEE) will be severely constrained over the next 5-10 years. The costs of meeting some environmental objectives will, however, be very high. The Environmental Action Programme provides a framework as a basis for setting national environmental priorities within each country in Central and Eastern Europe and for cooperation between Eastern and Western countries.

The main constraints to implementation arise from a general lack of financial and above all institutional capacity rather than from issues that are specific to particular environmental problems or potential solutions. Hence the most urgent problems will not be solved unless a clear goal is established at the outset and the most efficient way to reach that goal is identified. This is an essential prerequisite for a sustainable development strategy which identifies investments and policies in support of a socially and ecologically sound objective, thus avoiding the need for costly remedies ex post.

I. INTRODUCTION

Why an Environmental Action Programme for Central and Eastern Europe?

1.1 **Objectives.** The Environmental Action Programme (EAP) builds on the efforts by countries in Central and Eastern Europe -- in some cases together with donors and financing institutions -- to address environmental problems. The goal is,

- first, to facilitate a *consensus within and between countries* of East and West on the priority environmental problems, and
- second, to *endorse a mix of policy, investment, and institutional actions*, with complementary commitments on the part of all countries and institutions involved.

1/ The Environmental Action Programme will be revised after the Lucerne Ministerial Conference to reflect the comments and conclusions of the Conference.

1.2 The EAP reflects the spirit of the United Nations Conference on Environment and Development (UNCED) – in particular the Rio Declaration which stresses the concepts of global interdependence and cooperation, and Agenda 21 which describes the actions that should be undertaken in order for countries to move towards a pattern of sustainable development. More specifically, the EAP complements the numerous existing strategies already developed by Central and Eastern European countries, as well as the longer-term regional programs such as for the Baltic Sea, the Black Sea, the Danube River, and the Black Triangle. The EAP presents criteria and methods to identify immediate actions, and provides a broad strategy for the integration of environmental concerns into the economic transformation of the countries of Central and Eastern Europe. Unlike the geographically focused programs, the EAP does not so much prescribe *what* must be done, but it suggests ways of looking at *how* to address the problems so that decision makers in Central and Eastern Europe can apply their own judgment. Moreover, the EAP will be a living document: as our understanding of the environmental problems improves and changes, the EAP will be reviewed and updated periodically and adapted to country-specific circumstances (see chapter VII on implementation). Over time, the EAP would increasingly shift its focus from actions that are of a remedial nature toward measures which support sustainable development.

1.3 The recent political changes and the transition to a market economy involve substantial economic and social hardship for the countries of Central and Eastern Europe. Under these circumstances, concern for the environment has slipped down on the agenda. Even in these times, however, CEE countries continue to make significant environmental expenditures (in the range of 0.5-1% of GDP), and have committed themselves in a number of cases through the adoption of new and strict laws and regulations to continued important investments. The amounts of money at stake for environmental expenditures are of a similar magnitude as those associated with other budget items over which governments (both in the East and the West) have "control" (e.g., infrastructure and energy expenditures). Environmental expenditures are therefore the legitimate subject of public investment reviews, and should be an issue of concern to those making budgetary decisions. In Poland, for example, just the difference in annual costs between alternative approaches for reaching air quality targets *already adopted* is more than twice the projected average annual spending in the power sector over the next 20 years.

1.4 Similarly, the costs of meeting common Western standards are high, as has been discovered especially in the former German Democratic Republic. For example, the Eastern German State of Saxony has estimated that it will require DM 20-30 billion over the next 10 years to upgrade the wastewater treatment plants under its jurisdiction to meet Western German standards.

1.5 Many governments in Central and Eastern Europe have made international commitments under global conventions, treaties and other forms of agreements which have substantial financial implications, *viz.*

- the Vienna Convention for the Protection of the Ozone Layer (1985),
- the Montreal Protocol on Substances that Deplete the Ozone Layer (1987),
- the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal (1988),
- the Convention on Biological Diversity (1992),
- the Framework Convention on Climate Change (1992), and

- the 1979 Geneva Convention on Long-range Transboundary Air Pollution (LRTAP), with its related protocols on emission reductions for sulfur dioxide, nitrogen oxides and volatile organic compounds.[2]

The cost of applying the 1997 Polish emission standards (which are similar to the relevant current EC standards and are designed to comply with the LRTAP protocols) to existing thermal power plants in Poland has been estimated to range from US$3.0 to US$9.7 billion (depending on the age of the plants selected). Scaling this figure up implies a cost of US$ 30-35 billion for all of the CEE countries. Other agreements to reduce land-based pollution of the marine environment may also require substantial commitments over the coming 20-30 years, in particular under the following conventions:

- the 1974 Helsinki Conventions on the Protection of the Marine Environment of the Baltic Sea Area (HELCOM), as revised in 1992,

- the 1976 Barcelona Convention for the Protection of the Mediterranean Sea against Pollution, with its related protocols, and

- the 1992 Bucharest Convention on the Protection of the Black Sea against Pollution, with its related protocols.

1.6 **International Assistance.** Initial information for Poland and Hungary suggests that international assistance amounted to slightly more than 5% of national environmental expenditures from all public and private sources. This is partly a reflection of the very low disbursement levels, which in turn is an indication of the weak institutional capacity to absorb international funding.

1.7 International assistance to Poland and Hungary has probably been higher (certainly on a per capita basis) than to most other CEE countries. This means that CEE countries are meeting well over 90% of the costs of environmental expenditures out of their own resources.

1.8 The Action Programme recognizes that the bulk of resources for environmental expenditures in Central and Eastern Europe (CEE) will have to be found in those countries themselves. At the same time, the EAP is being developed so that donors can provide urgently needed assistance to address specific problems. Special assistance or burden-sharing arrangements also may be appropriate when dealing with transboundary environmental problems. The establishment of innovative financing mechanisms in CEE countries as well as between CEE and donor countries merits special examination.

Environmental Investment Expenditures in Poland

Expenditures have grown substantially in Poland, corresponding to the rapid increase in pollution charges and non-compliance fees up to 1992. In 1991, US$840 million was spent on the environment from public and private sources, corresponding to 1% of GDP:

State budget (grants)	5%
National Fund (grants + soft loans)	15%
Regional Environmental funds (grants)	25%
Enterprises (polluters' own resources + loans)	30%
Municipalities (budgets + commercial loans)	20%
International Assistance (grants + loans)	5%

Of the total environmental investment expenditures, 45% was spent on water quality, 40% on air quality, and 15% on solid waste management.

1.9 **The Need to set Priorities.** In view of the significant environmental problems, the countries of Central and Eastern Europe are faced with a situation in which they would have to make

2/ Information on the status of the global conventions is provided in Annex 8.

major environmental expenditures at the very time when they are suffering economic hardship unlike anything experienced by the Western market economies since World War II. At the same time, there is a risk that part of the scarce resources -- amounting to hundreds of millions of dollars in each country -- are not applied in an efficient manner (see box), and that urgent environmental problems are not being addressed. This report not only offers criteria for deciding on priorities, it also aims to focus attention on the need to carefully define the problems to be "solved". Experience in the wealthiest OECD countries suggests that "solutions" have sometimes been supported which did not address the real problems. What should be the measure of success: the amount of investment in air or water pollution control, or a cleaner environment? Some of the recommendations in this report therefore apply equally to many Western countries.

The Costs of Environmental Measures

1. The costs of air pollution control in Poland

The costs to achieve the improvements in air pollution emissions currently mandated by Polish law, and to match the equivalent of EC standards for vehicle emissions over the next 25 years, has been estimated at US$1.45 billion per year. A study carried out for the EAP has calculated that an approach involving emissions taxes would reduce the costs of achieving the same target to US$0.65 billion a year (see the box in chapter III). The potential *savings of US$800 million per year* for air pollution control alone is more than twice as much as Poland's projected power sector development program (10,000 MW power capacity over 20 years), and greater than the total amount of loans from all multilateral lending institutions to Poland in the past year.

2. Options for improving water quality

Hungary: Cost savings for one medium-sized town

Szeged is a town with a population of 180,000 which currently has no municipal wastewater treatment system. Current plans call for a technologically advanced treatment plant, with a total investment cost of US$80 million. However, both local and regional water quality improvements would be small because of the nature of the receiving water. While it may be politically difficult to justify no investment at all, it is possible to design a sequence of actions over the next 10-15 years that imply ***capital cost savings of at least US$40 million***, or almost double this amount in net present value terms. These are savings ***for just one medium-sized town*** (a full explanation is given in the box in chapter V).

Slovak Republic: Cost savings in a river basin

The Nitra River in Slovakia has about 600,000 people in its catchment area and is of rather poor quality. Under a minimum discharge policy (current EC standards), the capital costs for wastewater treatment would amount to US$65 million. However, to achieve a standard equivalent to second-class water in many European countries, the capital costs under a regional least-cost policy amount to only US$13 million (a ***savings of over US$50 million***). To achieve ambient water quality equivalent to what would be achieved by EC standards, a regional least-cost approach would require capital cost expenditures of US$42 million, which still represents a savings of US$23 million (details in the double-page box in chapter IV).

1.10 In this sense, the Environmental Action Programme implicitly emphasizes as much what should *not* be done, as what should be done urgently. As such, it not only tries to take a realistic approach, it also highlights ways to ensure that the scarce financial and human resources are indeed directed at the most important environmental problems.

1.11 It is recognized that many decisions are made on the basis of factors which go beyond narrow consideration of the merits of environmental measures. Often, the availability of local or foreign exchange for a particular investment, the apparent willingness and readiness of local institutions to undertake an investment, the degree of complexity of a proposed project, the demonstration value, and various other elements that are said to contribute to the "implementability" or "bankability" of projects are used as justification for undertaking certain investments. This should not, however, obscure the fact that most of these justifications do not address the central goal, which is to improve environmental conditions -- and hence the quality of life. Decision makers should therefore at least be offered a sound analysis which presents them with consistent options on which to base their considerations.

1.12 In other words, it is necessary to consider both priorities and implementation at the same time to obtain an overall view of the scope of the problem(s), the options to address the problem(s), the implications of implementing alternatives (including their cost-effectiveness) and the expected outcomes. This applies in particular to the desired level of ambient environmental quality.[3] The main constraints in implementation arise from a general lack of financial and above all institutional capacity rather than from issues that are specific to particular environmental problems or potential solutions. This reinforces the central message of the EAP to focus the limited resources that are available on those actions -- whether policies or investments or both -- that offer the greatest environmental benefit.[4]

1.13 Since the policy and institutional context may have a critical influence on the commitment and resources devoted by private and public sector enterprises to solving environmental problems, it follows that establishing an appropriate policy and institutional framework must be a central component of the Action Programme if it is to achieve its goals. Many of the past environmental (and economic) problems in CEE countries arose from a preoccupation with large investments, at a time when relatively small, incremental expenditures and especially institutional, management-related, and other "software"-type improvements were being implemented in the market economies. It is no surprise, then, that a large number of studies are being carried out in CEE countries to redress the lack of attention to non-investment related activities and detailed project preparation (see chapter IV).

1.14 The inadequate attention in the past to non-investment activities, the need to redefine and/ or strengthen institutions within and between different ministries, and the uncertainties brought about by the major economic and social changes of the past two years, all contribute to the relatively weak capacity to implement projects and also to absorb international assistance.

1.15 Tangible projects and specific investments nevertheless remain important, but they should contribute significantly toward an agreed objective. Indeed, this report presents a range of concrete actionable programs targeted at priorities such as, for example:

- reducing air emissions from specific types of industrial plants;
- implementing measures to reduce particulate/SO_2 emissions in urban areas, particularly those linked to the use of coal in the household and service sectors;
- launching low cost/high gain programs in the "dirtiest" industrial sectors (e.g. operation and maintenance, energy efficiency, auditing);

3/ See also the discussion on ambient environmental standards in chapter III.

4/ As chapters IV and V describe in more detail, most relevant decisions are taken at the enterprise and/or municipal level. To focus on environmental priorities in that context, it is important to develop institutions that can collect the necessary information to assess the contribution from various sources of environmental pollution and the costs for abatement.

- protecting groundwater from wastewater discharges and hazardous wastes;

- selected municipal wastewater treatment investments that offer the prospect of achieving significant improvements in ambient water quality at low cost; etc.

The Action Programme also includes specific elements relating to the maintenance of biological and landscape diversity and other longer-term needs where immediate actions are justified.

1.16 This document does not contain a specific list of projects. On the other hand, the following information is provided -- extending the fundamental work carried out, for instance, under the Baltic Sea Joint Comprehensive Environmental Action Programme:

- an inventory of major pollution sources throughout the region (**Annex 4**),

- an extensive list of locations where environment-related public health problems have been documented (**Annex 1**),

- an indicative description of the types of investments in different (sub)sectors which would be most appropriate and cost-effective to address serious environmental problems (boxes in chapter V); and

An inventory of the most vulnerable ecosystems, the sources of risk and appropriate measures is currently under preparation.

1.17 By combining this information, numerous further "projects" should emerge.[5] More importantly, though, *the Action Programme can provide a framework under which CEE countries can propose project concepts for inclusion in a separate portfolio of projects suitable for bilateral or multilateral cofinancing*. The purpose of such a portfolio is *not* to develop yet another "shopping list" of potential pollution control investments. This would amount to a repetition of the past inefficient practice of submitting proposals to central planning committees. Rather, the idea is to identify and describe high priority environmental *problems* and to individually or jointly agree on an effective set of *solutions* in the form of a mixture of projects and policies. The EAP provides examples of programs to address important environmental concerns.

1.18 In other words, the EAP is meant to form the basis for consensus and a *partnership* among Eastern and Western countries and institutions, as part of which CEE countries would undertake essential policy and institutional reforms. At the same time, donors would make a commitment to provide technical or other assistance to support these policy and institutional reforms, and contribute toward the implementation of projects mutually agreed to be of high priority.

1.19 The EAP also discusses possible measures to address transboundary pollution -- especially for air. Although the long-distance transport of pollutants such as sulfur dioxide and nitrogen oxide -- the precursors of acid rain -- cause acidification problems across Central and Eastern Europe, from the standpoint of human health, local sources of pollution pose the most serious risks. This situation need not necessarily present a dilemma. From the perspective of Central and Eastern European countries,

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5/ In this context, "projects" imply a package of investment, institutional and policy goals which together ensure the achievement of specific high priority objectives.

measures to address local pollution are likely to have the highest priority. However, by solving the local and national problems, CEE countries will also reduce the transboundary portion of the sulfur and nitrogen pollution by a significant amount. Progress in solving the remaining transboundary component will depend on a *Europe-wide consensus* on priorities.

1.20 **Why a Regional Approach?** Each country in Central and Eastern Europe has its own specific environmental problems, which reflect historical patterns of development and of the (mis)use of natural resources. However, there is a strong thread of common issues which define the major environmental challenges facing countries which are as diverse as Hungary, Lithuania and Ukraine. These are the legacy of decades of central planning and policies under the former regimes. The common issues may be summarized by the impact of certain interrelated but fundamental *economic changes associated with the transition to market structures which will affect all of the countries* discussed in this Action Programme. The most important of these are:

- Large increases in energy prices, especially for solid fuels and for household consumers. This will be accompanied by much higher prices for other natural resources including mineral ores and quarry products.

- The gradual imposition of "hard" budget constraints on enterprises together with a shift in their objectives from an overwhelming concern to meet production targets to a focus on financial and efficiency objectives.

- The progressive replacement of out-dated or inappropriate capital equipment, mostly embodying technologies originating in the 1930s or the 1950s, by more modern capital adapted to the relative prices, technical expectations and environmental regulations of the rich market economies.

- Large changes in the structure of economic activity. The historic emphasis on investment and the production of heavy industrial goods in all formerly socialist economies will give way to market pressures driven by consumer preferences and incomes. Preliminary projections indicate that this will lead to a relative growth in the output of services and of certain industrial sectors -- e.g. food processing, paper and paper products, chemicals and automobiles -- at the expense of metallurgy, machinery and construction materials. These changes are likely to mean that industrial production will lag substantially behind the general recovery in national income that will follow the successful conclusion of stabilization and reform programs.

- The countries of the region are also characterized by a well-educated and in some cases exceptionally skilled labor force, but a shortage of management capacity and skills to implement projects in a decentralized political system.

1.21 The similarities between the countries of Central and Eastern Europe in terms of the general character of their environmental problems and the direction in which they are likely to change over time are stronger than differences due to individual circumstances. Hence, a regional approach provides an excellent basis for applying the lessons of experience in different countries and sectors, and for developing an Environmental Action Programme.

Diversity among countries: The case of Albania

Most of the countries of Central and Eastern Europe face similar types of problems in the course of economic transformation and industrial restructuring. In this Action Programme, some of the most critical problems identified are related to human health problems associated with emissions from industrial plants.

However, there are wide differences among particular countries, and some countries might identify priority problems that diverge significantly from those discussed in this report. Albania is a case in point. Although the country also is faced with some of the traditional problems related to industrial pollution, one of its major problems is related to soil erosion and deforestation. The rural sector still plays a dominant role; fuelwood is an important source of energy supplies, and the country must address problems related to the rapid growth of livestock.

1.22 **The Environmental Action Programme in the Context of Ongoing Activities.** It has been stressed that the EAP is a framework document that complements the many programs and activities that are being carried out in Central and Eastern Europe. As such, it is hoped that it will provide the impetus for different countries to prepare their own concrete action programs, and assist in the priority setting process of some of the major regional programs. Thus the EAP is designed to serve as a guide for both Eastern and Western countries.

1.23 With reference to programs which received international support as part of the G-24 coordination process, the EAP tries to provide some balance in a few areas. This applies in particular to two concerns which were identified in a recent assessment of three years of G-24 assistance to the countries of Central and Eastern Europe:

- there was a tendency that air pollution has received a relatively small proportion of the assistance in some countries, particularly emissions from low sources (low stack emissions, vehicles);

- wastewater investments have tended to focus on large size plants, except possibly in cases where transboundary pollution was an issue.

More generally, the EAP extends the Environment Sector Strategy adopted by the G-24 in their Environment Working Group. In particular, it places considerable emphasis on the requirement that G-24 and other environmental assistance should reflect and support the recipient governments' own priorities, and actively support the reform process. The table below shows the main areas of focus for some of the G-24 countries and the EC (excluding international financial institutions).

	Estonia	Latvia	Lithuania	Poland	CSFR	Hungary	Romania	Bulgaria	Albania
Finland	• wtr, air			• wtr, air					
Denmark	• wtr, wst	• wtr, wst	• wtr, wst	• wtr,wst,air	• wtr,wst,air	• wtr,wst,air			
Sweden	• wtr	• wtr,wst,air	• wtr	• wtr, air	• wtr				
Norway				• wtr,air,inst	• wtr,wst,air				
Netherlands		• inst		• all sectors	• inst	• all sectors			
Belgium				• mon	• mon	• mon			
Switzerland					• wst	• wst			
Austria				• air	• wtr,wst,air	• air			
France				• inst (wtr)	• inst	• inst (wtr)	• inst (wtr)		
Germany				• inst	• inst	• inst	• inst	• inst	
UK				• inst	• inst	• inst	• inst	• inst	
USA	• inst	• inst	• inst	• all sectors	• all sectors	• all sectors	• inst	• inst	
Canada				• inst	• inst	• inst	• inst		
Japan				• air, wst	• air, inst	• wst		• inst	
EC (PHARE)	• inst	• inst		• all sectors	• wat,wst,inst	• all sectors	• inst, mon	• inst,mon	

The matrix shows the main areas of focus for some of the G-24 countries and the EC; it is not intended to be comprehensive. IFIs are not included.

wtr = water treatment
wst = waste treatment
air = air pollution control
mon = pollution monitoring
inst = institution building, inc. training & policy studies
inst (wtr) = institution buiding with water sector focus

II. CRITERIA FOR SETTING PRIORITIES

Setting environmental priorities involves choices. The damage to human health caused by poor environmental quality is the first concern in the region -- as it was in the West before the major environmental health threats had been addressed. Initial evidence suggests that the following types of environmental pollution have affected human health in particular areas in CEE:

- *Lead in air and soil from lead and zinc smelters and transport;*
- *Airborne dust from household furnaces, small-scale enterprises, power and heating plants, metallurgical and other large plants;*
- *Sulfur dioxide and other gases, especially in combination with dust.*

Other health impacts arise from:

- *Nitrates in water from inadequately maintained/designed rural septic tanks, feed lots and agricultural enterprises, and inappropriate fertilizer application;*
- *Contaminants in food and water, especially where heavy metals or toxic chemicals threaten drinking water supplies either directly or through poor disposal of hazardous/nuclear waste.*

But human health is not the only criterion to set priorities. In certain areas, the following may be of major significance:

- *productivity losses caused by damage or destruction of physical capital and natural resources, and*
- *the deterioration of or threat of irreversible damage to coastal ecosystems, lakes, forests and mountain habitats.*

Finally, priority might also be attached to low-cost/high gain measures to address issues of growing importance in the medium-to-long term and where there may be a long lead time to effect changes.

Each country must decide how the resources can be best allocated to remedy the problems that it regards as having the greatest priority. This will involve a combination of the following complementary measures:

- *better economic and environmental policies;*
- *expenditures that are carefully targeted to projects with high benefit to cost ratios; and*
- *institutional development, including training, education, and exchange programs.*

The Costs of Environmental Damage
Identifying the most serious issues and most affected areas
Focus on Human Health
Responding to the Problem:
Finding a balance between Policies and Investments

2.1 General environmental conditions in Central and Eastern Europe will eventually converge toward those in Western Europe and North America. This convergence might take several decades. Thus it is the *path* to achieving this objective that is at issue, not the goal itself. This path is determined by priorities established along the way -- either by design or by default. *Setting priorities is basically a process of ranking future actions, such that the things to be done first will achieve the greatest gain relative to given objectives and available resources.*

2.2 The principal analytic criteria to establish priorities for environmental action arise from the following questions:

(i) *What do people care about?* (a set of normative judgments reflecting basic social and humanitarian objectives which define the priorities assigned to various aspects of the quality of life in a particular country – both now and in the future)[1]

(ii) *What are the most serious environmental problems in light of these value judgments?* This requires an estimate of the costs of environmental damage (or the benefits of environmental protection and remediation) relative to the stated social and economic objectives.[2]

(iii) *What are the most efficient ways to achieve different environmental goals?*

Both the costs of environmental damage as well as the cost-effectiveness of the solutions will vary considerably over time, and so will environmental priorities (see Box).

2.3 This chapter first describes some of the tools with which to identify which are the most serious environmental problems (i.e., assessing the costs of environmental damage), then applies these concepts by providing an initial overview of the most serious types of problems. The description is still incomplete with regard to information on the former Soviet Union whose newly independent states joined the "Environment for Europe" process somewhat later. The chapter then focuses on human health as a particularly significant short-term matter of concern, and concludes by making recommendations on how to balance different actions to achieve the desired environmental objectives in the most efficient manner.

The Costs of Environmental Damage

2.4 The economic and social costs of environmental damage are usually divided into three broad categories:

Costs to human capital and productivity (Health Costs). Human welfare and productivity are reduced by sickness and premature mortality caused by degradation of air and water quality and by other environmental risks. Pollutants can cause health problems through direct exposure or indirectly through changes in the physical environment. To assess the health consequences of environmental damage in Central and Eastern Europe it is necessary to rely for now very much upon epidemiological studies from OECD countries since there are relatively few local investigations which control adequately for the contributory influences of factors such as smoking and diet.

1/ In this context, the signing and/or ratification of international obligations such as those mentioned in chapter I represents a priority criterion in itself.

2/ The costs from actual environmental damage and the costs due to man-made (e.g. nuclear accident or species extinction) or natural (e.g. earthquakes) disasters are captured in the same framework. They are both expressed in terms of the willingness to pay either to avoid/remedy the damage or to reduce the probability of an accident (see also para. 2.4).

How environmental priorities may evolve over time

The analysis in this report highlights air pollution, especially that due to particulates, as the first priority on the environmental agenda for Central and Eastern Europe. However, environmental priorities will change as the policies, structural changes and investments discussed in this report mitigate some environmental problems and make others worse.

Preliminary analysis suggests that air pollution will dramatically improve as a consequence of higher energy prices, the fall in the output of the metallurgical sector, and better environmental controls linked to investment in new capital equipment. For water pollution, the prospect is much less rosy. Over three quarters of BOD emissions come from municipal (household) sources, so that general progress in raising the dissolved oxygen level of river depends upon better municipal sewage treatment, which will be very costly and cannot be financed from the investment resources currently available to either national or local governments. Discharges of heavy metals and chemical pollutants are largely an industrial problem and depend on suitable industrial pre-treatment investments which are not necessarily amenable to simple policy changes such as higher energy prices or even pollution charges.

The projections discussed in this report suggest that the output of the food processing, wood products, paper and chemical industries -- all significant sources of water pollution -- will grow much faster than that of the building materials, metallurgy and electricity industries. The balance of industrial emissions will, therefore, shift towards water pollution and away from air pollution.

The effects of industrial change on the disposal of solid wastes is mixed, since there will be a decline in the total volume of such wastes – primarily due to a decline in mining activity – but there are likely to be increasing problems in dealing with hazardous wastes unless low waste technologies are adopted very quickly.

As living standards begin to recover, both the size and use of the automobile fleet are likely to grow rapidly which will lead to increasing problems of photochemical smog and ozone exposure. The volume of municipal waste will also rise rapidly as consumers begin to expect packaging standards equivalent to those in Western Europe.

The benefits attached to reducing environmental damage will also evolve. As the worst of the health problems associated with air pollution are addressed, the amenity benefits of a clean environment will gradually move to the center of the stage. This will focus attention on improving water quality for recreational purposes (i.e. sewage treatment), or better visibility (i.e. addressing the problem of vehicle emissions).

These considerations suggest that the primary focus of environmental policy will shift over the next decade from air pollution from stationary sources towards water pollution from both industrial and municipal sources, towards vehicle emissions and towards the management of solid and hazardous wastes.

The numerous studies being carried out in preparation for the Environmental Action Program for Central and Eastern Europe have been designed to provide a solid analysis of these issues and identify the most appropriate short-term measures in light of the anticipated longer-term developments.

Losses to physical and natural capital (Productivity Costs). Environmental degradation reduces the productivity of natural resources and physical capital. Destruction of natural resources can disrupt natural services such as water cleansing, stability of river banks, or oxygen generation. Water pollution damages fisheries; excessive levels of ozone lower crop yields; water salinity causes corrosion of industrial plant and equipment and of infrastructure; acid rain leads to acidification of soil and water, thereby damaging forests, reducing timber yields and causing fish death in large areas of Europe; soot, smoke and acid pollutants lead to higher levels of expenditure on the cleaning and maintenance of houses and other buildings. To the extent there may be productive uses of plant and animal species as well as ecosystems (e.g. wetlands and grasslands) that risk damage or even extinction, this also represents a (potentially very high) productivity cost of environmental degradation.

Irreversibility and loss of environmental quality (Amenity Costs). A clear view, a pristine lake, a mature forest, and clean and quiet neighborhoods all add to the quality of life. People are willing to forego expenditure on other goods and services in order to protect endangered species and ecosystems, and enjoy the benefits of better environmental quality either for themselves or for future generations.

These costs may impede sustainable development, in that current generations do not "meet their needs without compromising the ability of future generations to meet their own needs".[3]

2.5 While figures for the total cost of environmental damage are often quoted for various Central and East European countries (ranging from 2-10% of GDP), these are rarely based on a systematic and well-founded assessment of such costs. An initial review of the estimates which have been produced for Poland suggests that losses due to environmental damage might have amounted to 3-4% of GDP in the mid-1980s, an amount which is 2-3 times the relative magnitude of comparable costs in Western European countries. *The most important single component is thought to be the damage to human health caused by air pollution, especially exposure to high levels of particulates.* Productivity losses due to high levels of water salinity (caused by discharges from coal mines) and BOD in the country's major rivers are the next most important element[4], followed by the loss of amenity associated with poor air quality in urban areas.

2.6 Similar studies have not been carried out for other Central and Eastern European countries. However, there exist a number of studies demonstrating that health damage is the primary cost of environmental pollution even in some of the wealthiest OECD countries, where the gross forms of environmental pollution still found in parts of Central and Eastern Europe have been mostly eliminated. A recent study commissioned by the German Government suggests that the costs of health and related damages in Germany exceed those of material, forest or biotope damages.[5] It is therefore plausible (but still subject to confirmation) that damage to *human health* is also likely to be the most important component of the losses caused by environmental degradation in Central and Eastern Europe, especially as some of the worst forms of pollution still exist that have been solved in the West 20-30 years ago.

2.7 The costs of reduced *productivity* of natural resources and physical assets are much more unevenly distributed. Discharges of saline water from mines are a serious problem in Poland and a small part of the Czech Republic. In the mining areas of Ukraine, the dumping of mine and washery waste and acid mine drainage are serious problems. Material damage caused by exposure to particulates and acid pollutants is a significant problem wherever there are high levels of air pollution, but this is

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3/ The general principle of sustainable development adopted by the World Commission on Environment and Development (*Our Common Future*, 1987).

4/ The effects of heavy metals and micropollutants are also potentially significant.

5/ Klaus P. Masuhr *et al.*, *Identifizierung und Internalisierung externer Kosten der Energieversorgung.* Studie im Auftrag des Deutschen Bundesministeriums für Wirtschaft (Prognos Institut, Basel: Juni 1992).

necessarily very closely correlated with the health damage caused by such air pollution. Loss of *agricultural productivity* due to soil contamination, salinization and forest damage is a significant local problem in several countries (e.g., Kalmuckia in Russia), but the *overall* economic loss may be smaller because it is possible to replace the lost output from other sources. Forest damage, damage to fish stocks as well as other effects on the ecosystem have been valued quite highly in both Western and Eastern Europe. Results of research conducted in the framework of the Convention on Long-Range Transboundary Air Pollution of the UN-ECE show that the level of current acid deposition should be reduced to avoid further depletion of forest soils and surface waters in large parts of Western and Eastern Europe.

2.8 Little is known about the *amenity* value of a better environment in Central and Eastern Europe. There is active support for measures which deal with severe local pollution, especially if this is seen as jeopardizing the health of those living in the neighborhood of the emissions, but it seems that the economic problems associated with the transition to market economies have lessened the general priority attached to diffuse environmental problems. Thus, amenity concerns may become more important as the most severe forms of pollution are dealt with but they should not be a primary consideration in establishing priorities for environmental policies and investments in the immediate future, except in the few instances where there are risks of irreversible sacrifices now. In general, the maintenance of healthy and diverse natural ecosystems and human-made landscape should go hand in hand with air and water pollution improvements to increase the effectiveness of such clean-up measures.

2.9 The intrinsic values of both health risks and risks to ecosystems are implicit as part of the policy making process. In such a process both costs and secondary effects (e.g. employment) of a policy decision are weighed against the benefits in terms of physical changes in the environment or reduced (short term or long term) risks. The ultimate "willingness to pay" for different environmental concerns (e.g. water or air pollution) and types of health risks (e.g. bacteriological or chemical induced risks, chronic diseases or genetic effects) is therefore only expressed during the policy process itself. What this *Action Programme* therefore recommends is a transparent and consistent process in which the problems to be addressed are clearly described, and the costs and benefits of different solutions openly debated.

2.10 There are certain rules that may assist policy makers in taking a decision. As several environmental problems are sometimes related to the same cause (e.g. energy use or the use of certain minerals), there are a number of measures that will tackle several problems at the same time (e.g. energy conservation or improving the efficiency in production processes in the metal industry). Often, end-of-pipe measures are related to just one environmental problem (e.g. water purification, dust collectors), but structural changes (e.g. in energy use and fuel mix, restructuring of industrial processes, and improvements in the quality of products) will have an influence on several environmental problems simultaneously and could therefore be given priority. A major advantage of such structural measures is that they not only reduce emissions but also reduce the need for inputs (e.g. of energy and materials) and therefore have a financial payback. A good example of a measure that reduces both (dust and SO_2 related) health risks, acidification and (saline) water pollution, and greenhouse warming is a reduction in the use of coal.

2.11 Another rule that can be used in priority setting is that it will always be more expensive to clean-up or mitigate environmental problems once they have occurred than it is to prevent them. For example, in the long run it is cheaper to prevent soil pollution by producing less waste and carefully managing the waste, than it is to clean up contaminated soils. Moreover it seems hardly sensible to clean up the soil when the waste stream is not yet under control. Efficiency improvements in mining and industry -- leading to a reduction of losses -- and the application of stricter rules in waste management will be more urgent then a general soil clean-up program.

2.12 The willingness to pay on the part of local beneficiaries for long term and transboundary external effects will generally be much lower than the willingness to pay for short term and local effects. For example, it may stand to reason to give higher priority to short term health risks in hot spot areas than to long term effects to ecosystems. However, the two extremes -- local versus transboundary effects -- do not necessarily need to be inconsistent with one another. Measures to reduce emissions and local damage in hot spot areas can also bring about positive transboundary effects. (Chapter VI discusses this issue in more detail.)

Identifying the most serious issues and most affected areas

2.13 The evidence of environmental damage in Central and Eastern Europe is mixed, and there is no doubt that there are several locations with problems of unique and major proportions. However, in many respects, Central and Eastern Europe is no different than most other areas in the world: air (and to a lesser extent water) pollution is largely confined to mostly urban areas exposed to emissions from industries, power plants, and home heating and transport. At the same time, Poland, Ukraine, and especially Russia, contain some of the world's most extensive natural areas that are virtually untouched, yet are also highly sensitive to pollution.

Portrait of a *Regional* Hot Spot:
The Mining Districts of Northern Bohemia

- Five-to-eight-fold increase in mortality from respiratory causes among 1-12 month old newborns in the areas of highest ambient dust and SO_2 levels.
- Increased rates of low birth weight and congenital anomalies among newborns.
- Allergies and respiratory diseases more prevalent among school children than in the rest of the Czech Republic.
- Children temporarily removed from the area to attend "nature school" in an unpolluted area show immediate evidence of improved red blood cell count which reverses when they return home.
- Increased all-cause mortality and lung cancer mortality among both men and women compared to the Czech Republic as a whole.

2.14 From a long-term perspective, it is worth keeping in mind that some of today's "hot spots" in Central and Eastern Europe already had environmental problems in the early part of the century. What we are observing in some areas is a traditional (though often exacerbated) pattern associated with old industrial areas, implying that the experience in the rich market economies -- both positive and negative experience -- may be quite useful in guiding CEE countries. Central planning under the former regimes only perpetuated and exacerbated the old patterns, preventing successive adjustments from taking place as occurred in the market economies.

2.15 **Air Quality.** Air pollution is potentially the most serious short-to-medium term environmental problem for human health. It is also one that has received relatively less emphasis in the environmental expenditure programs of Central and Eastern European countries. From a health perspective, polluted air is more difficult to avoid than polluted water. Thus, any country which has zones where ambient air quality *could* affect human health will tend to have evidence that it *has* affected human health, and the more people live in the zone, the greater the public health significance. Nor can man-made structures and nature "escape" the pervasive character of air pollution. This emphasizes the point that what matters first of all are *exposures* to pollutants, and that one should work backwards to the *emissions* responsible for the most damaging exposures. Exposure to pollutants -- as expressed in terms of *ambient* environmental conditions -- varies greatly from location to location, depending on geographical and meteorological conditions and the extent to which point-source emissions are dispersed. **Annex 3** [a map is currently in production] shows the locations where ambient exposures to two of the principal air pollutants -- particulate matter and sulfur dioxide -- exceed annual average ambient standards of the European Communities.

2.16 In many towns and cities -- especially in coal producing areas -- a major portion of the population is affected by the particulate and gas emissions from thousands of "low stack" sources -- small coal stoves used in homes for domestic heating, and small- and medium size enterprises burning coal for space heating and process heat. This is the case particularly in the Sulfur Triangle region covering Upper Silesia in Poland, Northern Bohemia in the Czech Republic, and the eastern part of Germany (Saxony).[6] Local heating and home furnaces tend not to have any pollution control systems, while large factories most often do for particulates. In Katowice (Poland), for example, 46% of soot and dust emissions come from low stack emissions of high-ash coal. In the republics of the former Soviet Union, the availability of natural gas has brought about much more progress towards solving the low stack problem in the major cities, though not in smaller towns located in coal producing areas.

2.17 In the Sulfur Triangle area, there are in addition hundreds of larger sources of pollution (primarily energy and metallurgical industries), and the air shed is influenced more or less uniformly throughout the region. This has been the typical "disaster scenario" often described as Eastern Europe started to open to the West. It is also what most frequently has been referred to as a regional environmental "hot spot". Average annual concentrations of particulate matter and SO_2 in the Sulfur Triangle exceed 35 $\mu g/m^3$ and and 50 $\mu g/m^3$, respectively. Average daily concentrations during smog episodes and in busy urban areas have reached 1,200 $\mu g/m^3$ and 650 $\mu g/m^3$, respectively.

2.18 Three other areas in Europe stand out as regional hot spots due to large concentrations of heavy industry: The Donets and Southern Dniepr basins in Ukraine, the Middle Volga region (Nizhnii Novgorod oblast, Samara, Volgograd) and the Ural region (Sverdlovsk, Chelyabinsk, Perm Oblast/Bashkir Republic). These areas are shown in Maps 1 and 2.[7]

Portrait of a Town at the Confluence of Point Sources of Exposure: Copsa Mica, Romania

Dust and Gases. Pulmonary function was studied in 371 children aged 7-11 and compared with controls.

- 30.2% exposed children versus 10.0% controls had reduced lung function (peak expiratory flow);
- 18.1% versus 10% had reduced lung function (forced expiratory capacity).

Lead. Psychological testing was carried out on the same sample as above, as well as a group of 12 year-old children. This was done because high lead exposures to children affect neuro-behavioral responses, including IQ. Approximately 30% of children are expected to test "weak or very weak," which means below the first standard deviation of the "normal" distribution on each of the following tests: Instead, 73% tested weak or very weak on the IQ test; 58% on the concentration test; 52% on the learning test; and 60% on the memory test.

2.19 In general, however, hot spots are local, not regional. It is more common to find small districts or towns such as Borsod County in Hungary or Copsa Mica in Romania which are reminiscent of "rust belt" areas in North America (Pittsburgh/Allegheny County, Gary), or Japan (Kitakyushu). These are old industrial areas where the nearby population is exposed to emissions from a confluence of point sources whose influences on air (and water) can largely be distinguished from one another. The problems are especially acute in the case of metal smelters and lignite power plants emitting heavy pollutants such as metal dust, soot and particulates which tend to settle near their sources. Many of the

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6/ The "Black Triangle" is defined as an area which consists of Central-European brown coal basins, formed primarily by south-western Poland, the north-western part of the Czech Republic, and the south-eastern part of the Federal Republic of Germany.

7/ In the northern parts of Russia, sulfur dioxide emissions cause a variety of damages in urban areas. Nordic countries have indicated a willingness to cooperate with Russia to reduce environmental problems in particular in the Kola area.

old industrial areas are associated with specific industries, such as steel production (and associated supply industries), and the economic and social fate of those areas is now closely linked to the economic viability of those industries.

2.20 Finally, some of the most dramatic environmental health problems have emerged in locations where "bad town planning" has augmented the impact of emissions from a single point source. Bad town planning simply means that housing or farms have been put right next door to an offending plant with no *cordon sanitaire* to protect them. In such cases, an effective environmental action strategy may be to close the plant, eliminate/reduce to safe levels the emissions, or abandon the housing/farms.

Portrait of "Bad Town Planning": Dimitrovgrad, Bulgaria

Thick, acrid effluent containing hydrogen fluoride and hydrogen sulfide comes from a single smoke stack at a fertilizer plant. High-rise apartments and other settlements had been built right up to the plant gate, thus maximizing the opportunities for exposure to these emissions.

- 50% of children from Dimitrovgrad had below normal height, weight, and chest expansion for their age.
- Lung function was also compromised in Dimitrovgrad. (By age 14, "forced expiratory volumes" averaged approximately 25% below a control group of children from an unpolluted town.)
- An overall assessment was made of children's developmental status in Dimitrovgrad, compared to the control town. Whereas 72% of control children had normal development, in Dimitrovgrad only 18% of children were so classified.

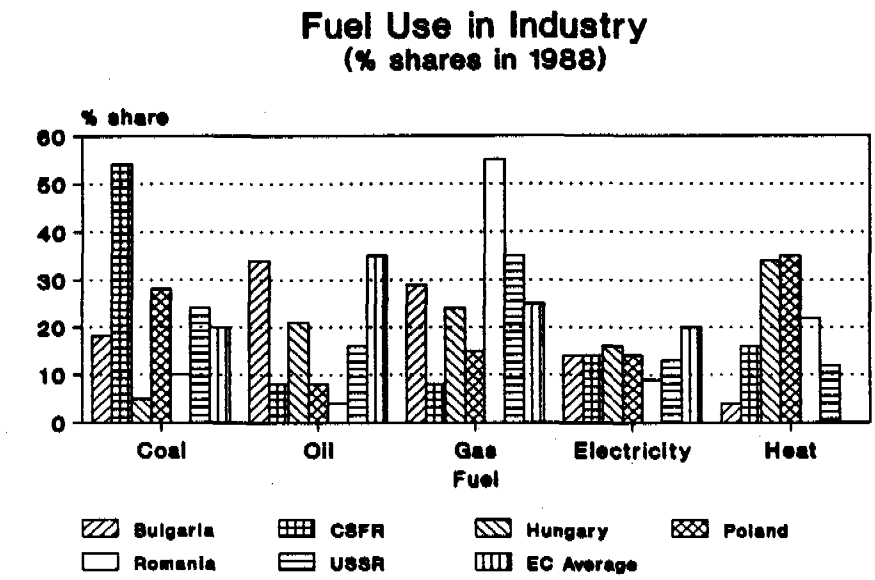
2.21 By recognizing a variety of exposure scenarios other than "regional hot spots", it is possible to broaden the range of actions to be considered in developing an environmental strategy. Whereas regional hot spots are best addressed by remediation and investment strategies for the energy and metallurgical sectors, dozens of other locations may need to be addressed on a case-by-case basis (see chapter V).

2.22 In identifying factors to be taken into account in setting policies, a very important issue is that of *intermittent peak exposure* levels (rather than average exposure over the year). In Katowice, Poland, for example, maximum 24-hour ambient concentrations of black smoke in the winter heating season exceed EC standards more than six-fold. It is worth noting, though, that a London smog in 1952 (which reportedly cost the lives of almost 4,000 people) exceeded the current EC standard more than ten times; and that current EC standards are frequently exceeded in many Western European cities during peak smog periods, which has led to the enactment of special smog alert and smog control measures. One implication may be that, in the short run, CEE cities need better systems for dealing with air pollution emergencies as well as general emission controls.

2.23 During the past several years, air pollution in many areas in CEE has been decreasing. In the former Soviet Union, air pollution in major cities is reported to have declined by 10% during the 1980s, and the nationwide reduction in emissions in Poland has been 20-30% over the past three years. In certain urban areas, pollution levels dropped even more. It is, of course, difficult to identify how much of these reductions is attributable to improved pollution controls and/or long-term economic restructuring, and how much is due to temporary declines in production. The discussion in chapter III sheds more light on this question.

2.24 Air pollution also leads to *acid rain*, which is caused primarily by SO_2 and NO_x emissions from power plants and the growing fleet of motor vehicles, and which leads to damage to forests and eco-systems of lakes. The impact of acid rain, however, is not straightforward, as it depends on climatic, biological and geological conditions which determine patterns of rainfall and the capacity of the soil to buffer acidity in the rainfall. This may have important implications in setting priorities for cleanup of transboundary air pollution. Clearly, in some areas of Europe, acid rain has had a serious detrimental effect on forests and ecosystems, and rapid action may be warranted. This is particularly true where soils are less capable of buffering acid depositions.

Figure 1



to generate the heat

Figure 2

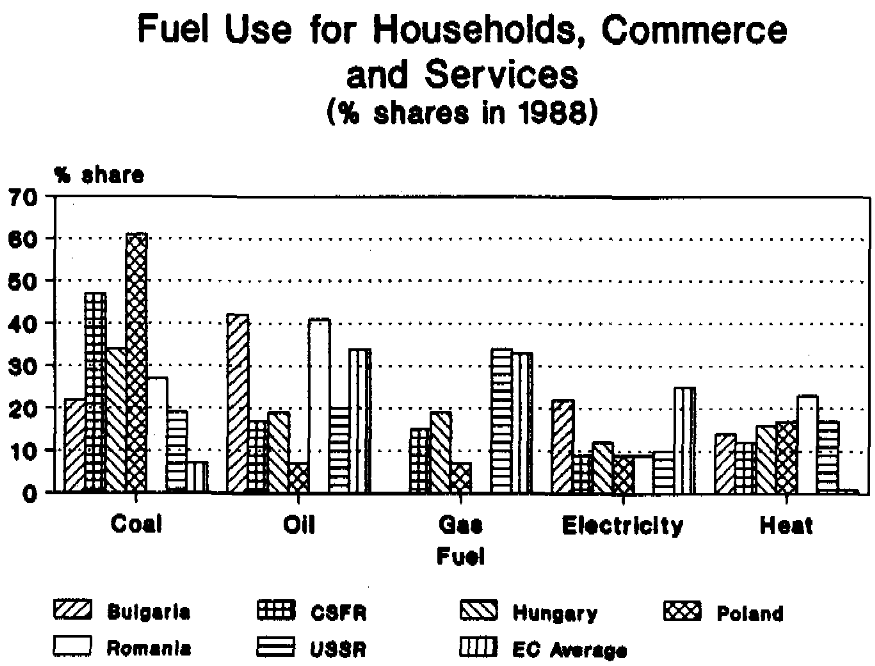
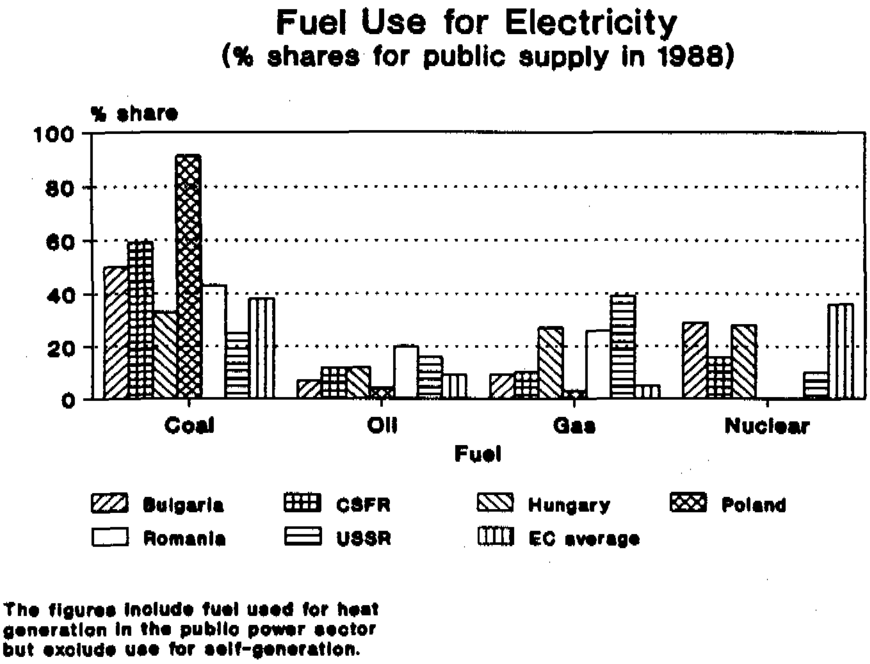


Figure 3



2.25 *The high use of Coal and Lignite in certain countries.* Coal is one of the major causes of harmful dust and gas emissions, reflecting the heavy reliance upon that source of fuel in Central and Eastern Europe (75% of total primary energy supply in Poland, 24% in Hungary, 19% in OECD Europe). **Figures 1-3** (detailing patterns of fuel consumption by sector calculated in tons of oil-equivalent) show that, while coal is an important fuel in CEE industry, the EC average is not significantly different except for CSFR. On the other hand, the reliance upon coal by households and the service sector is far greater than in the West -- 63% in Poland, compared to less than 5% in Western Germany and Spain.

2.26 The data on coal consumption in Central and Eastern Europe in the figures understate the extent of the damage caused by reliance upon coal, because poor quality brown coals and lignites -- typically with high levels of ash and sulfur -- account for a much higher proportion of CEE coal use than in Western Europe. A strong preference for domestic energy resources prompted the CEE countries to develop reserves of brown coal and lignite during the 1960s and 1970s when the market economies were turning away from coal towards first oil and then gas. As a result, brown coal and lignite represented more than 75% by weight of total solid fuel consumption for Bulgaria, CSFR, Hungary, Romania, and the territory of the former Yugoslavia in 1989, though the shares measured in terms of tons of oil-equivalent are, of course, much lower because of the low calorific value of the solid fuels concerned. Even for Poland and the USSR -- both countries with large reserves of hard coal -- these shares were 32% and 28%, respectively. In contrast, the highest proportions of brown coal and lignite in total solid fuel consumption in Western Europe were 58% for West Germany and 45% for Spain, while for most countries the share was less than 10%.

2.27 The pattern of relatively heavy reliance upon coal, especially for household and other small scale uses, combined with a poor average quality of the coal consumed, lies at the root of the urban air pollution problems in many parts of Central and Eastern Europe. In particular, it is emissions from the low chimneys, or "stacks", of households and small-scale enterprises that are especially harmful to health. Indeed, the minimum damage costs from high and low stacks emitting air pollution has been estimated as follows in Poland (**Table 2**):

Table 2: MINIMUM DAMAGE COSTS FROM HIGH AND LOW STACKS (Households) EMITTING AIR POLLUTION

Source	SO_2	Particulate Matter	NO_x
	---US$ per ton---		
High Stacks	265	60	180
Low Stacks (Households)	650	720	460

Assumptions: The majority of low stack emissions take place in urban areas. About 24% of emissions of SO_2 and NO_x, and 45% of particulate matter from low stack sources are deposited in urban areas. High stack emissions are assumed to be fully dispersed and so to be either exported or deposited uniformly over the country. In the case of Poland, this implies that about 5% of high stack emissions are deposited in urban areas. High stack emissions cause primarily forest and agricultural damage. All damage to health and buildings has been assumed to occur in urban areas, and all damage to forests and agriculture has been assumed to occur in rural areas. Monetary damage functions have been assumed to be linear functions of deposition above the critical load, so that the marginal value of a ton of avoided deposition is the same wherever the reduced deposition takes place.

Source: Environmental Assessment of the Gas Development Plan for Poland (World Bank)

The example of West Germany shows that given appropriate equipment and good maintenance -- neither condition being satisfied in most CEE countries -- it is possible to burn lignite and low grade coal in power stations and some large industrial plants without causing significant pollution problems. However, the only way of controlling pollution from burning coal in smaller boilers and open grates is to require the use of expensive smokeless fuels. This undermines the economic attractiveness of using coal, so that most households and small or medium sized enterprises will prefer to switch to electricity, gas or petroleum products if possible.

2.28 The importance of emphasizing the household sector in the affected countries is clear from this analysis, especially in the context of public financing. As described earlier, the target area for this kind of intervention is particularly the Sulfur Triangle. For the power sector, the main issue is to identify least-cost approaches to environmental improvement in the context of overall power system planning. As identified above, however, the immediate health impacts of emissions from the "high stacks" of power plants are probably much less serious than for those from households, so that the latter should be the major focus of public expenditures to mitigate air pollution in the worst affected areas.

2.29 *Other Energy-related Sources of Pollution.* Finally, there are various other aspects of energy use which have an impact on environmental pollution. In particular,

- relatively heavy reliance on low-grade Russian fuel oil (3% sulfur) generates sulfur and particulates in the air;

- natural gas has been allocated to industrial use as feedstock (such as for fertilizer production), rather than to households and small-scale enterprises as a fuel. Bulgaria, for example, did not distribute natural gas at all to households but nevertheless had a very high national consumption level. The gas was used to produce fertilizers at a price equivalent to about 10% of the world market price.

2.30 **Water.** As in Western Europe, many rivers in Central and Eastern Europe are seriously polluted downstream of major urban areas, especially with organic waste (BOD), and probably heavy metals and micro-pollutants from the discharge of industrial and municipal effluent which has been only partially treated or not treated at all. However, few of them are biologically "dead" and, in general, their

Regional Environmental Programs

The *Baltic Sea Joint Comprehensive Environmental Action Programme* was developed by a Task Force on the basis of the Baltic Sea Declaration adopted by the Prime Ministers of the countries in the catchment area at a 1990 conference in Ronneby, Sweden, and preliminarily approved at the Diplomatic Conference on the Protection of the Marine Environment of the Baltic Sea Area held in Helsinki in 1992. Initial work has provided information on 132 "hot spots" which involve point and non-point sources; the Programme also deals with wetlands, agricultural run-off and atmospheric deposition. The twenty-year Programme has been estimated to cost at least ECU18 billion. Chapters V and VI provide further details.

The *Environmental Programme for the Danube River Basin* was launched in 1991. A strategic action plan is being developed in a first phase, with financial support from the Commission of the European Communities, the Global Environment Facility, the European Bank for Reconstruction and Development, the United States Agency for International Development, the governments of Austria and The Netherlands, and The World Bank. Thhere is also a series of technical and institutional activities and an applied research program, which should lead to the creation of an international accident alert system, a strengthened monitoring system, and longer-term improvements in environmental management and scientific knowledge in the region. A separate grant from the Global Environment Facility will contribute to the formulation of a *long-term management plan* for the Danube delta.

The *Black Sea Environmental Management Programme* has been initiated in conjunction with the Global Environment Facility and other donors in cooperation with the littoral states -- Bulgaria, Georgia, Romania, the Russian Federation, Turkey, and Ukraine. The program's main purpose is to identify the principal sources of pollution of the Black and Azov seas, which has resulted in extreme eutrophication and a drastic decline in fish populations and biodiversity.

The *Black Triangle Environmental Programme* was established in August 1991 by the environment ministers of Poland, Czechoslovakia, and Germany. The Commission of the EC later became the fourth official partner. To date, a framework plan has been endorsed, a Programme Coordination Unit established in Usti nad Labem, and a joint air monitoring system is being established.

problems are probably less severe than for the rivers passing major industrial centers in Western Europe up to 20 or 30 years ago.

2.31 While attention has been focused on (large) point sources of water pollution such as industrial plants (including intensive livestock enterprises) or municipal facilities, it is important to remember that non-point sources (especially storm and agricultural runoff) probably account for the majority of discharges of BOD, suspended solids and nutrients into rivers and lakes. Estimates for the rivers draining into the Baltic Sea put the share of non-point sources at a minimum of 50 percent[8].

2.32 *Municipal Water Supply.* In Western Europe, safe drinking water is usually amply available and the high level of drinking water treatment provides satisfactory protection to avoid major outbreaks of infectious disease. In Central and Eastern Europe, however, there is much more wasteful use of water (due, in part, to low water pricing) and less drinking water treatment, and growing amounts of investment may be required to ensure the supply of acceptable drinking water. Moreover, there remain frequent shortages in a number of CEE countries.

8/ U.S. estimates put the share of non-point sources prior to the implementation of the 1972 Federal Water Pollution Control Act at 57 percent for BOD and greater than 80 percent for solids, phosphorus and nitrogen. (L.P. Gianessi & H.M. Peskin, "Analysis of National Water Pollution Control Policies: 2. Agricultural Sediment Control", *Water Resources Research*, Vol 17, August 1981.)

2.33 In general, municipal water supplies in most CEE countries have been safe enough from a human health perspective to not cause major outbreaks of *infectious* disease. This is mostly due to the adequate level of disinfection (chlorination), but it is also a reflection of the temperate climate as well as the widespread reliance on bottled water. Nevertheless, safe drinking water is not generally assured. Thus, there has been an epidemic of waterborne hepatitis A in Riga (Latvia) as a result of a temporary lack of coagulant to treat drinking water from the Daugava River.[9] There is also evidence of infectious disease problems from contaminated water in St. Petersburg, Murmansk and Volgograd (in the Russian Federation, 60% of the population is believed to be exposed to unsafe drinking water). It is difficult at this time to assess the severity in CEE of water pollution due to carcinogenic substances (e.g., chlorinated pesticides). The problems still require careful documentation on the basis of established scientific principles.

Paucity of available data

Human exposure to contaminated water in Central and Eastern Europe is not confined to nitrates. There are many locations in which levels of chlorinated pesticides, PCBs, mutagens, arsenic and heavy metals are "unacceptable". Unfortunately, with the exception of arsenic pollution, it is not clear what the epidemiologic significance of these other exposures really is. The countries of Central and Eastern Europe have so far produced little useful data to address this question, and investigations into similar conditions in Western countries have tended to be inconclusive. Thus, chemical pollution problems in water cannot be given the same priority as airborne exposures where there is clear evidence of human health impact.

2.34 *Municipal Wastewater.* The major types of water pollution in urban areas are organic wastes (BOD), nitrogen and phosphorus compounds, and suspended solids from municipal sewers, and to a lesser degree chemical wastes from industry.[10] To the extent that municipal wastewater treatment plants are available (in Poland, for example, at least a third of the sewage continues to be discharged without any treatment), they tend to be overloaded, improperly maintained and managed, or bypassed. All three Baltic countries have had to close beaches in recent years to prevent the spread of infectious diseases due to inadequate sewage treatment in adjacent settlements.

2.35 In the past, many large enterprises traditionally pre-treated the wastewater they discharged into the municipal wastewater systems. Today, as firms are split up and privatized, the costs of industrial pre-treatment are felt to be high, and there is a risk that increasing amounts of industrial discharges (heavy metals, chemicals, PCBs, etc.) will flow directly into municipal sewers which are not equipped to handle such wastes. On the positive side, the change in water price systems and collapse/restructuring of industry often diminish the earlier overload of existing facilities. Also, due to past design traditions (e.g. oversizing), a significant portion of uncompleted treatment plants represent unnecessary excess capacity. The major issues therefore are: (i) to ensure that industrial wastes are (pre-)treated separately; and (ii) to find innovative, cost-effective wastewater treatment measures depending on site-specific features; and (iii) to redesign the partially constructed but not completed treatment plants (depending on the level of completion and other factors).

9/ There has also been a reported outbreak of milk-borne dysentery based on contaminated water in Jelgava, Latvia.

10/ Heavy metals and micro-pollutants could represent a serious problem, too, though they are not usually captured because of limited measurement capability. On the other hand, even in those countries that possess advanced instruments, there is a lack of funds to use them properly. Western experience shows that it is very difficult and expensive to measure/identify all the micro-pollutants and their impact. Micropollutants are best dealt with at the source.

Nitrates in Drinking Water in Romania

Elevated nitrate levels are found in local water supplies in all but 2 of the 41 districts of the country. According to a 1990 survey of water supplies in 2474 rural locations around the country, 7.1% were above 200 mg/l, 10.1% were between 100 and 200 mg/l, and a further 19.1% were between 45 and 100 mg/l. In 14 districts (Mehedinti, Dolj, Olt, Teleorman, Calarasi, Constanta and Bucuresti-SAT in the South; Tulcea, Braila, Galati, and Vaslui in the east; Botosani and Suceava in the northeast; and Satu Mare in the northwest), more than half of the water supplies exceed the standard of 45 mg/l. In these districts, up to 13% of the newborns were reported to develop methemoglobinemia annually. Reporting of death from methemoglobinemia is very incomplete around the country, so it is difficult to accurately provide case numbers. Some insights into the impact may be gained from a special study of children in high nitrate areas in the Mehedinti/Dolj area. In 1989, 55% of the children in the study area had elevated methemoglobin in their blood. In 1991, there were 181 cases of methemoglobinemia, including 35 which were associated with diarrhea. In total, there were 9 deaths, for a case-fatality rate of 5%. This is a much higher rate than would be implied by routine reporting, since only 1-2 deaths from methemoglobinemia per year were routinely reported from Mehedinti and Dolj in 2 years preceding the study. Furthermore, a case-fatality rate of 5% would potentially make a significant contribution to infant mortality in any district where methemoglobinemia was a common problem.

2.36 *Rural Water Supply and Wastewater, Agricultural and Non-Point Source Pollution.* The problems in rural areas are quite different and potentially more serious from a human health perspective. Nitrate pollution, in particular, affects a large part of the rural population (about 35% of the total population of Poland, Czech and Slovak Republics, Hungary and Bulgaria). In Borsod County, Hungary, for example, nitrate levels are twenty times Western standards, and in about ten different regions in Bulgaria, an average of 35-45% of the population is exposed to elevated nitrate levels. One of the primary adverse health effects is methemoglobinemia[11] ("blue baby syndrome") which is life-threatening for infants. Recent preliminary evidence suggests that *careless and unsatisfactory disposal of wastewater (e.g., septic tank runoff close to village wells) may be contributing significantly to the nitrate problem.* The next major sources of nitrate pollution are agro-industries (e.g., pig farms/feed lots), and of course the runoff from inappropriately applied fertilizers (too much applied at once -- frequently at the wrong time of year). In all of these cases, the solutions will depend critically on education, training, and awareness building at the local level.

2.37 However, leaching of nitrate in agricultural soils is much more widespread in Western Europe, as shown in Map 4. In several countries in Western Europe, a high concentration of cattle and relatively high fertilizer use (on average, double the application rates in CEE) has led to accumulation of nutrients in soil and leaching to groundwater that exceeds EC drinking water standards. In CEE, by contrast, the rural population is more at risk because of the use of heavily contaminated *shallow drinking water wells.*

2.38 *Saline Water Discharges and Mine Wastes.* There is one important water quality problem which particularly affects Poland and to some extent the Czech Republic and Ukraine. This concerns the discharge of highly saline wastewater from a small number of coal mines. Such water is highly corrosive if used for industrial or municipal purposes, so Poland, especially, incurs substantial costs of treatment or transport to avoid the effects of such corrosion as well as damage to local infrastructure due to excess corrosion. The productivity costs of these discharges probably account for the largest component of total losses due to water pollution in Poland (0.5-0.8% of GDP).

11/ Methemoglobinemia is a blood disorder; symptoms are bluish skin, faintness, and shortness of breath. Severe anemia occurs because the blood loses the capacity to carry oxygen.

2.39 Unfortunately, it is likely to be difficult or expensive to deal with discharges of saline water from the mines which are responsible. These are among the most productive mines in Poland, yielding high quality coal from deep but thick seams. New mining techniques together with better management of the saline water pumped out of the mines could reduce the volume of water discharged and its impact on the rivers affected, but these are no more than a partial solution. Eliminating the discharges altogether would either mean closing certain mines or would require substantial costs to reinject water into the mines or for desalinization. At present the mines have little incentive to find cheaper solutions, since they do not have to bear the costs of the damage caused by the discharges. Tackling this problem has a high priority in Poland, but the best outcome is certainly not obvious. This is a clear case where appropriate pollution charges can be implemented in order to provide an incentive to stimulate the search for low cost solutions. (Recently, the implementation of increased pollution charges is reported to have led to an active search by a consortium of mines for investment finance to install desalination equipment. It is unclear, however, whether all the mines are paying the required pollution charges.)

2.40 In Ukraine, the iron ore mines of Kryvyi Rih produce almost 50 million m3/year of effluent, which is not only saline but also contaminated with heavy metals and radionuclides from nearby uranium deposits. Though the volume of water is much less than that discharged from coal mines, it is far more hazardous in thhe short term, given the high concentration of heavy metals.

2.41 *Transboundary Water Pollution.* A distinction should be made between local and regional impacts, depending on the type of the receiving water and pollutants of concern. In many cases, the local effects of pollution from organic material (oxygen depletion) are compensated by the "self-purification" capacity of rivers. This is the case if the flow is reasonably rapid and dilution is large (as for the main river Danube). Thus, there are rivers carrying large loads of suspended solids, BOD and to some extent phosphorus, without causing local problems.[12] However, there are major amenity problems in the Baltic and Black Seas -- the receiving waters of these rivers -- caused primarily by phosphorus and nitrogen loads. This peculiar feature of water pollution calls for strong coordination to deal with national and international shared water resources.

2.42 International attention has focused on developing programs to understand the long-term threats arising from transboundary water pollution affecting the Baltic, the Black Sea, the rivers in the Danube catchment and the Mediterranean, and to develop phased programs. As mentioned, transboundary water pollution is associated with flows of nutrients and the danger of eutrophication, requiring the adoption of expensive advanced methods of treatment (tertiary treatment).[13] Resources to achieve substantial reductions of such emissions are not likely to be available in the short-to-medium term. During the next decade or more, national priorities will be set on the basis of problems of local water quality (primarily related to dissolved oxygen, bacterial contamination, eutrophication of lakes and the consequences of industrial pollutants), water uses and future targets.[14] It is worth noting that the Baltic Sea states, in addition to their commitments under the 1974 Helsinki Convention to reduce

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12/ A large portion of nitrogen compounds is converted sooner or later to nitrate which is persistent and not easily removed. "Self-purification" is therefore less effective in assuring the quality of drinking water resources -- a problem which is compounded by the inability of existing water treatment plants to cope with nitrate contamination. There may also be local problems with phosphorus which can cause high algae biomass if light conditions are favorable and the flow is slow. Again, existing water treatment facilities cannot cope with this problems.

13/ See also *footnote* 8.

14/ There may, of course, be special problems caused by cities located just upstream of borders or by highly damaging discharges such as saline water. In these cases, negotiations between countries are required to establish a mutually acceptable level of water quality at the border.

pollution from rivers, formally agreed in 1990 to a 50% reduction of specified pollutant inputs to the marine environment. Similar commitments for coastal states are envisaged under the new Black Sea Convention.

2.43 A question that can be raised is whether priority should be given to implementing measures in the most upstream section of international watercourses (i.e., to maximize of national benefits) or the most downstream section (i.e., to maximize international benefits). As in the case of transboundary air pollution, there may be situations where such a tradeoff is not necessary. This is especially the case in coastal areas where there are significant tourism and/or wildlife and ecosystem benefits. Chapter V provides examples of possible investments as proposed in the Baltic Sea Environmental Programme.

2.44 **Solid and Hazardous Waste.** Reliable information on the volumes and composition of municipal and hazardous wastes in Central and Eastern Europe is relatively sparse, especially since it is believed that a significant proportion of industrial hazardous wastes is disposed at municipal landfills. This unsafe co-disposal of hazardous and domestic wastes often occurs in unlined landfills which do not adequately protect against seepage into groundwater supplies. Toxic wastes stored at industrial sites also threaten and/or contaminate nearby soil and groundwater supplies. Finally, because of the growing shortage of available landfill capacity, inadequate enforcement procedures, and rising disposal costs, illegal dumping of both hazardous and non-hazardous wastes is increasing (implying potential additional health costs from groundwater pollution).

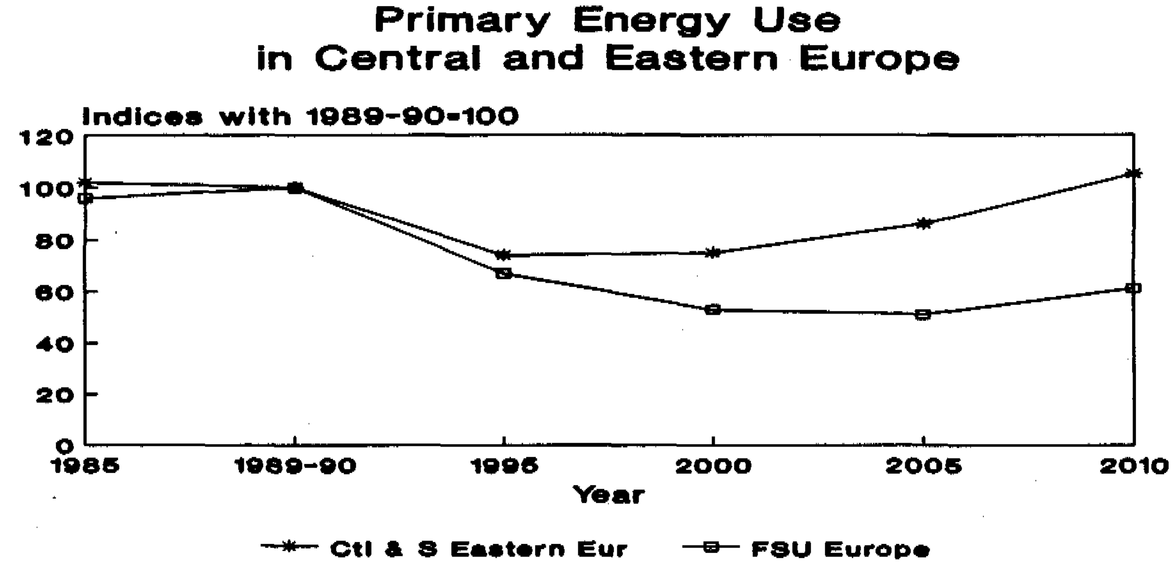
2.45 Mining wastes and ash from thermal power generation represent site-specific sources of concern, and, in some cases, these wastes have a high radioactive content. Former Soviet military installations are also believed to be potentially dangerous sources of toxic wastes, not only in the newly independent republics, but also in Poland, the Czech and Slovak Republics, and Hungary. Clearly, given past security concerns, little is known about wastes stored at former military sites, but their implications for environmental quality could be equally as serious as conventional industrial hazardous wastes.

2.46 Mining of coal, lignite, and metals such as chromium, copper, and iron contributes to environmental degradation in areas near mining operations. Inadequate land reclamation and land subsidence reduces the availability of land for agriculture in some areas and contributes to soil erosion and may affect ground water resources. In Poland, less than 4% of the land used for mining had been reclaimed as of 1988. In addition, spoil heaps of tailings from mining operations (and slag from smelting) also contribute to toxic metal contamination of nearby soil.

2.47 Uranium mining and milling releases radon and radon daughters which are potential occupational hazards. It also releases process effluent and tailings which may cause groundwater contamination (or even contamination of surface waters where management of mining operations is negligent). In-situ-acid leaching extraction techniques (as practiced for example at Straz in northern Bohemia in the Czech Republic) may result in increased risks of groundwater contamination. Up to the present, the former USSR provided for disposal of radioactive wastes from nuclear reactors in many eastern and central European countries in cases where it provided uranium, or services such as enrichment and fuel fabrication for locally produced uranium. These waste disposal arrangements have been, or will shortly be cancelled. Wastes will increasingly have to be stored and eventually disposed of in their country of origin with the result that many countries in the region must now construct or expand waste storage and disposal facilities. Nuclear waste disposal involves varying degrees of hazard depending on the characteristics of the wastes and whether or not they are released into the environment or isolated from the biosphere.

2.48 *Nuclear Issues.* Russia, Ukraine, Bulgaria, Lithuania, Czechoslovakia, and Hungary are all heavily dependent on nuclear power. Work so far has included a wide range of assessments and improvements to operating safety supported by EC and non-EC countries.

Figure 4



2.49 The 1992 Munich G-7 Summit adopted a multilateral program of action comprising immediate measures in the areas of operational safety, near-term technical improvements to plants based on safety assessments, and enhancing regulatory regimes. In addition, the program will create the basis for longer-term safety improvements by examination of the scope for replacing less safe plants by the development of alternative energy sources and more efficient use of energy, and the potential for upgrading plants of more recent design. The Summit extended the existing G-24 Coordination mandate to the new States concerned of the former Soviet Union and proposed the setting up of a supplementary multilateral mechanism to provide for financial support for immediate measures not covered by bilateral programs.

2.50 The period of economic stabilization and transformation provides a good opportunity to put sound long term energy policies into place and to develop non-nuclear sources of electricity supply. **Figure 4** shows that primary energy demand in both Central and South-Eastern Europe and the former Soviet Union is projected to decline by more than 20% from 1989/90 to 1995 and will not rise significantly before 2000. Electricity demand will grow as a share of total energy demand, but it is unlikely to recover to pre-reform levels in any country much before 2005.

2.51 **Environmental Impact of Motorized Transport.** With the exception of some major cities, such as Budapest, Kiev, Kharkov, Krasnodar, or Moscow/St. Petersburg, air pollution from the transport sector is not yet a serious problem in most Central and Eastern European cites. The level of motorization is still low compared with Western European countries: in CEE in 1990 the number of passenger cars per one thousand persons was on average only one-third that of Western Europe (**Figure 5**). Growth rates for passenger car fleets are very high, however -- indeed among the highest in the world -- and demand for motorized transport is likely to increase with rising incomes and with market liberalization (**Figure 6**). In addition, the proportion of freight carried by road transport (including multi-modal and container transport) in CEE is still much lower than in Western Europe and is likely to grow rapidly with the development of new export markets. Thus, as emissions from stationary sources are brought under control, and as vehicle populations rise, mobile sources will contribute an increasingly important share of air pollution.

Figure 5

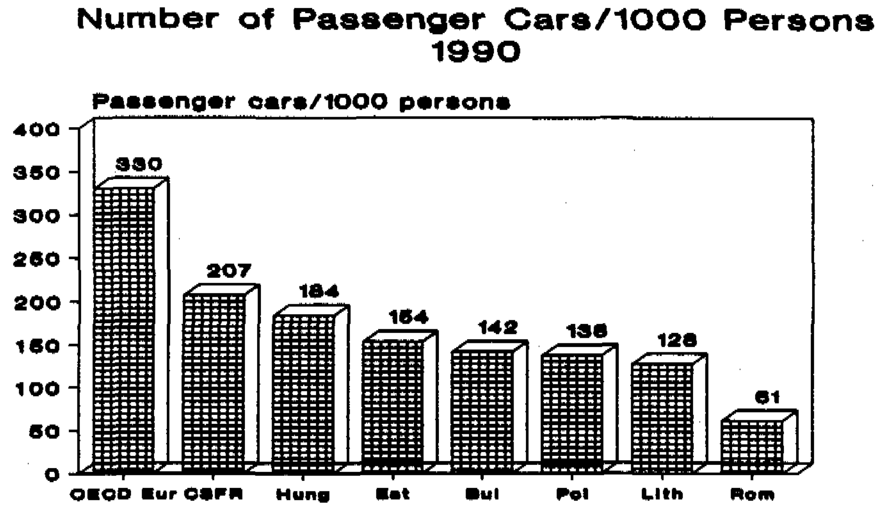
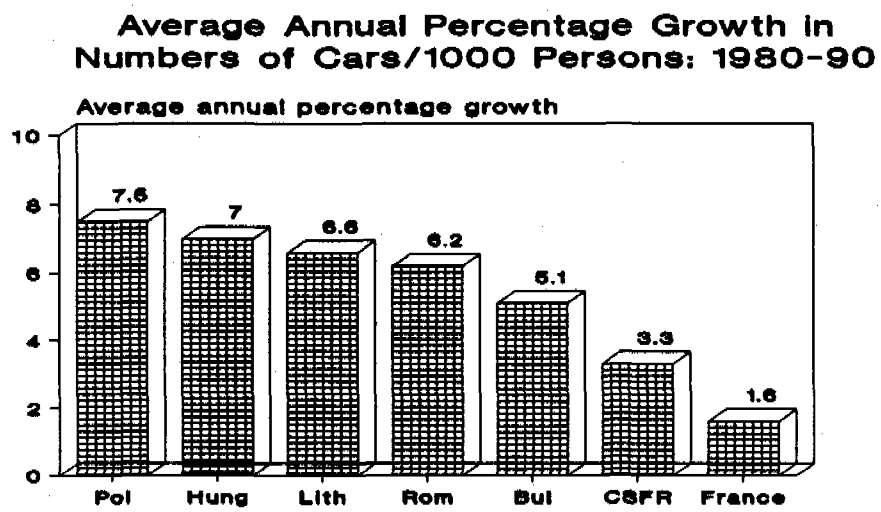


Figure 6



2.52 In Central and Eastern Europe, mobile sources (mainly road traffic) are responsible for about 30-60% of emissions of nitrogen oxides, between 40% and 90% of emissions of carbon monoxide, between 35% and 95% of lead emissions, less than 10% of particulate emissions, and less than 5% of sulfur dioxide emissions (vehicles also emit small quantities of a variety of toxins and carcinogens such as benzene and aldehydes). In some cities -- those without major industrial sources and which do not rely upon coal for domestic heating -- the relative contribution from transport sources to ambient air quality is greater than their emission share on a national basis. In Budapest for example, transport sources contribute about 80% of carbon monoxide and lead levels, 60% of nitrogen oxides, 75% of hydrocarbons (HC) levels (the precursors to ground-level ozone), and 12% of sulfur dioxide levels. In most cities in the region however, the contribution of home heating, power generation and industry to air pollution still outweighs the contribution from traffic. Thus, while countries with reasonable air quality in most towns and cities should rightly give priority to addressing the pollution associated with urban traffic, this would not be appropriate for the majority of CEE countries for which emissions of particulates and sulfur dioxide from industrial and small stationary sources are the major contributors to health damage associated with poor air quality.

2.53 **Degradation of Ecosystems and Biodiversity Conservation.** Protected areas cover about 3-5% of the land area in most of the countries of Central and Eastern Europe. These areas have varying classifications, with the most common being national parks, nature reserves, and specially protected areas. For the most part, these areas encompass mountains and forests; wetlands and sensitive marine environments are generally not as well protected. In most of the countries, environmental degradation of protected areas has been quite limited. There are some notable exceptions, however. In the Czech and Slovak Republics, acidic deposition has adversely affected 75% of the protected areas and seriously damaged 25%, with the primary damage being to trees, while in Poland 6 out of 18 National Parks are located in zones designated as "ecological hazard" or "ecological disaster." Addressing the sources of environmental pollution will therefore reduce costs to both human health and to living natural resources.

Definitions

Biodiversity: The totality of genes, species and ecosystems in a region.

Biodiversity Conservation: The management of human interactions with genes, species and ecosystems so as to provide the maximum benefit to the present generation while maintaining their potential to meet the needs and aspirations of future generations.

2.54 More importantly, biodiversity conservation is not just a question of parks and protected areas, but involves sectoral policy issues in agriculture, forestry, fisheries, etc. The past practices of central planning in CEE countries, ironically, served traditional biodiversity conservation well, and some Western European countries are now recognizing the role of central government in conservation (e.g., the Netherlands government is purchasing land for conservation purposes). Biodiversity in CEE countries is richer than in Western Europe -- in some CEE countries now undergoing major structural changes, relatively large populations of species can still be found which have already become extinct in north-western Europe. The growing trend toward decentralization, land privatization, and Western-style agricultural policies in Central and Eastern Europe creates formidable challenges for biodiversity protection, especially in the face of intense economic pressure to exploit natural resources beyond carrying capacity at a time when human and financial resources and legislative measures are largely missing.

2.55 In some CEE countries, (e.g., Poland), some environmental experts have argued that the practice of constructing extensive drainage systems (so-called land amelioration) throughout the country may be a significant longer term environmental problem. These experts point to the problem of excessive drainage in the summer, leading to a drop in the groundwater table, and to soil compaction and other arid zone symptoms affecting large parts of the agricultural area. Poland's serious water constraints may be in part a consequence of rapid runoff and groundwater depletion on one hand, and high levels of water pollution and wasteful water use on the other hand. There are indications of a clear trend of decreasing agricultural productivity related to inappropriate availability of water. One consequence of the excessive construction of drainage systems has been the substantial reduction in the number of wetlands and the consequent destruction of natural habitats which have been home to endangered species.

Focus on Human Health

2.56 From a social and political perspective, focusing on human health has been viewed in most countries as a sensible short-term priority. Indeed, governments involved in the preparation of the *Environmental Action Programme for Central and Eastern Europe* have explicitly requested that special emphasis be given to human health concerns. In many CEE countries, the linkage between human health information and environmental action has been relatively weak, and human health issues in this context are therefore addressed in somewhat more detail in this report.

2.57 **The Physical Environment as a Determinant of Health in Central and Eastern Europe.** Since the mid-1960s a *life expectancy* gap has emerged in which the countries of Central and Eastern Europe have fallen behind Western Europe, North America and Japan by approximately 5 years. This gap is primarily attributable to relative increases in mortality from chronic diseases in mid-life. However, the reasons for this pattern of relative increase are not yet clear. The explanation must involve some combination of factors in the socioeconomic and physical environments, behavioral and lifestyle choices such as smoking and diet, and shortcomings in the delivery of health care.

2.58 While it is unclear how large the relative contribution of the physical environment is, it is doubtful that it will turn out to be the principal factor. The relative decline in life expectancy has taken place in both heavily polluted and relatively unpolluted parts of the region, a fact which puts a conceptual ceiling on the impact of environmental pollution. At the same time there are several important observations which suggest that the physical environment is not an insignificant aspect of the explanation for the relative decline in life expectancy. In Poland, life expectancies in rural areas have surpassed those in urban areas in recent years, a highly unusual demographic trend which is associated with the fact that environmental pollution is concentrated in urban areas. In the Czech Republic, there is good evidence that ambient dust and sulfur dioxide conditions are an important risk factor for infant mortality. Moreover, there is a strong correlation between declines in life expectancy by region in the Czech Republic and increasing proportions of people living in locations affected by heavy air pollution. Recent evidence from studies done in the West will allow us to estimate the impact of respirable dust on overall mortality in Central and Eastern Europe. Preliminary estimates show that the effect is likely to be substantial.

2.59 The analysis for the Action Programme has focused on exposures that are not related to occupational health problems.[15] Based on an analysis of data from *ten CEE countries*, locations have been tentatively identified where exposures meet specific health criteria. The nature and prevalence of the human health problems identified in an incomplete review for the EAP are as follows (the specific locations where health problems have been identified are described in **Annex 1** and in a map which is being prepared -- many of the locations overlap):

(i) **Overexposure to lead among children**--*37 locations in 7 countries*
This problem is important because it may lead to compromised mental development which will have long-term effects on children's educational attainment. Evidence of neuro-behavioral deficits among exposed children has been found in several of these places.

15/ To the extent that polluting industries affect both the health of the communities in which they are located and, also, the workers who work there, a remediation strategy which targets environmental health problems will also be effective in capturing work places with significant occupational health problems. The best example of this is lead smelters, where significant community exposures to children and in-plant exposures to workers seem to coexist everywhere they have been measured in tandem in Central and Eastern Europe. There are some important exceptions to this general pattern which are discussed in **Annex 2**.

(ii) **Acute (short-term) respiratory/irritant conditions**--*46 locations in 10 countries*
This category includes problems such as sinusitis, pharyngitis, bronchitis, and conjunctivitis.

(iii) **Chronic respiratory conditions**--*29 locations in 9 countries*
This category includes chronic bronchitis/emphysema and asthma.

(iv) **Excess infant and lung cancer mortality**--*8 locations in 3 countries*
This category includes places where there is reasonably strong evidence of a connection between lung cancer or infant mortality and air pollution.

(v) **Abnormal physiological development**--*18 locations in 7 countries*
Places where there are documented associations between abnormal lung, blood, or immune system development; growth retardation or congenital anomalies, and air pollution.

(vi) **Waterborne methemoglobinemia**--*widespread in 6 countries*
Places where nitrates in drinking water are high enough to require water replacement to protect newborns against methemoglobinemia, or where morbidity and mortality from methemoglobinemia is endemic. Methemoglobinemia is a form of chemical asphyxia whereby the oxygen-carrying capacity of the blood is chemically inhibited by nitrates.

(vii) **Other problems**
These include air and waterborne arsenic exposures, infectious disease outbreaks from drinking water, thyroid cancers following the Chernobyl accident, fluorosis near aluminum smelters, disease associated with exposures to chlorinated hydrocarbons and pesticides, etc. In a number of countries, food pollution is mentioned as a threat to human health. Data on the chemical and industrial contamination of food has been analyzed from five countries -- Bulgaria, the Czech and Slovak Republics, Lithuania, and Poland. As discussed in **Annex 1**, there is strong evidence of environmentally-related problems in only a few areas. A common recommendation is to remove land in the neighborhood of highly polluting metallurgical plants from all forms of food production to avoid heavy metal contamination (and to ensure a high quality of food inspection). Some of this land may be well-suited to afforestation.

2.60 As this list suggests, there is a pattern of environmental health problems which recur in a wide variety of locations. The *prevalent* (i.e., most commonly occurring) health problems, in turn, are the result of *exposures* which are similar to one another. These **exposures** are:

- *Lead in Air and Soil.* Specific industries such as lead and zinc smelters. Affected locations frequently mentioned--for example Plovdiv and Asenovgrad in Bulgaria; also Slatina, Copsa Mica, and Baia Mare in Romania. In certain cities, population living in close proximity to major traffic arteries are affected by car exhausts containing lead.

- *Airborne Dust.* Household coal furnaces, small-scale enterprises using inefficient coal heating systems, power and heating plants burning solid fuels without or with poorly operating dust filters; metallurgical and other large plants emitting dusts (especially metal dusts). Cities in Upper Silesia and Northern Bohemia are frequently mentioned as having high suspended particulate concentrations (often combined with high sulfur dioxide levels). Similarly, in the Russian Murmansk region, aluminum smelters cause high fluoride emissions which will require important improvements in production technology. There are hot spot areas of cadmium emissions (caused by energy combustion and emissions from the non-ferrous metal industry) in ten countries (see Map 3).

- *Sulfur Dioxide and other Gases.* Power and industrial plants, as well as households using high-sulfur coal or high-sulfur fuel oil typically imported from Russia. In the longer term, transportation will gradually contribute significantly to NO_x emissions. In addition to the cities in Upper Silesia and Northern Bohemia, this is a particular problem near to the large Maritza East lignite power complex in Bulgaria and in the neighborhood of metallurgical plants in Russia and Ukraine (examples are two large nickel smelters in the Murmansk region in Russia).

It is difficult to come up with a clearcut distinction between "important" environmental exposures and "unimportant" ones. In reality, there is a continuum of importance, based on the prevalence of the exposure, the severity of the health problems related to it, and the certainty of the causal relationship between the exposure and the disease(s) of concern. The exposures identified below cannot be discounted as unimportant, but are, on average, less prevalent and/or involve claims of causation that are less certain, than the ones above:

- *Nitrates in Water.* Inadequately maintained/designed rural septic tanks, feed lots and agricultural enterprises, and inappropriate manure and/or fertilizer application. Many rural districts in Hungary, Romania, Slovakia and Croatia suffer from high levels of nitrates in drinking water drawn from shallow wells.

- *Food Pollution.* In addition to the role of food as a source of lead exposure (acknowledged above), food in several parts of Central and Eastern Europe is a source of exposure to other heavy metals, pesticides, polycyclic aromatic hydrocarbons, and chlorinated organics such as PCBs. Many of these substances have well-documented toxic properties and yet the human health significance of ingestion at largely unknown doses is uncertain.

- *Other Contaminants in Water.* Arsenic, viruses/bacteria, pesticides, radionuclides, and chlorinated organics have all been found in drinking water in various places in Central and Eastern Europe. Waterborne arsenic and viruses/bacteria have been directly implicated in a small number of episodes of human disease in the region. The other exposures like their counterparts in food, represent risks of unknown prevalence, magnitude, and certainty.

Because of synergistic effects between airborne particulates and gases, there is a need to review carefully the places with environmental health problems due to airborne exposures to evaluate the relative importance of gaseous exposures *in the absence of dust* (see Box on Airborne Dust *vs* Gases in chapter V).

2.61 **Conclusions.** It is clear that the environment is one of many factors affecting public health. The point is that, even after accounting for the role of smoking, diet, and other factors, exposure to certain kinds of pollution causes damage to human health. Thus, policies to ensure a better environment can contribute to human welfare in a manner that is complementary to other public health measures.

2.62 Especially from a human health perspective, short-to-medium term priorities for environmental measures focus on the problems associated with local air pollution. As these problems are gradually addressed -- as a consequence of economic transformation as well as targeted expenditures -- the emphasis will shift to water pollution and municipal solid waste management as more resources become available and local and regional institutions become established under new political conditions. As discussed in chapter V, there already exist selected opportunities for cost-effective expenditures in the water sector -- especially where effective institutions are not vital to their implementation. In rural areas, management of water quality and availability is already a high priority.

Responding to the Problem: Finding a balance between Policies and Investments

2.63 Choosing among the wide range of possible measures to remedy environmental damage requires a criterion that identifies those alternatives which offer the greatest possible improvement in environmental conditions for the limited resources available. The benefit-to-cost ratios of investments or policies provide a simple basis for ranking alternative courses of action. The benefits of a measure are equivalent to the amount of environmental damage that would occur if the investment or policy were not implemented. *Policymakers should focus their attention on the actions which have the highest benefit-to-cost ratios.* This is, however, quite different from focusing on financial indicators of profitability, since both the benefits and costs are defined in a much broader sense.

2.64 In fact, benefits and costs can be described in relation to virtually any social objective. It is a matter of presenting the advantages and disadvantages of different options relative to a given objective. The essential point is that first the environmental problem should be clearly defined in relation to social and economic objectives; the solution and the way it is implemented will depend significantly on how the problem is defined. This may seem obvious, but experience suggests that environmental solutions are frequently offered before the problem to be solved is assessed. Thus, even if a particular municipal wastewater investment reduces the amount of effluents (the "solution"), it may be a wasteful use of scarce finances if the same funds could be used -- e.g., upstream -- in a manner that has a larger impact on ambient water quality ("the problem") either at a single location, or at a number of locations, taking account of the populations affected. Similarly, there may be many different ways to solve a given problem -- some of them much less costly than others (see boxes in chapters IV and V).

2.65 The crucial premise is that it is not just a matter of scaling down environmental investments because of resource constraints. Rather, the benefits of broad economic policies should be captured, and a judicious mix of different technologies, management, institutions, and policy approaches should be applied so as to ensure that the most serious environmental problems are addressed rapidly and in the most efficient manner.[16]

2.66 **Economic Policies.** Some economic policies -- including market reforms, higher energy prices and improvements in industrial efficiency -- are "win-win" policies in the sense that they contribute to more rapid economic growth while also improving the environment. The costs of achieving the associated environmental benefits are low (they depend essentially on the available institutional capacity), so that such policies should obviously be adopted as rapidly as possible.

2.67 **Environmental Policies.** Targeted environmental policies -- such as pollution charges, regulations which are carefully designed and enforced, and the establishment of appropriate property

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16/ Attention also should focus on the need to avoid merely transferring problems from one environmental medium to another. This calls for an integrated approach to pollution prevention and control.

An Illustration of Benefit-Cost Analysis - Water Priorities

This box provides an analysis of how water priorities can be established. It suggests that priority should be given in the immediate future to protecting drinking water supplies, to ensuring that unpolluted rivers and lakes are preserved from deterioration and to avoiding (almost) irreversible pollution of groundwater sources. As incomes rise and other forms of pollution are dealt with, the amenity value attached to improving the quality of urban rivers will increase which will focus attention on the large investments required to improve standards of sewage treatment and disposal. In the meantime, phased investment programs which focus on lower cost investments for partial treatment can prevent further deterioration in river quality and even begin the process of gradual improvement. These may be justified in terms of the *health*, *productivity* and *amenity* benefits of avoiding a complete collapse of water quality in those rivers subject to the most environmental stress.

The benefits of improving water quality -- for rivers, lakes and groundwater -- depend greatly upon the ways in which the water is used. There is a distinction between the "abstraction benefits" which arise when water is drawn off for households and industry, and the "*in-situ*" benefits associated with fisheries and the recreational uses of water. Abstraction benefits are linked to the costs and availability of fresh water treatment, whereas *in-situ* benefits depend upon the state of river or lake ecosystems and our response to them.

Abstraction Benefits. The *health* benefits of improving water quality are small in most parts of CEE because most households have access to and are willing to pay substantial sums for adequate supplies of treated drinking water. The costs of fresh water treatment and supply are, typically, much lower than the costs of reducing pollution, so that it is reasonable to give the provision of clean drinking water priority over wastewater treatment. Ensuring that drinking water supplies continue to be protected and avoiding episodes such as the outbreak of hepatitis in Riga should have the highest priority in the allocation of recurrent resources to meet operating costs, since all estimates show that the benefits are very large and the costs are trivial by comparison.

The other set of circumstances in which the health benefits of improving water quality may be significant arise when a community relies upon a single water source -- often of groundwater -- whose quality is jeopardized by the intrusion of heavy metals, toxic chemicals, pesticide residues or excessive nitrates. In this case, the choice lies between shifting to alternative water sources or tackling the pollution at source. The first of these options has been adopted in most of the region, but over time the costs of taking water from more distant sources can become large. Eliminating the discharges, especially if these originate from a small number of sources, may then be the most cost-effective way of ensuring safe drinking water.

The *productivity* benefits of improving water quality for abstraction uses are closely linked to the nature and costs of water treatment. Most of the water required for industrial processes does not need to meet drinking water standards. However, if river water used by industry is saline or contaminated with heavy metals, the life of capital equipment will be shortened by corrosion or the efficiency of industrial processes reduced. Thus, both household and industrial users may incur substantial costs to avoid relying upon low quality water supplies either from rivers or municipal treatment plants. As a specific example, the benefits of reducing discharges of saline water in Poland will accrue in the form of lower treatment and avoidance costs for water consumers plus a reduction in corrosion and damage to equipment and infrastructure that cannot be protected from the effects of water salinity.

***In-situ* Benefits.** The *in-situ* benefits of better water quality are primarily -- but not entirely -- linked to the *amenity* value of unpolluted rivers and lakes, since most studies suggest the productive losses caused by the impact of water pollution on fisheries are relatively modest. In general, people attach the greatest value to preserving the quality of unpolluted streams or lakes, particularly in areas of natural beauty or in vacation spots, so that protecting water quality in Lake Balaton, the Mazurian Lakes or along the Black Sea and Adriatic coast line would take priority over improvements to water quality in rivers passing through industrial centers. The costs of such preservation tend also to be low relative to the costs of achieving significant improvement in urban river quality. Of course, many people are affected by the loss of recreational opportunities and other amenity benefits caused by pollution of rivers like the Danube, the Dnieper and the Vistula, but parts of these and other rivers are much less polluted so that there are alternatives available, albeit at some cost in time and resources.

rights -- are not costless, but their costs are typically low by comparison with the benefits that are generated by establishing appropriate incentives and institutions. The development of an appropriate institutional framework for ensuring that the maximum benefit is achieved from environmental investments is a lengthy but crucial aspect of developing environmental policy. In the short run, constraints on institutional capacity may even mean that investments which might appear to have a large benefit-cost ratio ought to be deferred until they can be most effectively implemented (e.g. in the water sector through the creation of river basin management).

2.68 **Environmental Expenditures.** It is inevitable that attention will focus upon the most dramatic environmental problems, i.e., on cases where the costs of environmental damage are very high. However, these may not rank high on the list of potential expenditures because the costs of remedying the damage may also be very high. For example, addressing the problems of the unsafe disposal of hazardous and toxic wastes or of poorly-designed nuclear reactors may be judged to have high environmental benefits, but the potential costs of remedying all of the problems that have been identified are also likely to be very large. In such cases, *inexpensive measures designed to make significant improvements without tackling every problem would be more appropriate than massive programs of expenditure, most of which will have a relatively low benefit-to-cost ratio.*

2.69 One lesson, of course, is that prevention is much better than cure, so that it is even more important to ensure that appropriate standards for the disposal of dangerous wastes or for nuclear safety are introduced and enforced in future. A second lesson is that partial solutions which offer substantial environmental improvements at a modest cost may be strongly preferred to "permanent" but expensive measures. In setting objectives for environmental policy it is the incremental benefit-to-cost ratios that matter, since the basis of *comparison must be how much environmental improvement can be obtained by spending an additional $100,000 on one problem rather than on another.*

2.70 The purpose of this Environmental Action Programme is to offer some of the tools with which senior decision makers can judge the merits of different approaches to address environmental concerns in Central and Eastern Europe. *In principle*, the above approach permits a ranking of priorities such that the first $100,000 spent will have the greatest impact in bringing about environmental improvement. This process can be continued until the limit of available resources has been reached. *In practice*, there are of course many possible projects with similar benefit-to-cost ratios in different sectors. The "pyramid" of priorities is therefore relatively blunt, and it is clear that many factors will contribute to what kinds of decisions are made.

2.71 On the other hand, there clearly are projects which would have quite a low priority at this time. Thus, the criteria described here serve as much to identify what should *not* be done, as what is urgent. This should be a significant aspect of any realistic action program.

2.72 Benefit-cost analysis should be seen as a method of thinking systematically about choices. There will always be difficulties in assessing the benefits because people differ in the value judgments they make about various forms of environmental damage. The priorities articulted in this document are based on what appear to be the value judgments by governments tackling environmental problems in most countries -- rich and poor.

2.73 **Conclusions.** Balancing the many considerations is difficult and not easily amenable to scientific planning procedures, since the range of factors that must be taken into account is large, and the quality of any numerical data is often highly suspect. However, the general direction in establishing priorities can be summarized as follows:

(i) Support as much as possible economic policies which also have environmental benefits -- *market reform* associated especially with energy price increases, and *economic and industrial restructuring*, including a steady pace of capital stock turnover as well as improved approaches to industrial management.

(ii) Adopt targeted *environmental policies* which establish a framework of incentives and environmental institutions designed to discourage the emission of pollutants as well as the loss of biodiversity where this can be achieved at reasonable cost.

(iii) Allocate resources for *environmental expenditures* to those projects with the highest benefit-cost ratios (especially in sectors where the above measures are not effective, e.g. the household sector which cannot respond as well to energy price changes). In the short term this is likely to mean that problems of air pollution take a disproportionate share of the expenditures, but investments to deal with water pollution, land quality and biodiversity conservation with high benefit-cost ratios should also be implemented immediately.

(iv) Allocate modest expenditures on programs whose benefit-cost ratios are expected to be near the top of the ranking in future but which have a long lead time from start to completion.

2.74 All four measures are complementary and must be applied simultaneously; they are all necessary for improving environmental conditions.[17] Targeted environmental investments should be directed to those problems which will not be "solved" by market reform and/or industrial restructuring, or indeed, which may be exacerbated by the latter. To avoid the risk that resources could be squandered on unnecessary investments, an estimate of the likely future impact of the economic or environmental policies needs to be carried out (see chapter III).

2.75 The single most important goal of the Action Programme is to demonstrate that difficult choices have to be made, and that the available resources should be spent on those problems where the greatest environmental benefits can be achieved relative to the costs.

2.76 Once a broad range of possible instruments have been evaluated for effectively addressing clearly defined environmental problems, expenditures should focus on *cost-effective* technologies that provide widespread benefits and have the potential to be upgraded over time as additional resources become available. This report emphasizes that in designing projects (e.g. in the power sector), least-cost

17/ Environmental policies and expenditures should complement, not substitute for sound economic policies.

programs need to be identified for the sector as a whole. Environmental considerations should be an integral part of this process and might require a mix of measures, such as fuel switching, scheduling, location-specific management practices, and temporary or longer-term rehabilitation. This is a practical first step toward developing sustainable policies in different economic sectors.

2.77 Thus, there need not be a tradeoff between longer-term "sustainability" issues and the most urgent short-term problems. It may be efficient to spend resources today to avoid costly environmental problems in the future, and/or to build the elements of sustainable development. Conversely, it may for social reasons (e.g. employment) be necessary to make some short-term environmental investments to alleviate serious environmental (e.g. health) problems, even though such investments might have little justification in the long term.

2.78 The key to sustainable development is provided by the major premise of this Environmental Action Programme: That environmental quality objectives should be established first, clearly and in a socially transparent manner. Then projects and policies will naturally be designed to fit the sustainability objectives, unlike in the past, when "micro-solutions" were applied without a clear recognition of the overall situation.

2.79 Over the coming years, CEE countries will be in a position to focus more and more of their attention on developing policies and investments which support a true sustainable strategy, rather than to react to the problems of the past. In many respects, there is a real opportunity to seriously *learn from the mistakes in the West*, and to forge a new path which blends environment and economic development more successfully.

III. POLICY REFORM

The transition from central planning to markets should not only improve the countries' economic performance in the longer term, but will contribute to environmental improvements. Among the key factors are increases in energy prices, and hard budget constraints on public and private enterprises. These provide powerful incentives to reduce waste of resources and to improve industrial "housekeeping" with the result that pollution emissions are reduced. Many CEE countries have already made major strides in raising energy prices.

***Privatization** should assist these changes, provided that liability for past environmental damage is clearly assigned, and enterprises are held accountable for all current emissions.*

***Targeted environmental policies** will be required to ensure that the potential benefits of economic restructuring are fully realized. To achieve the most cost-effective use of resources, the CEE countries should, where possible, rely upon economic instruments for achieving environmental goals. Existing systems of pollution charges can be developed to provide an effective incentive for sound environmental practices. There is scope for very large savings by choosing simple market type approaches which are realistic even in the current economic and institutional situation.*

*Where **regulatory policies** are more appropriate -- especially to control emissions of some micro-pollutants such as heavy metals and toxic chemicals -- governments should adopt either the EC framework of standards or an equivalent system. The implementation of stricter emission standards should be phased, allowing industries an extended but well-defined period to comply with them. More generally, ambient standards should receive more attention as a simple decision framework to guide policy making at the local level. Appropriately set, ambient standards reflect environmental and economic sustainability criteria.*

The greatest contribution to achieving a continuing decline in total emissions is likely to come from improving the environmental performance of old plants which continue to operate in the medium term. To achieve conditions equivalent to those in Western Europe, emissions per unit of output equivalent to those obtained by applying Best Available Control Technology (BACT) would only be required in some of the worst "hot spots" and only for some pollutants.

Economic Transformation and Industrial Restructuring
Privatization and Environmental Liability
Better Environmental Policies

3.1 The context for environmental policies and investments in Central and Eastern Europe will be determined by the profound economic changes which are transforming incentives, institutional arrangements and the composition of economic activity. The transition from central planning to markets should not only improve the countries' economic performance in the longer term but will contribute to environmental improvements by penalizing the massive waste of resources which characterized production in the past. Incentives which encourage the more efficient use of energy, mineral and water resources will reduce both air and water pollution. Recognition of the true opportunity cost of capital will shift the emphasis away from large capital investments drawing upon the products of heavy industry, towards a continuous process of replacing existing capital equipment and incorporating new technology with consequential reductions in the average amount of pollution generated per unit of output. These structural changes will take time, but they will have a major impact on emissions over the next 10-15 years.

3.2 Economic reform will not and need not be justified on environmental grounds. Still, many (though not all) of the policies which comprise the typical reform package in Central and East European countries -- macro-economic stabilization, pricing reforms, privatization, industrial restructuring and trade liberalization -- can be expected to contribute to reducing environmental degradation. Environmental considerations simply reinforce the case for moving as rapidly as is politically possible to implement these reforms.

3.3 The nature and extent of the environmental improvements that may be expected to flow from economic reform vary considerably across environmental media and pollutants. *Markets are no panacea*; strong environmental policies will be required to address the failure of markets, in particular when the costs of environmental damage suffered by individuals and communities are not borne by those responsible for causing the damage. Some of these policies may be designed to correct market incentives -- by requiring polluters to pay a charge reflecting the damage resulting from the pollution that they emit -- while others may suspend market incentives by imposing regulatory limits on emissions and environmental performance.

3.4 Once the *mechanisms* for an appropriate structural framework -- leading to macroeconomic stability, market incentives and penalties, and a system of environmental regulation -- have been put in place, it is possible to identify the public investments that will be required to solidify and enhance the environmental improvements that will occur. Such investments may be designed to bring forward the reduction of emissions from existing plants by installing low cost end-of-pipe controls or by adapting processes to lower the amount of residuals that they generate. Other *investments may mitigate conflicts between environmental and social goals during the course of restructuring* by enabling public utilities and state-owned enterprises to meet stricter environmental controls without drastic reductions in output and employment. There will also be a need for investments whose purpose is to prevent the emergence of major environmental problems in the future following the well-tested precept that "prevention is cheaper than cure."

3.5 In general, the incremental cost of improving environmental quality by targeted measures increases with the shift from a reliance upon appropriate taxes and similar policy instruments towards specific public investments. It is very important, therefore, to ensure that any investment is only undertaken in the context of a broader framework of environmental policies designed to reduce emissions in the lowest cost manner. Limited investment resources and the many claims on government budgets means that it is necessary to *mobilize private capital, expertise and ingenuity* by providing appropriate incentives for enterprises to reduce their emissions rather than relying upon outside funding, whether from the government or from external donors.

Economic Transformation and Industrial Restructuring

3.6 **How will economic transformation affect the environment?** The level, composition and resource requirements of economic activity in Central and Eastern Europe are changing or will change radically as a consequence of the economic transformation that is taking place. Since it takes a considerable period to implement environmental policies and investments, it is clearly essential to ensure that these are directed at the environmental problems that will persist after the economic and structural changes have run their course. An important by-product of economic transformation will be large reductions in the amount of environmental damage associated with excessive energy use and with some forms of heavy industrial production. This environmental "free ride" implies that we need a vision of what the economies will look like in 5 or 10 years time rather than focusing on concerns which may be based on out-dated or rapidly changing economic and environmental assumptions.

3.7 Attempting to forecast the impact of economic transformation in Central and Eastern Europe on the environment is fraught with difficulty. Even short term predictions about the macroeconomic consequences of stabilization programs or about the responses of enterprises to the new circumstances in which they operate have proved notably hard to get right. On the other hand, simple extrapolation of past trends clearly provides little guide to the future of these economies. Without some idea of the nature of the changes that are likely to occur over the next decade, resources could be wasted on a large scale by investing in environmental improvements which subsequently prove to be redundant.

Short term threats to the environment in Russia during the transition.

In its recent State of the Environment report for 1992 the Russian Government identified the following ways in which the current economic difficulties might threaten the country's environment :

(a) Inadequate expenditures on maintenance and capital replacement could lead to serious environmental accidents and more routine spills and wastage.

(b) A shift to poorer quality raw materials and towards coal because of higher prices for exportable oil may lead to greater dust emissions and the creation of more solid waste.

(c) An increasing risk of illegal logging, more reliance on clear-cutting and poorer forest management which would threaten large areas of the Taiga, especially in Eastern Siberia.

(d) Weaker enforcement on controls on hunting and fishing plus intrusion into protected areas by poachers may deplete wildlife stocks, especially of some endangered species. This would be reinforced by the lack of budgetary resources to maintain the staffing of agencies responsible for the management of protected areas.

(e) The decentralization of government responsibilities might encourage local authorities to assign rights to exploit natural resources without imposing appropriate requirements to protect the environment and without establishing mechanisms to ensure that the natural resources are properly managed.

3.8 The scenarios which have been prepared for the Action Programme are based on a careful analysis of a large number of structural, institutional and microeconomic changes in the economies of Central and Eastern Europe that are expected to occur over the next two decades. The most important structural influences on environmental prospects in the short and medium term are as follows:

(i) The shares of national income devoted to investment have declined dramatically during the period of macroeconomic stabilization. Even as the economies recover, investment shares will be much lower than in the past because investment resources were used so inefficiently. This implies a permanent drop in the demand for the output of heavy industry relative to national income.

(ii) The composition of private and public consumption will gradually change in a number of ways. Overall, a smaller fraction of income will be spent on industrial goods but the shares of expenditure devoted to processed foods, paper and chemical products, and transport equipment will increase. Spending on services will grow rapidly as these have always been underprovided in centrally planned economies. The implication of these changes is that growth in industrial output will lag far behind aggregate economic growth, while, within the industrial sector, there will be a shift from activities which are important sources of air pollution to those which discharge water pollutants. The growth in private transport and in packaging will pose new problems for cities and towns in coping with traffic pollution and municipal waste.

(iii) The past focus on meeting output targets meant that many industries were notoriously wasteful in their use of material inputs (including energy), labor and capital. Simple changes in the organization of production will allow enterprises to reduce such waste, to eliminate over-manning and to get more output out of the same stock of capital. In this way the economies will be able to produce more final output for the same volume of resource and other inputs, thereby reducing the volumes of residuals that are generated.

(iv) Despite high levels of investment, capital equipment in the region is significantly older on average than what is typical of market economies, because old plant and equipment was rarely scrapped. Some industries and plants are at the forefront of their technology, but most are technologically backward, especially in the heavy industrial sectors. Much of the oldest capital equipment will be scrapped as a result of the decline in industrial output and the process of industrial restructuring. New investment, once economic recovery gets underway, will embody modern, more efficient and less polluting, technologies. Even if old capital equipment were simply scrapped at rates typical of market economies less than one-half of the existing stock would still be operating in its present manner after 10 years.

3.9 Some of the economic and social responses to the changes in income, employment opportunities and government spending during the transition will tend to have a detrimental impact on the environment, especially where the framework of environmental policy is weak or government monitoring and enforcement activities are underfunded. The Russian government has considered how to address these problems. Its primary recommendations concentrate on (a) the need to avoid environmental accidents due to poor maintenance and management, and (b) the importance of providing resources and strengthening the institutions concerned with the protection natural resources such as timber, wildlife, and rare habitats. Other countries could follow this example in deciding how to allocate staff and budgets in order to prevent a haphazard worsening of environmental conditions in these spheres over the next few years.

3.10 The process of industrial restructuring will, in many cases, force governments to choose between a number of more or less unpalatable options. Conflict between economic, social and environmental considerations is inevitable, especially when the resources available to mitigate the social or environmental consequences are so limited. Some old and highly-polluting plants will be allowed to continue operating because the social costs of closure are too large to be contemplated. Even so, it is possible to insist that such plants improve their environmental performance without committing any significant amount of investment. Large gains can be achieved by simple "good housekeeping" measures -- better maintenance, mending leaks, installing better controls, insisting on stricter standards of plant and process management. These are all "win-win" actions which will improve the economic results of enterprises as well as lessening the environmental damage that they cause (chapter V provides some specific examples). Thus, it is crucial that governments should not direct all of their resources -- human as well as financial -- towards new investments or enterprises, since remarkable improvements can be made if the managers of old plants are put under pressure to make continuous improvements and are rewarded appropriately for above average performance.

3.11 The costs of environmental damage, especially to human health, are as real and as potentially large as the other social costs of industrial restructuring. They tend to be less visible and more long term in character, but they should not be neglected on this account. It is very important, therefore, that Ministries of Environment should work with Ministries of Finance, Industry and Privatization to ensure that environmental considerations are built into decisions about which plants or enterprises in the public sector should be closed and which should be allowed to continue to operate. By affecting the pattern of closures and the conditions which must be met before plants receive assistance to support their continued operation the environmental authorities can have a significant impact on the damage caused by old plants. Pollution charges provide one mechanism for "internalizing" environmental damage in a manner that will directly affect the speed and pattern of plant closures or contractions in output. This is not the only possible approach. Other methods of allowing for the environment aspects of such decisions could be used instead. The crucial point is that some attempt should be made to take environmental costs into account in a systematic manner.

3.12 **Raising energy prices.** One of the most painful but essential features of the market reforms in all countries in Central and Eastern Europe is to raise the basic level of energy prices paid by industry to world market levels or higher. This can be justified solely on grounds of economic efficiency (see **Annex 6**) but the changes will have large environmental benefits. The after-tax prices paid by industry and households may rise further, to West European levels, if governments decide to impose taxes on the consumption of energy either to generate revenue to reduce fiscal deficits or for environmental reasons. The extent of the adjustment in real energy prices will vary greatly across countries and between industrial and household consumers, since households are more dependent on heavily subsidized fuels such as electricity and district heat. Comparing prices paid by industrial users prior to the reforms with those typical in Western Europe implies that the range of the necessary increases in energy prices relative to the prices of other industrial goods varies from less than 25% in Hungary to over 300% in the former Soviet Union. The process of adjustment is largely complete in Hungary, is well advanced in Bulgaria, the Czech Republic, Poland, and Slovakia but has only just started in the Russian Federation and other FSU countries.

3.13 The response to allowing energy prices to rise to market levels will have two principal effects which have a bearing on air pollution. It will promote energy conservation, so that it is reasonable to expect that the energy intensity of economic activity will fall in most countries by one-half over the next decade. It will also bring about a shift in the composition of fuel use. Historically, governments have encouraged the consumption of domestic sources of energy. In most Central and South-East European countries this means that coal was favored in order to lower dependence upon imported supplies of oil and gas. In the Russian Federation, the preference was for oil and, more recently, for gas whose environmental effects are more benign. As a result, there will be large relative shifts in the prices of various fuels. The prices of coal in Bulgaria, the Czech Republic, Hungary, Poland, and Slovakia have to rise much more than either oil or gas prices to come into line with West European prices. As a consequence, large increases in electricity and heat prices will be required. These changes will encourage substitution towards oil and, especially, gas in all uses including power stations which will tend to reduce emissions of most air pollutants. In Russia and other FSU countries the relative price movements will bring less clear environmental benefits, though they are likely to encourage the continued substitution of gas for other fuels.

3.14 Comparison of the experiences of West European countries and the US over the last three decades illustrate the long term environmental benefits of maintaining higher energy prices. Low energy prices mean that much stricter environmental regulations are required to achieve target levels of ambient air quality. Nonetheless, the difficulties of making the adjustment should not be underestimated. *Provided that the long run goal of raising energy prices to market levels is clearly promulgated, it is reasonable to phase the increases over a period that reflects the economic and social costs of adjustment.* Some countries have felt that their economic situation does not permit a gradual series of price increases, while the circumstances of other countries may be such that concerns about a rapid rise in unemployment are more important. *All countries, including Russia and other states of the former Soviet Union, have made substantial progress in raising real energy prices over the past 2-3 years.*[1] *The crucial issue is that this progress should be sustained with, if necessary, transitional assistance being provided to vulnerable enterprises and households which bear the brunt of the adjustment.* However, such assistance should *not* be tied to current levels of energy consumption so that those concerned have a substantial incentive to conserve energy wherever that is possible.

3.15 **Effects of Environmental Standards.** The replacement of old plant and equipment by new capital embodying modern technologies brings an environmental "free lunch." In response to the need to meet stricter environmental standards in the West, the designers and manufacturers of capital equipment and plant have developed new processes and machinery which generate much lower emissions than in the past. Even without a need to meet tighter emission limits it is economically efficient for industries such as textiles, paper, chemicals and metallurgy to invest in capital which will bring substantial reductions in their average levels of emissions per unit of output. These environmental improvements combined with the assumption that new plants will be required to meet emission standards typical in North America and Western Europe (though not in West Germany which had much stricter standards) provide the basis for the main scenarios presented here.

3.16 Countries in the region may decide to adopt stricter standards, for example ones equivalent to those applied to new sources in the European Community today (see **Annex 9**) on the grounds that this will accelerate the rate of decline in emissions from the most heavily polluting industries. However, there

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1/ Average energy prices in Hungary are now at or above West European prices. Industrial prices for coal, oil and gas in Bulgaria, the Czech Republic, Poland, Romania and Slovakia are at or close to import or export parity prices. After falling during the early months of 1992, the real prices of coal, oil and (most recently) gas for industrial users in most states of the former Soviet Union have risen substantially above their pre-reform levels. Electricity and heat prices have tended to lag behind other energy prices, as have household prices for coal and gas. However, these account for less than 30 percent of total energy consumption in most countries, so that the overall picture is one of substantial progress in raising energy prices to market levels, thereby encouraging greater efficiency in the use of energy.

is a familiar dilemma in following this approach. Applying stricter standards to new but not to old plants has the effect of extending the economic life of older plants if there are significant costs involved in meeting the stricter standards. Thus, the long term benefit of lower emissions because of stricter standards may result in higher pollution in the medium term as well as the additional cost of meeting the higher standards. One way of resolving this dilemma is to require that all plants which are still operating should meet the stricter standard by the end of a transitional period. This is the approach that is followed by European Community directives with transitional periods that may be as long as 15 years. It involves greater expenditure on environmental controls but ensures that there can be no long term disparity between the environmental performance of old and new sources.[2] The impact of applying EC new source emission standards either to new sources alone or to all sources by 2010 is illustrated below in various of the scenarios.

3.17 **Scenario analysis.** Key results from the scenario analysis are shown in **Figures 7-13** and Maps 1-6. These are taken from two complementary studies carried out by RIVM in the Netherlands and by the World Bank. The World Bank study, based on a detailed industrial model summarized in **Annex 5** focused on the links between the nature of economic and industrial reform and the environment. On the other hand, the RIVM study used a less detailed model to focus on the technical possibilities for reducing emissions and on the spatial distribution of pollution. This study shows how economic reform combined with different environmental standards affects the average concentrations of key pollutants across the region and provides the basis for identifying how policy may alter conditions in environmental hot spots.

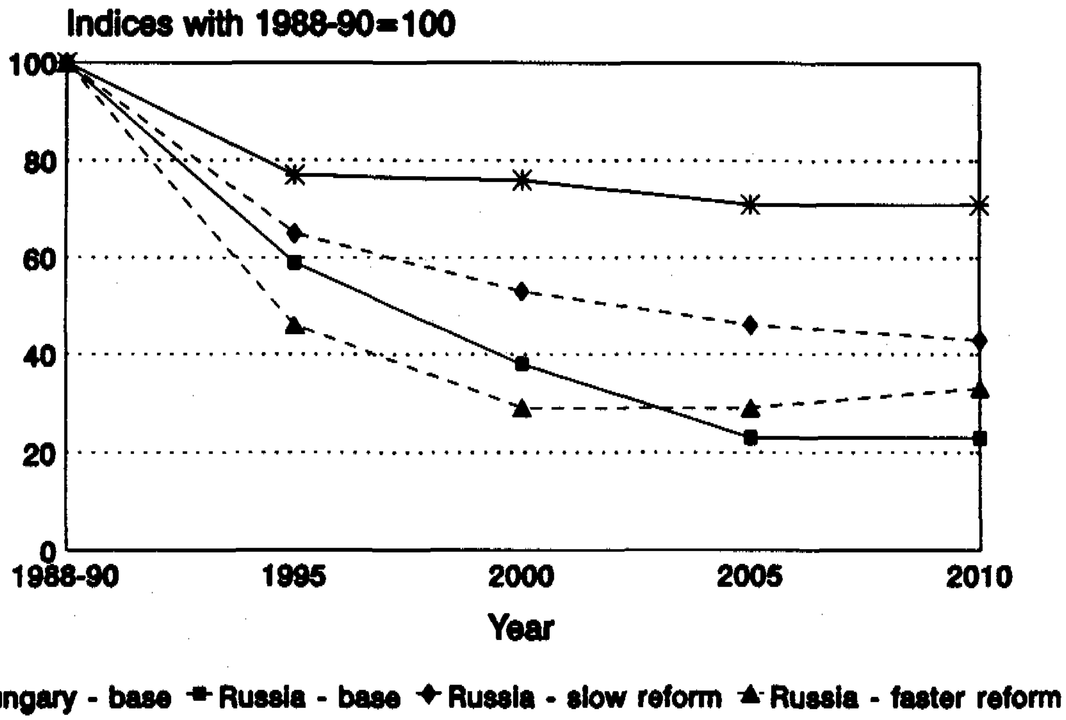
3.18 Economic decline in Central and Eastern Europe in the last three years has already resulted in a reduction in emissions and this will continue up to 1995 (see table inside the back cover). However, this decline provides nothing more than a temporary abatement of the pressure on the environment. The critical question is whether emissions can be stabilized or reduced further as economic activity begins to recover from the deep recessions that have accompanied economic transformation. All countries in the region will hope to achieve high rates of economic growth in the early part of the next century, so that the question is how long it will be possible to maintain stable or declining emissions in the face of vigorous economic growth. The earlier the initial decline is reversed the more stringent will have to be the policies that are implemented to prevent a worsening in environmental conditions.

3.19 **Figures 7-13** show the projected paths for emissions of various pollutants in different countries in the region. In each case the two solid lines define the band into which the countries fall. The top line represents the outcome for a country with high emissions over the period and the bottom line a country with low emissions. The figures show that in almost all cases emissions continue to fall until after 2000 as a result of the combined impact of higher energy prices, industrial restructuring and new investment. Emissions of NO_x are one exception to this pattern because growth in the number and use of vehicles can easily outstrip the decline in emissions from stationary sources.

2/ The process of phased, negotiated compliance at the local level is further elaborated in chapter IV.

Figure 7

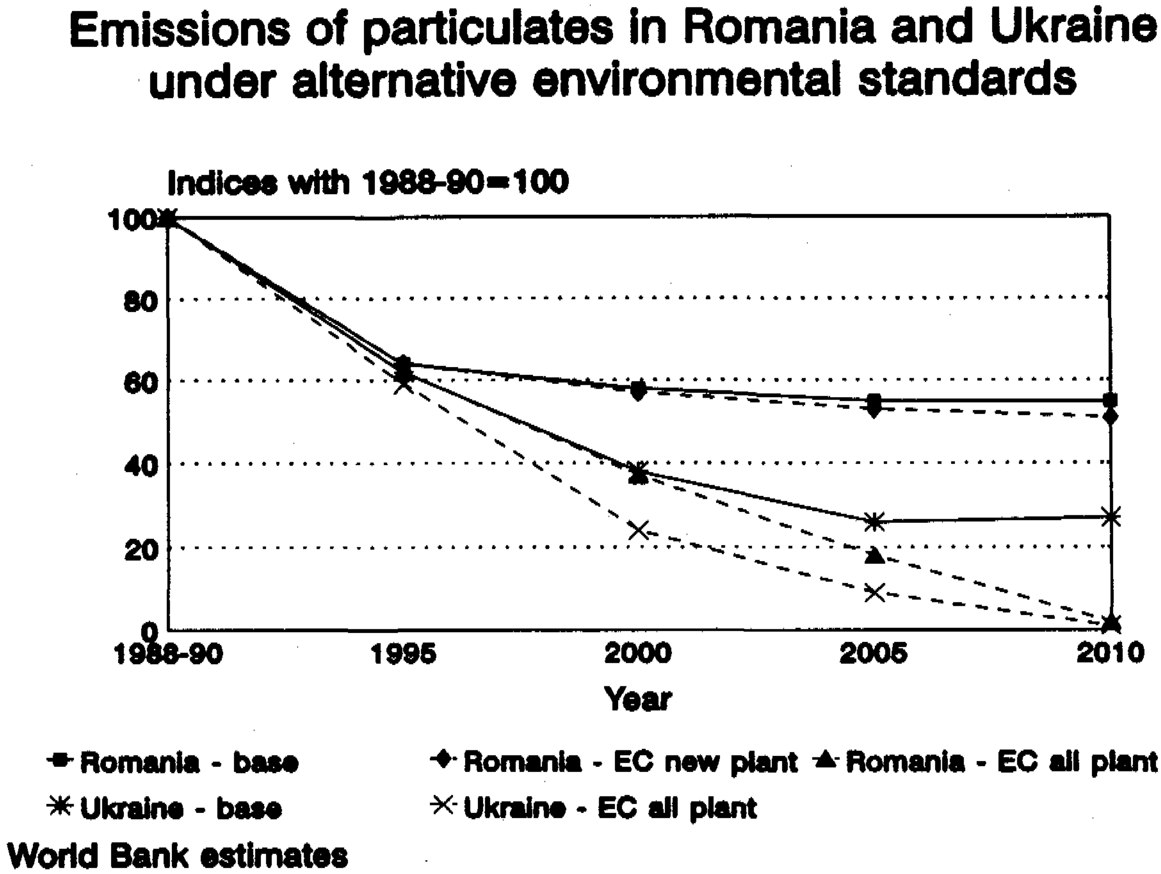
Emissions of particulates in Hungary and Russia under alternative reform scenarios



World Bank estimates

Hungary had higher energy prices and a lower level of energy-intensity in 1988 than other countries in Central and Eastern Europe. Thus, the reduction in energy-related air pollution due to economic reform is much less than elsewhere. In Russia, however, the gains will be large with a fall of 77% in total particulate emissions for the main reform scenario. Slower reform means that the decline will be less, though still significant. Faster reform implies a greater initial fall in emissions, which is offset by faster economic growth after 2000. Bulgaria, Poland, Ukraine and other FSU republics should follow paths similar to that for Russia, whereas Romania and the Czech and Slovak Republics lie between Hungary and Russia.

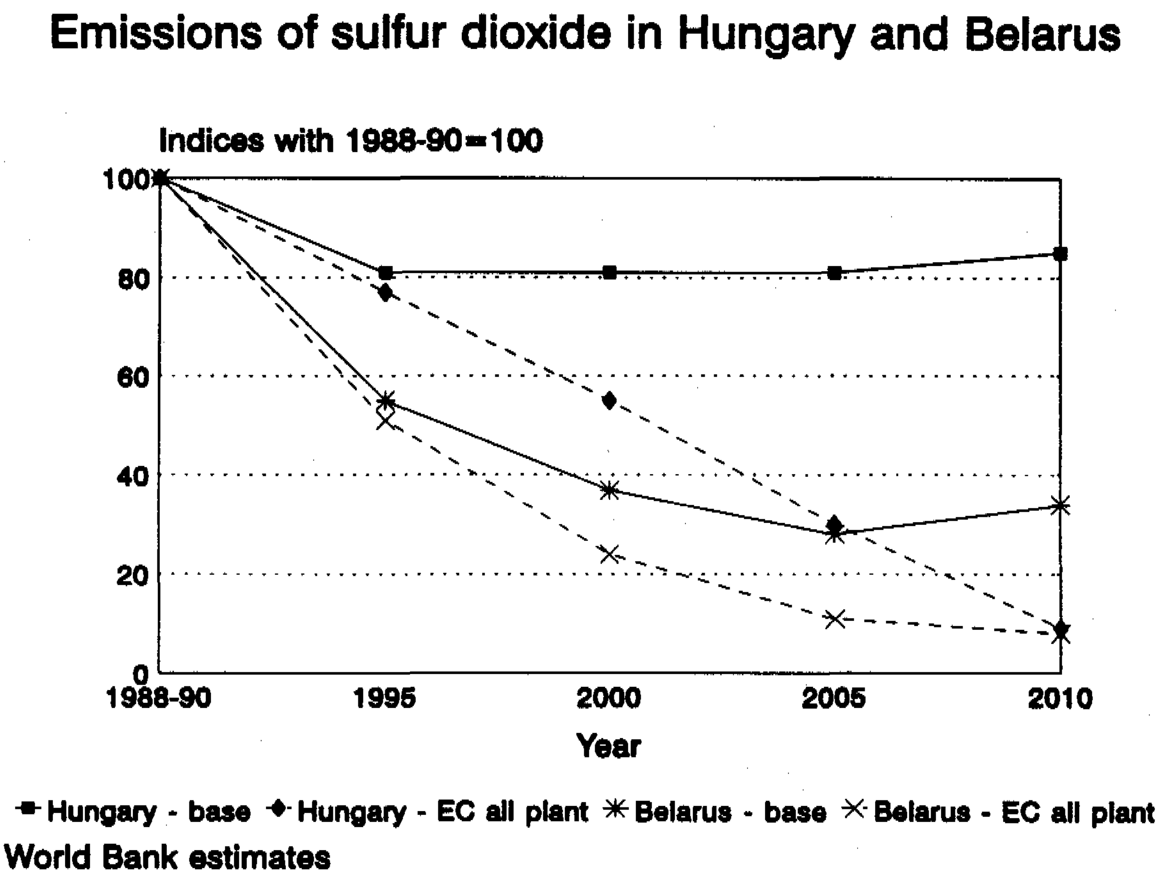
Figure 8



Romania can expect only a modest reduction in particulate emissions from economic reform alone because it already relies heavily on gas for power generation. The imposition of stricter standards on *new* capital equipment alone implies a relatively small improvement in emissions; applying the same standards to all sources progressively would reduce emissions in 2010 to a tiny fraction of their 1989 level. Though reform makes a much bigger contribution in Ukraine, it too would benefit by the gradual implementation of stricter standards for all sources with particulate emissions less than 10% of their 1990 level by 2005. With a few exceptions, imposing stricter standards on new capital equipment alone does not lead to a significant reduction in pollution, unless the new sources performance standards are very strict indeed. It is the reduction of emissions from old plants which is critical to achieving substantial improvements beyond those provided by economic reform.

Economic reform and new investment can lead to substantial changes in the composition of emissions by source type. Figure 1 in Annex 5 illustrates how the source composition of particulate emissions in Poland will change under alternative scenarios.

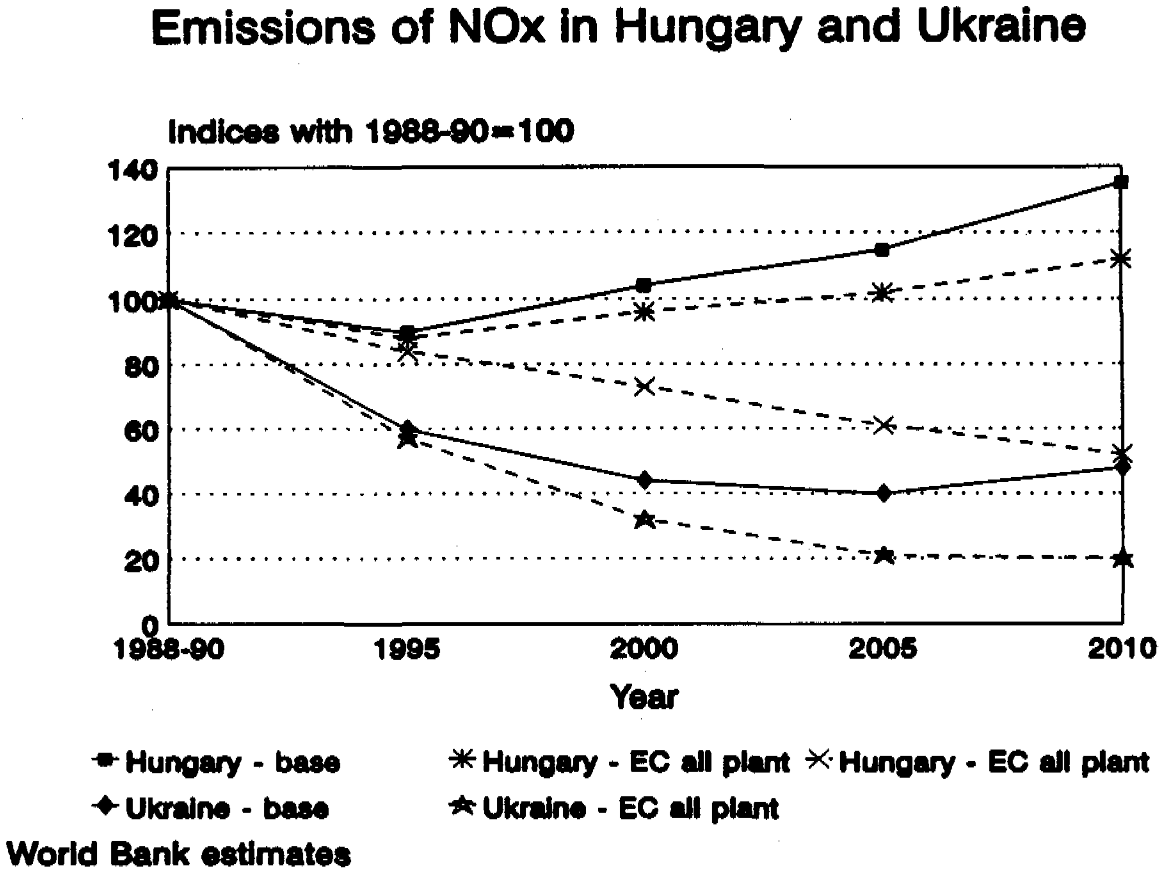
Figure 9



The pattern for SO_2 emissions is similar to that for particulates, though the decline due to economic reform in Hungary is less for SO_2 than it was for particulates. In part this reflects a reported decline of 25% in SO_2 emissions from 1980 to 1989. A similar decline is reported for the European part of the former Soviet Union, but the published data cannot be reconciled with more recent data on trends in energy consumption in the former Soviet republics during the 1980s. Total emissions of SO_2 fall to 28% of their 1990 level by 2005 in Belarus before rising again due to economic growth. Applying stricter controls progressively to all plants would reduce Hungarian emissions to 30% of their 1989 level by 2005 and to less than 10% of their initial level in all countries except Poland. Economic reform alone should reduce emissions to less than 40% of their initial level in Bulgaria and Ukraine as well as Belarus with Russia and other FSU republics falling in the range 40-50%.

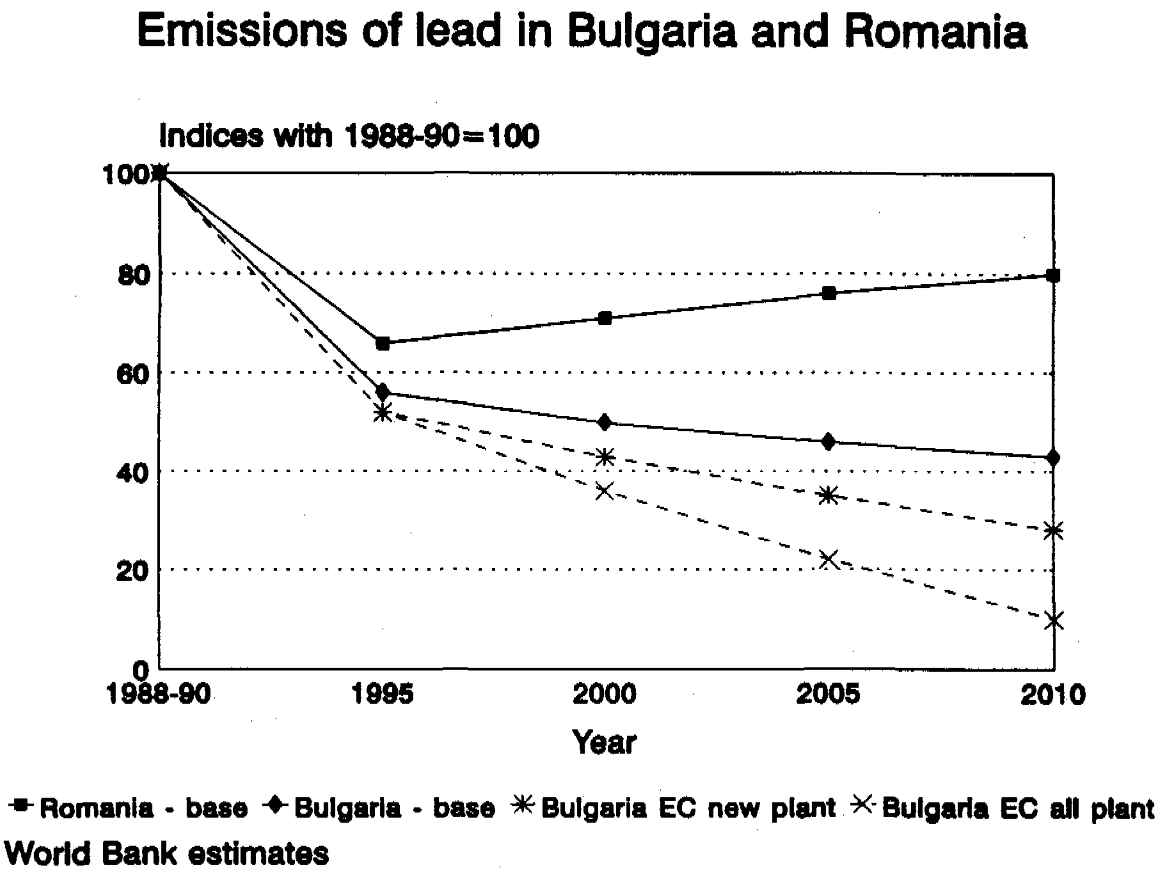
Figure 2 in Annex 5 illustrates how the source composition of SO_2 emissions in the Czech and Slovak Republics will change under alternative scenarios.

Figure 10



Emissions of nitrogen oxides in Hungary are the clearest case of economic growth outstripping any gain from greater energy-efficiency induced by higher energy prices. The use of petroleum products is responsible for a substantial fraction of NO_x emissions whereas coal is much more important for particulates and sulfur dioxide. In 1989 Hungarian prices for petroleum products were above US prices and only about 30% below West European prices, whereas coal prices were less than one-half of comparable West European prices. The same pattern of relatively lower price distortions for petroleum products than for coal applied to all of the other countries outside the former Soviet Union. As a consequence, total emissions of NO_x from the Central and South-Eastern countries only falls to 66% of the initial total by 1995 and rises thereafter to 97% by 2010. On the other hand, prices for petroleum products in the Soviet Union were only one-fifth of West European prices on average, whereas coal prices were about one-half of West European prices. Thus, the decline in NO_x emissions is much more dramatic in all of the FSU countries with Ukraine's emissions falling to 44% of the 1990 level in 2005 before rising slowly thereafter. Strict emission standards applied to all existing plants and equipment would be required to bring Hungary's emissions down to the same ratio by 2010. However, the application of stricter emission standards to new equipment alone does have a significant impact in this case, leading to an average growth in NO_x emissions which is much lower than the general rate of economic growth.

Figure 11

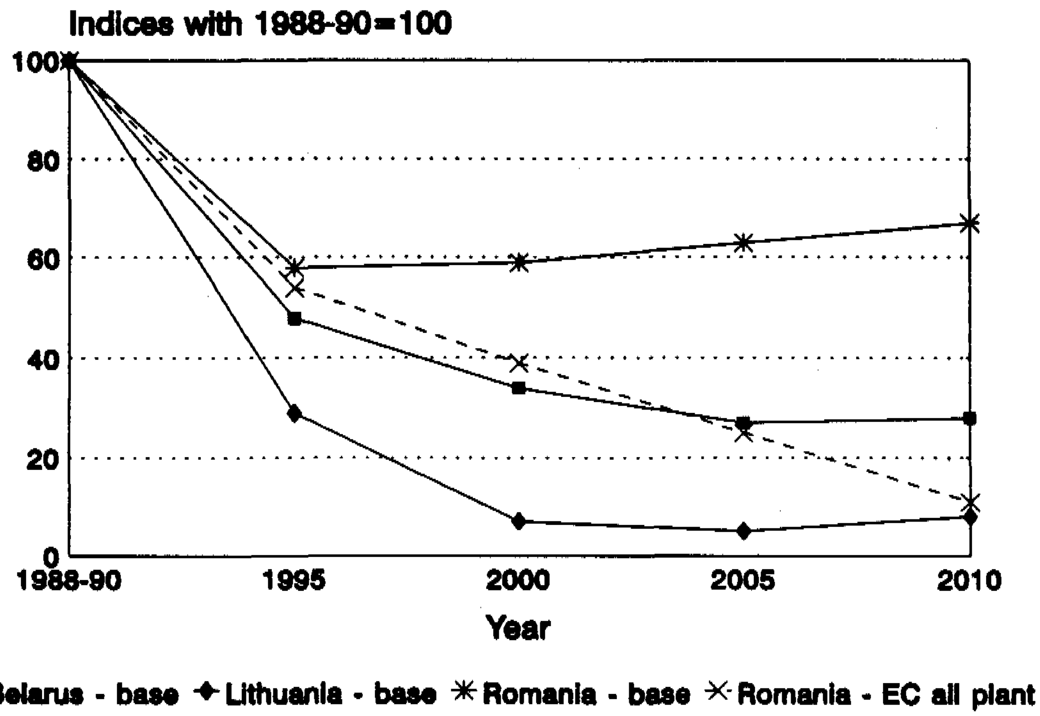


Economic reform should lead to a substantial reduction in emissions of lead particles in Bulgaria, but the improvement is both less and more transitory in Romania. The differences reflect the relative contributions of the non-ferrous metals sector, combustion of fuels in other large plants, and leaded gasoline. Where non-ferrous metal plants make a substantial contribution to total emissions, as in Bulgaria, the initial decline in production followed by a reduction in emissions of lead per unit of output associated with new equipment and stricter controls will ensure that total emissions can be sharply reduced even without a large shift to the use of unleaded gasoline. In Romania, however, stricter standards on the lead content of gasoline are crucial if total lead emissions are to be reduced substantially. The projection for EC standards applied to new plant alone assumes that the average lead content of gasoline is reduced to 0.15 grams per liter. This would lower the 2010 index of total emissions to 55 (from 80). The projection for EC standards applied to all plant assumes that one-half the vehicle stock will rely upon unleaded gasoline by 2010, which yields an emissions index of 17 at the end of period.

Figure 3 in Annex 5 illustrates how the composition of lead emissions by source type in Bulgaria will change under alternative scenarios.

Figure 12

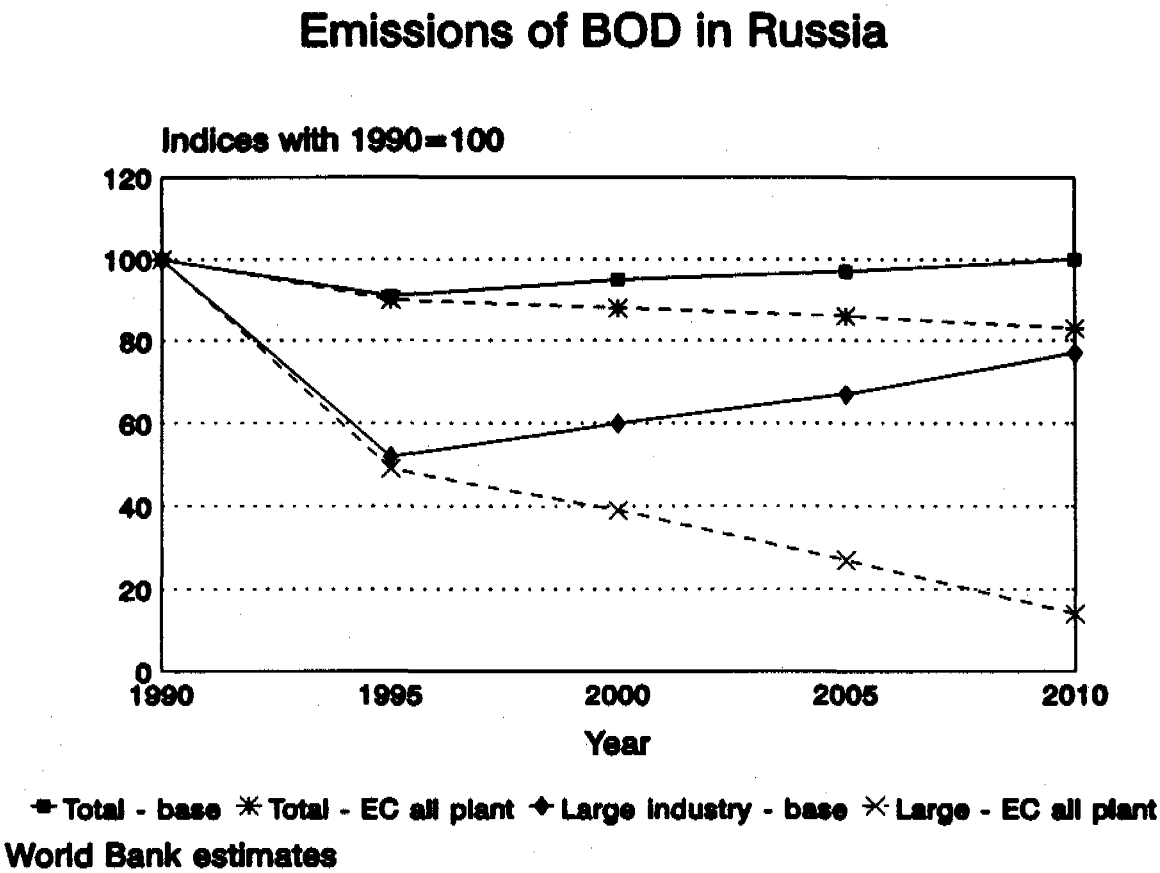
Emissions of cadmium in Belarus, Lithuania and Romania



World Bank estimates

Emissions of heavy metals other than lead, with cadmium being used as a general indicator, depend upon output in the metallurgy sector and on the use of coal and oil. Lower output from the metallurgy sector, greater energy efficiency and better environmental performance as old plant is scrapped all lead to large falls in cadmium emissions in Belarus and Lithuania. The main scenario for Romania indicates a sharp initial fall in emissions followed by a gradual rise. This upward trend can, however, be reversed by the gradual introduction of stricter environmental standards for all plants, so that total emissions in 2010 would be only 10% of their initial value.

Figure 13



Large industrial plants account for less than 15% of total emissions of BOD in Russia. The remainder comes from households and small industrial plants which are likely to discharge their effluent to municipal sewers. Thus, a substantial drop in large industrial emissions up to 1995, even if reinforced by stricter environmental standards for all plants, has a relatively small impact on total emissions. Even if governments encourage or require small industries to discharge their wastewater to central pre-treatment or treatment plants, the relative contribution of municipal discharges to water pollution will grow over time. In view of the limited resources available for treating these discharges, any significant improvement in water quality on a broad basis must depend upon investment in facilities and technologies which maximize the reduction in pollution loads given the constraints on investment.

3.20 Slower economic reform leads to a slower decline in emissions but over a longer time span. Still, delays in economic reform imply that emissions will be higher throughout the whole of the two decades studied. Accelerating economic reform also accelerates the rate of decline of emissions, but this means that the trough is reached more rapidly and continuing rapid economic growth can lead to the total level of emissions overtaking those under a scenario in which both reform and economic growth are less rapid.

3.21 The social costs of industrial restructuring may be high so that people require more than an assurance of better environmental conditions to accept the disruption and pain involved. However, short of an attempt to reimpose a command economy, it is an illusion to believe that the costs of restructuring can be avoided or even much reduced. The breakup of CMEA trading arrangements followed by the dissolution of the Soviet Union has irrevocably destroyed the foundations of the economic system that supported inefficient and polluting industries. Centralized control over the economic decisions is no longer acceptable, while countries have to adjust to fiscal and trade constraints arising from the loss of implicit subsidies on energy supplies and other raw materials. Thus, the issue is not *whether* industrial restructuring will occur but *how*. All governments face difficult choices in deciding to what extent the long term rewards generated by faster economic adjustment are sufficient to outweigh the immediate costs involved. In that context, the correlation between faster economic reform and the extent of the environmental gains may shift the balance towards more radical reform but it is hardly decisive.

3.22 The results of the scenario analysis show that the environmental benefits of economic reform can be high. Total emissions of particulates and sulfur dioxide decline by 70 percent or more of their pre-reform level by 2005 in many countries despite a recovery of GDP to pre-reform levels or higher in all cases. Falls of 50 percent or more in other air pollutants such as NO_x, air-borne lead and cadmium are likely. However, sustaining the rate of decline in total emissions after 2000 in these countries and achieving equivalent declines in the high range countries will require environmental policies that involve additional costs by restricting emissions below the level that can be attained by modern technology at a negligible cost. In particular, emissions of NO_x and lead may grow rapidly in the next century as a result of traffic growth unless measures are adopted to improve the environmental performance of motor vehicles and/or to limit their use in polluted urban areas.

3.23 The crucial question is whether to require that all plants should meet tighter emission standards or whether it is enough to impose these on new or rehabilitated plant and equipment alone. It turns out that *the environmental gains from imposing EC standards on new capital alone are modest* for most pollutants. Thus, it would be necessary to insist on retrofitting or scrapping old capital which does not meet these emissions standards in order to achieve the very large reductions in emissions that are shown to be possible by 2010. The costs of accelerated capital replacement would partly be covered by the greater efficiency of new capital, but nonetheless the financial burden is likely to be large. A program that requires retrofitting or capital replacement for all plants in hot spots but not elsewhere would certainly offer the most cost-effective way forward if governments wish to go beyond what can be achieved by imposing stricter environmental standards on new or rehabilitated plant and equipment alone.

3.24 Projections such as these show what can be achieved, given the technology that is readily available in the West, but they do not tell us how it should be done. Emission standards are only one possible instrument of environmental policy. The analysis later in this chapter indicates that other instruments may be preferable on economic or institutional grounds. Further, the fact that emissions could be reduced by the amounts shown does not imply that this should be the target for environmental policy in all or any of the countries. For example, even stricter emission controls via the application of Best Available Control Technologies (BACT) would reduce average emissions per square kilometer in Central and Eastern Europe to a level only one-fifth of that in Western Europe because of differences in income per head and population density. *A BACT-approach would, therefore, only make sense in regional hot spots, even if the goal is to achieve ambient environmental conditions equivalent to those in Western Europe.*

3.25 Costs must play a central role in setting emission reduction targets. It is much cheaper to install dust collection and filtering systems on both new and old plant than to install some kinds of sulfur or NO_x emission controls. Thus, *it is sensible to aim for larger reductions in emissions of particulates, air-borne lead and heavy metals than for gases. The relationship between the costs of control in new and old plants is important in deciding how far to go in retrofitting or scrapping old plant, which in turn determines the length of the transitional period that should be allowed and the stringency of the intermediate emission standards.*

Combining policies and investments while taking account of economic forces

1. Over the medium-to-long term, households and other small-scale users of coal are likely to switch to gas and other fuels;
2. The use of coal will therefore become more concentrated in large sources (as in Western Europe);
3. In the short run and during the transition, the environmental/health damage from small-scale sources and households will continue to be high, partly because these users cannot afford to undertake the investments necessary to comply with energy price increases and other consequences of economic reform;
4. It is desirable to reduce emissions from low stacks more rapidly than would occur as a result of economic forces alone (see 1) -- this therefore becomes a legitimate element of a public investment program;
5. At the same time, however, environmental standards and policies should be directed at ensuring strictly that large sources are reducing their emissions similarly. However, the environmental policies should force enterprises and utilities to internalize the environmental costs they cause, forcing them, in general, to finance their own investments. (Chapter V analyzes this issue and the possible exceptions.)

3.26 In general, it is much easier to monitor and enforce environmental policies that apply to a small number of large sources than to many small sources. Certain instruments -- e.g. differential fuel taxes, regulations concerning fuel specification or vehicle equipment -- can be applied uniformly to all sources but ensuring that they are not nullified by poor maintenance requires substantial resources. Economies of scale in control technologies combined with institutional considerations mean that environmental policies should focus on large sources initially. The scenarios show that large sources such as power and heat plants and heavy industrial plants account for nearly 80 percent of dust and sulfur dioxide emissions and 50 percent of lead emissions. Thus, a *strategy in which EC standards (or their equivalent) are applied to large sources will yield most of the benefits derived from an attempt to apply them to all sources, large or small.*

3.27 The phasing of stricter environmental controls must be considered carefully. To the extent that a country is going to rely upon the application of stricter controls to new plants only, it is essential that appropriate standards or other instruments should be introduced before investment recovers after the trough of the economic recession is past. The scenarios suggest that giving clear priority to environmental policies and investments which reduce emissions of all forms will reinforce the underlying trends associated with economic reform and restructuring. This will enable large and permanent improvements in the ambient air quality enjoyed by many tens of millions of people to be achieved by the end of this century.

3.28 The strictest controls upon emissions of NO_x, VOCs and lead from vehicles imply the installation of catalytic converters on all automobiles. This will take a considerable period to come into effect, though product standards can be changed immediately to reduce the lead content of gasoline. (Indeed, automobiles without catalytic converters can operate on unleaded gasoline.) In the short run this measure is not required in order to achieve the substantial reductions in NO_x and lead emissions shown in the figures, though it is more difficult to deal with VOC emissions without tackling automobiles. However, photochemical smog -- resulting from the action of sunlight on NO_x and VOCs -- is not one of the highest priority problems at present in most of Central and Eastern Europe, so that priority should probably be given to reducing VOC emissions from the chemical industry because of their relative toxicity as well as the relative costs of reducing emissions. Controls on vehicle emissions will be required in due course because of the expected growth in traffic volumes, but these are not an immediate priority and could be left until after 2000 which allows time for the efficiency and cost of control equipment to improve.

3.29 With regard to water pollution, the outlook is not entirely positive. The scenarios show that emissions of BOD and other water pollutants barely decline or rise after 1995, even if large reductions in industrial emissions occur. Households and small sources dominate the discharge of these pollutants and the only effective solution is large scale investment in municipal wastewater treatment. The time span involved will be lengthy -- several decades -- and the effect on ambient water conditions will vary greatly from place to place. It follows that *it is essential to ensure that scarce resources are allocated to maximize the improvement in ambient conditions by choosing the most cost-effective methods and standards of wastewater treatment.*

Privatization and Environmental Liability

3.30 Privatization is another structural change associated with market reforms which may also contribute to improving the environmental performance of industrial enterprises, provided that an appropriate framework of environmental policy is in place. The simple fact of transferring the ownership of an enterprise from the public to the private sector need not have an immediate effect on its behavior. Indeed, there are those who worry that private enterprises may be less willing to be "good environmental citizens" than public ones. The crucial issues are: (a) whether the change in ownership alters the enterprise's response to pricing, taxation and regulatory polices; (b) whether the break-up of a monolithic public sector allows environmental policies to be enforced more effectively than before; and (c) whether clear and credible environmental regulations are in place. Another issue which arises at the time of privatization is how responsibility for contamination from past industrial operations will be allocated. Legal uncertainty about this can delay the privatization of some enterprises.

3.31 One of the objectives of privatization is to stimulate enterprises to respond more vigorously to price and other signals. Experience suggests that it may only be partially successful in meeting this goal, because it is competition as much as the form of ownership that determines the behavior of enterprises. Thus, breaking up large enterprises is as important as privatizing them in obtaining the best response to higher energy prices, pollution taxes or regulatory measures.

Environmental Liability and Foreign Investment

Western investors are inhibited from investing in Central and Eastern European industries because of concern about environmental problems, according to a survey conducted by the World Bank and the Organization for Economic Cooperation and Development (OECD).

The survey of major North American and European corporations indicates that liability for sites previously contaminated by hazardous substances is the top concern of survey respondents. However, uncertainty about environmental requirements and the costs of compliance with environmental regulations were also major concerns.

The survey of Western corporations reveals several reasons for CEE governments to be worried. More than 60 percent of survey respondents ranked environmental issues at least as important as non-environmental impediments to investments.

Among those respondents indicating that lower costs were their primary reason for considering CEE investment, the percentage rose to 72 percent.

Privatization officials recognize the need of investors to incorporate environmental risks into the terms of an investment deal, but say the lack of expertise and infrastructure for carrying out environmental audits and other assessment procedures makes it difficult to meet investors' demands in a timely manner. They note that some investors are pressuring for special concessions such as reductions in price and indemnifications, while others are willing to undertake cleanup if reimbursed from purchase funds.

Further details of the survey and its results are given in **Annex 7**.

3.32 The same conclusion applies to the other major benefit of privatization, which results from eliminating the potential conflicts which arise when the government acts both as environmental regulator and as owner of the regulated enterprises. Advocates of paternalistic government used to suggest that public ownership of enterprises would enable officials and managements to pursue environmental and other social goals without hindrance from the constraints imposed by the interests of private owners. In practice, the reverse was true, so that the environmental performance of large public enterprises has tended to be worse than that of private ones. Size and incentives were part of the explanation, but so too was the conflict between the various goals that the managers of public enterprises are expected to meet. Environmental concerns were far from the top of the list and, thus, received scant attention. Decentralization of responsibility for different aspects of government policy combined with privatization means that environmental considerations become an essential element of the context in which new managements have to operate. They are no longer expected to choose between a wide range of economic and social objectives. Instead, they can focus on operating efficiently and profitably subject to meeting reasonable environmental constraints. There will, of course, be bargaining over what those constraints should be, but the negotiations will take place between parties with clearly defined responsibilities which do not overlap.

3.33 *The Need for Information.* The neglect of environmental concerns in the past makes the process of privatizing industrial enterprises more difficult. The main problem is that of liability for the damage resulting from careless or unsafe disposal of hazardous materials in the past. With complete information the issue is straightforward: either the government accepts responsibility for dealing with the consequences of past damage or the obligation is transferred along with the assets of the enterprise in which case the government will receive a lower (perhaps even a negative) price for those assets. In practice, it is the lack of information about what has been done in the past that gives rise to the greatest difficulties.[3] All the more, it is critical that the responsibility for past environmental problems must be decided *before* privatization, when property relationships are still simple. This requires (a) technical information on the extent of pre-existing contamination and the potential costs of rectifying the damage, (b) an administrative decision about what remedial action is required, and (c) clear legal rules – either in legislation or in specific contracts – defining how any costs will be allocated.[4]

3.34 It will be very difficult for the governments to privatize the large, heavily polluting industries with unknown past environmental liabilities. To the extent these industries continue to operate, they are likely for economic reasons to be broken up into smaller parts, some of which may be able to be privatized. In any case, *it is important to develop an appropriate monitoring system as a basis for drawing a clear dividing line between environmental damage resulting from past actions and the consequences of current emissions -- whether or not an enterprise is privatized.* The extent of past liability must be clearly established at the time of ownership transfer to avoid the kind of uncertainty and protracted legal battles that can otherwise be expected in the future.

3.35 Privatized enterprises must be responsible for the consequences of their emissions after privatization. If they inherit old, polluting plant and equipment which must be modified or replaced to meet current environmental standards, this will be reflected in the value of the assets. The government for its part must be willing to *define the environmental standards that the privatized enterprise is required to meet and the period of adjustment that will be permitted.* Thus, the process of privatization is closely bound up with the formulation of a wider set of environmental policies and standards.

3.36 *Cleanup of old Wastes. Experience from the West suggests that cleanup of hazardous and toxic wastes should be approached very cautiously, and that only those sites that could cause damage to water supplies or otherwise imply immediate danger to human health should be cleaned up right away.* Other sites should, as a rule, be cordoned off and carefully monitored with information being registered in a national inventory of waste sites. Inappropriate transport and disposal of dangerous substances could be riskier than leaving the sites untouched for the time being. Moreover, financial limitations in CEE countries argue strongly for this approach.[5]

3/ On the other hand, if governments accept liability for past pollution, there will be an incentive for full disclosure by the enterprise, partly solving the problem of lack of information.

4/ Though it may be possible to set in place legal rules specifying who will pay for past pollution costs, collecting the technical data and making administrative decisions about required remediation may not be *feasible* for the majority of CEE enterprises before they are transferred to private ownership.

5/ In the U.S., only 63 of the 1,200 sites on the National Priority List of hazardous waste sites (32,000 potential sites have been identified) could be cleaned up during the last 12 years, at a cost of US$11 billion. Under the Superfund procedure in the U.S., it has been estimated that the cost of litigation has amounted to 55% of actual clean-up costs. Moreover,

(continued...)

3.37 From the government's perspective, environmental liability will often be regarded as a small problem that can be deferred to later. The evidence suggests that environmental issues are indeed a small factor in most property transfers, albeit one for which the government must have the expertise to make the necessary adjustments in the price of the property. In a few instances, however, environmental concerns could become a serious obstacle to privatization, and the government may need to provide explicit assurances that it will assume certain well-defined responsibilities. This may imply some significant budgetary expenditures in the short run.

3.38 *Environmental liability: immediate actions.* Uncertainty about future policies concerning the responsibility for past environmental damage is a significant factor discouraging foreign investment in heavy industrial sectors. At the same time, insufficient attention seems to have been paid to problems of environmental liability in domestic privatization programs. This discrepancy may provoke future conflicts that could be avoided by establishing a clear and uniform set of legislative and administrative guidelines defining who will be responsible for costs related to pre-existing pollution. *Ministries of Environment will need the resources and staff required to work with the authorities responsible for privatization to negotiate the environmental aspects of large individual deals and to provide general guidance in the case of medium and small enterprises.*

3.39 Practical considerations imply that, in one form or another, governments will bear the costs of dealing with past emissions. *The funds and staff required to carry out detailed environmental inventories dictate that these should be limited to a small number of the largest enterprises, especially when foreign investment is involved.* If an environmental audit has been completed, then the terms of the privatization can specify the environmental clean-up actions that are to be taken by the new owners and the discount built into the sale price to take account of the costs involved. Both parties must be realistic in the negotiations. Potential purchasers, especially those from countries with very strict environmental regulations, may be inclined to allow for a more comprehensive clean-up than the government would choose to undertake. On the other hand, the new owners will have an incentive to minimize the costs of meeting their clean-up objectives and should be able to act more rapidly. On isolated sites where the nature of past pollution can be clearly identified, the balance of advantages is likely to lie with accepting a lower privatization price in return for a commitment to undertake specific remedial actions. Where multiple sources or great uncertainty is involved, governments would be best advised to retain the responsibility for rectifying past damage.

3.40 Since the privatization of medium and small enterprises is a key element of the reform process, *concerns over environmental liability should not be allowed to delay* this process. This means that governments will have to bear the costs of any clean-up that is subsequently required. However, this does not justify the tendency to neglect the issue altogether. Substantial costs will be involved, so governments should set aside an appropriate fraction of all privatization proceeds to fund the investigation and remediation of damage caused by past emissions.

3.41 In all cases, but especially for medium and small enterprises, steps must be taken to *distinguish clearly between the inherited consequences of past pollution and the impact of current*

5/(...continued)
between 1986 and 1988, only US$166 million was recovered from private parties, or roughly 7% of the US$2.4 billion spent on Superfund cleanups.

Who should pay for environmental damage ?

The "Polluter Pays Principle" (PPP), adopted by the OECD in 1972, states that "the polluter should bear the cost of measures to reduce pollution decided upon by public authorities to ensure that the environment is in an acceptable state." As stated by OECD, the main objective is to harmonize policies among countries so that differential environmental regulations do not distort comparative advantage and trade flows. The principle has been widely accepted as a basis for environmental policy making in the rich market economies, and many CEE countries have endorsed it.

In applying the principle, two classes of environmental problems have to be considered:

(i) *Current emissions.* Making the polluter pay has advantages in this case, provided that an appropriate set of incentives can be established. The key concern must be to find the most cost-effective method of either reducing emissions or mitigating the damage that they cause. Pollution charges or appropriate emission standards can mobilize the ingenuity of enterprises that have an interest in finding low cost methods of control. In other circumstances (e.g. in dealing with water pollution from small or medium-sized enterprises), it may be better to adopt collective solutions to which the polluters contribute some, but not necessarily all, of the costs of pollution controls. Finally, it may be necessary to subsidize the installation of controls (e.g. to deal with groundwater pollution in rural areas) because the costs of attempting to make polluters pay could be prohibitive.

(ii) *Past Pollution.* In this case the PPP provides little guidance. In one form or another the costs of cleaning up damage that was caused under a completely different regime are going to be borne by the community at large. Any attempt to impose a part of this cost on those said to be "responsible" for the damage will simply distort current and future behavior without making it any more likely that socially cost-effective methods of avoiding or cleaning up environmental damage will be found. Strict policies may be necessary to deal with current emissions, but any attempt to apply these retrospectively may undermine the support and cooperation that are required to achieve satisfactory compliance with current standards.

There is a crucial distinction between those who nominally pay for cleaning up pollution and those who ultimately bear the cost, which may be illustrated by the example of the insurance industry. The costs of settling an insurance claim are usually perceived to be borne by the insurance company. In fact, those costs fall on all policyholders. Insurance companies operate in moderately competitive markets and they have to compete for capital and other resources in highly competitive markets. Thus, the costs of insurance settlements must, sooner or later, be passed on to the insurance company's customers. In the same way, the costs of reducing pollution must eventually be borne by those buying the products produced by polluting industries, which means the community at large. The manner of the payment should encourage polluting enterprises to reduce the costs of controlling their emissions and consumers to reduce their consumption of environmentally damaging products. However, this cannot be relevant to damage caused by past emissions. Neither is it likely to establish a precedent that would allow enterprises to escape the consequences of future negligence because the circumstances are so unusual.

Difficulties also arise in applying the PPP to environmental effects that spill over national borders and jurisdictions, though it provides a basis for defining the efficient outcome. The problem is that a country cannot be compelled to act in ways that run counter to what it consider to be its national interest. International agreements depend upon voluntary cooperation and that cooperation may not be forthcoming if the costs of participation are seen as exceeding the benefits to the country concerned. In such a case, insistence on following the PPP may hinder the adoption of measures required to reduce the damage caused by transboundary flows of pollution. By offering inducements or compensation to polluting countries, the efficient outcome can be achieved though the distribution of net benefits will be different to that under the PPP.

emissions. Governments should indicate clearly to the new owners of all enterprises that they will be held responsible for any damage resulting from violations of emission standards after the transfer of ownership. To ensure that this means something, Ministries of Environment must take immediate steps to implement the monitoring systems and associated databases that will be required to track the performance of newly privatized enterprises as well as those remaining in public ownership. In doing this, Ministries should set themselves implementation targets to cover all sources emitting more than some defined level of pollutants in particular industries within a specific time period -- for instance, by the end of 1994.

Better environmental policies

3.42 Most Central and Eastern European countries have environmental legislation which could be used even now to bring about improvements in environmental conditions. In the past, local and national governments were unwilling to enforce their own rules because priority was always given to maintaining levels of production. As more power is given to environmental agencies at a local level and as governments disengage from direct involvement in the ownership and management of industry, it should become possible to establish an effective system of environmental regulation. However, the choices will be very difficult. With falling output and rising unemployment, the authorities may be understandably reluctant to enforce strict environmental rules if that means closing down industrial plants.

3.43 The first step is to establish a clear set of priorities and targets which can be realistically achieved over the next 2-3 years. In the past, governments in the region established environmental standards which were much stricter than those in Western Europe but then did little about meeting them. In the future it is clear that they will move toward Western European standards, but the convergence may take one or two decades. *One of the earliest measures should be to require that non-ferrous metallurgy and parts of the chemical industry reduce or largely eliminate their discharges of heavy metals -- especially lead -- to air and water.*

3.44 **The choice of policy instruments for major sources.** Once a set of local or national priorities has been drawn up, attention must focus on the best method(s) of implementing these priorities. Over the last 20 years, arguments about this issue have focused on the choice between "command and control" (CAC) and "market-based" (MB) approaches. The kernel of the dispute is that the regulatory approach using CAC instruments -- new source performance standards (NSPS), emission permits -- offers the prospect of certainty in achieving pre-determined emission limits and is generally regarded by politicians and industries as being easier to implement and more acceptable in political and business terms. On the other hand, there is overwhelming evidence that, in most circumstances, it is much more costly to achieve some level of emission reductions if CAC rather than MB instruments (pollution charges or taxes, tradeable discharge permits, deposit-refund schemes) are used. The reason is that the cost of cleaning up emissions is not the same for all sources. Therefore, the cheapest method of meeting the reduction target is *not* to impose the same proportionate reduction in emissions or the same emission standard on all sources. Instead, those with the lowest costs of clean-up should reduce their emissions by more than those facing higher costs. This may appear to be inequitable to the different industries or plants involved but it is an essential condition for economic efficiency.

3.45 The severe financial constraints in Central and Eastern Europe suggest that the governments in the region might have to give more serious consideration to market-based instruments than has been usual in Western Europe. Even though CEE countries have embryonic markets at best, this is not as

The scope for using market instruments to control pollution

A study of instruments to control air pollution in Poland was carried out in preparing the Action Programme. It compared the costs of relying upon alternative instruments to meet emission reduction targets for particulates, sulfur dioxide and nitrogen oxides. These targets corresponded to the projected emission levels (at five-year intervals) up to 2015 under Poland's air pollution regulations introduced in 1990, along with other controls in the household and transport sectors (the Polish CAC approach).

The present value of pollution controls over 1991-2015 (using a 12 percent discount rate) was estimated at US $12.6 billion for the Polish CAC approach. A little over one-half of this cost would be borne by energy conversion activities, just under one-half by transport, and small amounts on the rest of the economy. Applying EC CAC controls would have the same cost but would lead to lower emissions of particulates and sulfur dioxide. Yet stricter CAC controls equivalent to German standards would reduce emissions of sulfur dioxide and NOx by one-third relative to the outcome under EC standards but only by increasing the present value of pollution control costs for energy conversion from US $6.6 billion to US $15.4 billion.

Relying upon pollution charges rather than CAC would reduce the present value of control costs by 54 percent to US $5.7 billion in total. The savings would amount to US $1.1 billion in energy conversion and US $5.9 billion in the transport sector.

The latter is particularly significant because it arises from redistributing the burden of reducing NOx emissions. Under the CAC approaches this involves the installation of catalytic converters on all cars by 2005 plus improvements in the environmental performance of diesel vehicles. The results indicate that it is much cheaper at this stage to reduce NOx emissions from large stationary sources than from vehicles.

This assessment of the costs of using alternative instruments to control emissions conforms with the findings from other studies in the US and the UK which have found that reliance upon CAC instruments will in many cases result in costs that are at least double those incurred when efficient economic instruments are used. There are, of course, difficulties in comparing the environmental consequences of controlling emissions from different sources. Catalytic converters on cars reduce VOC as well as NOx emissions. Cars cause more low level pollution than stationary sources, so that equal reductions in total emissions will affect urban populations and transboundary flows in quite different ways. However, other policies may be used to mitigate traffic-related pollution in cities, so that the study suggests that it may not be necessary to move rapidly to adopt West European vehicle emission limits in order to meet current emission targets for the early part of the next century.

unrealistic as might seem at first. In several of the countries in the region, there is paradoxically a fairly long tradition of environmental charges which have been applied with varying effect. Moreover, there may be institutional mechanisms (e.g., negotiated emission permits) for simulating the use of market-based instruments, until such time as these can be applied directly. It is important to note that this is not necessarily a substitute for -- but rather a complement to -- emission limits, provided these are well enforced and take account of regional variations in ambient conditions.

3.46 There are very limited resources available for environmental improvements, while some of the environmental issues which are receiving attention -- such as wastewater treatment or acid rain -- are among those where the costs of relying on CAC approaches are particularly high. Thus, *the cost of failing to utilize efficient MB instruments wherever possible will be incurred in the form of less* *environmental improvement, more damage to human health and the natural environment, and lower economic welfare.*

3.47 The contrast between CAC and MB approaches is often overstated. With sufficient information it is possible to achieve an efficient reduction in emissions by relying upon different combinations of instruments. The real problems are those of practical implementation which, in many cases, focus on the question of the information that is available to the policy maker or regulator and to the industries concerned. There is no point in attempting to use a MB approach if it is not possible for each source to monitor the level of emissions. On the other hand, technology standards are particularly inappropriate for an industry where the range of production processes and options for emission reductions is large or is changing rapidly, because regulators are likely to impose unnecessarily costly solutions. Since there must be substantial uncertainty about the costs and consequences of adopting alternative instruments, an important consideration guiding the choice of instruments must be the relative costs of making mistakes, that is of imposing too strict controls or achieving too little reduction in emissions.

3.48 Detailed assessments are required of the suitability of different combinations of instruments for dealing with various environmental problems in Central and Eastern Europe. These must focus on practical issues of implementation as well as an economic assessment of the relative costs of the alternative approaches.[6]

3.49 It is possible to state some general conclusions in advance of the full assessments.

(a) There is little alternative to reliance upon a regulatory approach and CAC instruments to deal with micro-pollutants such as heavy metals and most toxic chemicals. The costs and difficulty of monitoring emissions of such pollutants are large, the costs of making mistakes also tend to be high, while the range of control costs seems to be relatively limited. In these cases it is usually necessary to adopt blunter forms of regulation including technology standards which require enterprises to install certain kinds of process or end-of-pipe controls.

(b) Pollution charges -- which have a tradition in a number of CEE countries -- can be used in dealing with emissions from large or medium industrial plants that can be monitored at reasonable cost. This includes air pollutants such as dust, sulfur dioxide, nitrogen oxides as well as water pollutants such as organic material, suspended solids and some heavy metals. Where pollution charges have been applied in the past in CEE countries, they have usually been set too low to cause any change of behavior among enterprises.

6/ The OECD's **Guidelines on the use of economic instruments in environmental policy** together with a number of related publications on Western experience of the application of economic instruments provide valuable guidance on how pollution charges, tradeable permits and similar instruments might be introduced.

(c) Tradeable discharge permits have an advantage over pollution charges in that they offer relative certainty about the total level of emissions. However, they can only offer an effective alternative if the number of sources within the area covered by the permits is sufficient to sustain a reasonable level of permit trades without any one source having a disproportionate influence on the market. The main experience of using tradeable permits has been in the US. There a scheme for phasing out lead in gasoline was very successful, but other schemes have been less successful with the number of trades limited by regulatory uncertainty, onerous CAC requirements imposed in parallel with discharge permits, and geographical restrictions which reduced the number of sources that were eligible to participate. The 1990 Clean Air Act is expected to lead to a large increase in the role of permit trading in meeting overall targets for reducing emissions of sulfur.

(d) The major problems in introducing market-based instruments arise from the distributional consequences of alternative levels of charges or permit allocations. It may be necessary to adopt transitional arrangements which mitigate the immediate impact of the new control system on existing sources, usually by "grandfathering" sources for a period. For instance, pollution charges could be increased gradually or a substantial share of permits could be allocated to existing sources. Such provisions may play an important role in ensuring that proposed schemes are politically acceptable.

(e) Despite these difficulties, there is a clear trend among OECD countries to consider the introduction of market-based instruments to address energy-related emissions. This includes recent US legislation and proposals for a new energy tax, the EC's energy-cum-carbon tax, Sweden's carbon tax, the UK's green paper on environmental policy, and other initiatives. Underlying this trend is the realization that even for rich countries the costs of adopting inefficient CAC regulations jeopardize the achievement of national environmental goals.

(f) Deposit refund schemes have been used with considerable success in many countries to deal with various types of solid waste and to encourage recycling of glass and aluminum. This approach is now being expanded to control the disposal of hazardous wastes in Thailand and other proposals are under consideration elsewhere. There is considerable scope for introducing similar arrangements in Central and Eastern Europe in order to provide appropriate incentives to reduce the generation of waste as well as to ensure that it is properly managed.

3.50 **Pollution charges.** Several countries in Central and Eastern Europe -- including Bulgaria, Czech Republic, Hungary, Poland, Russia, Slovakia and Ukraine -- have legislation which allows

Ministries or provincial governments to impose emission fees and fines on polluters. In many other countries -- for example, Belarus and Croatia -- such legislation has recently been introduced or is being actively considered. Such emission fees and fines can form the basis for efficient systems of pollution charges.

3.51 In the past, the levels of the fees and fines were too low to act as a serious deterrent and, in any case, payment of them was often not enforced or was simply regarded as a cost to be passed on in the prices for the goods produced by the enterprise. *In most countries, it will be necessary to raise the level of the charges dramatically and then to enforce payment of any charges levied.* If this is done, the charges will provide a very powerful incentive to encourage enterprises to find low cost methods of abating their emissions, even if they cannot afford to make large investments in new plant and technology. Often, good environmental management is just a reflection of good industrial management. The great merit of pollution charges is that they mobilize the ingenuity and skills of plant managers in order to achieve better environmental performance while they avoid the danger of enforcing technology standards which may be unnecessarily costly or rapidly outdated.

3.52 Poland has raised the level of its pollution charges by about 10 times in real terms since 1990, providing a genuine incentive to reduce emissions. The revenue collected in this manner goes to a National Environment Fund and is used to finance various environmental investments. There have been problems in collecting the revenue from many enterprises whose financial situation was or was claimed to be such that they could not make the payments for which they were liable. As a result the Fund's revenue fell short of its expected level in 1992. The Ministry of Environment announced in late 1992 that pollution charges would be reduced temporarily by 90 percent to allow industries to adjust to the much higher level of charges. Public reaction to this decision by enterprises as well as environmental groups has demonstrated that the pollution charges were having their intended effect of encouraging polluters to invest in reducing their emissions. As a result, abrupt changes in the level of charges disrupt plans based on the assumption that the charges will be much higher than in the past.

3.53 A clear distinction must be drawn between (a) fees for emission permits or pollution charges whose purpose is to cover the administrative and monitoring costs involved in any system of environmental regulation, and (b) pollution charges which are linked to the amount of damage caused by emissions. Reliance upon cost-based fees to finance regulatory expenditures are common in Western Europe and should be regarded as a minimum requirement in the CEE countries to ensure that the environmental authorities have sufficient funds to fulfill their basic responsibilities for monitoring and enforcement. Pollution charges generate additional government revenue that can be used for any purpose, though in practice it is usual to use the revenue to finance environmental expenditures via an Environment Fund or an equivalent arrangement. While linking revenues and expenditures is generally not recommended -- the constraint that revenues from a particular program must equal expenditures on that program may lead to inefficient levels of taxation or spending -- the loss of economic efficiency may be a political price worth paying in order to introduce an effective system of pollution charges. So long as cost-based fees are used to finance the fundamental regulatory functions, no serious problems should arise if the additional revenue from pollution charges is used solely to finance environmental improvements. A fall in the amount of revenue collected would indicate a decline in total emissions and thus in the clean-up expenditures, so that the arrangement provides a greater degree of flexibility in setting expenditure levels than is typical for most other assigned taxes.

3.54 While the changes in Poland were a major step forward, charges are still set below the marginal damage of pollution in most cases. For example, the charges for emissions of saline water are not set high enough to force the mines concerned to control their discharges (though the sharp increases in charges has prompted the mines to give serious consideration to more limited measures designed to reduce emissions). In this case the government was concerned that charges set high enough to fully reflect the damage caused by saline water would cause the mines to shut down resulting in a loss of jobs and greater dependence upon imported energy. While this view is understandable, it neglects the fact that the costs of the damage caused by saline water are equally real even though they may be not be immediately apparent to the many enterprises and other organizations which have to bear them.

3.55 Poland's experience with pollution charges suggests lessons for other countries which are considering similar measures. Two major issues must be addressed in implementing any system of charges:

(a) The relationship between CAC regulations and economic instruments must be carefully considered. In Poland, emission standards have not been linked to pollution charges either in the way they operate or in the implied weight placed on reducing emissions of different pollutants. Enterprises are confused and feel that they are being unfairly subjected to inconsistent signals.

(b) An efficient system of pollution charges that reflect the environmental damage caused by emissions will impose a heavy fiscal burden on enterprises that have never had to meet strict environmental standards in the past. Since the financial position of many enterprises is very weak, enforcing payment may lead to bankruptcies while a failure to levy the charges due will undermine the credibility of the system.

3.56 Both of these issues are much more acute during the transitional period while enterprises adjust to the new policy regime than they are in the long run. CAC regulations which are retained can be amended or eliminated to ensure that they do not undermine the impact of the pollution charges. The total fiscal burden on enterprises can be adjusted by varying non-environmental taxes. This will, of course, result in a redistribution of the tax burden away from "clean" activities towards large scale emitters. This redistribution is essential if the costs of environmental damage are to be internalized, so governments must be prepared to resist the complaints that will come from those which will in future have to bear the costs of the damage that they impose on the rest of the community.

3.57 As indicated above, various arrangements can be introduced to cushion the transitional difficulties. None is ideal, but countries could consider one or a combination of the following :

(a) Impose a relatively low charge on emissions up to the level specified in each plant's emission permit but require that the full charge should be payable on all emissions above that level. This is equivalent to the original system of fees (low pollution charges) and fines (full pollution charges) which was or is still operated in several countries. It provides a strong incentive to reduce emissions to the permitted level, but sacrifices some of the efficiency gains which can be achieved by encouraging plants with low emission control costs to reduce their emissions below the level specified in their permits.

For this reason, the quantity of emissions subject to the lower charge should be gradually reduced to zero over a period of 3-4 years.

(b) Apply a uniform pollution charge to all emissions which is gradually increased over a period of years to the level implied by estimates of the damage caused by emissions. This approach provides less of an incentive to reduce emissions immediately, but may be more practical if emission permits are ambiguous or have not been issued for many sources.

(c) Impose the full rate of pollution charges from the beginning, but introduce a "banking" scheme under which enterprises can defer payment of the charges in exchange for making larger reductions in emissions or paying higher emission charges in future. There must be a limit on the amount that can be "borrowed" in this way, so that the length of time allowed for "paying back" the deferred sum of pollution charges must be rather short -- no more than 4 years. This arrangement reflects the reality that the government is likely to be unwilling in the short run to bankrupt heavy polluters which are unable to pay their pollution charges. However, it will only be credible if the authorities take steps to make clear that enterprises which fail to "repay their loans" will be closed down in future. One way of doing this might be to take out a lien on the property and other assets of privatized enterprises which defer payment, so that their new owners cannot evade the charges by asset-stripping.

3.58 No system of pollution charges or other economic instruments can change the underlying political choices. If governments give priority to maintaining production and employment, then environmental policies which threaten these goals will be set aside in one way or another. Adopting policies which are not enforced will just undermine the credibility of the environmental authorities and of the government in general. Thus, the transitional arrangements that are implemented must reflect the authorities' willingness to follow through on difficult cases in order to achieve their environmental goals. It is better to accept that a lengthy transitional period will be required than to set targets which few believe or are able to meet, since deadlines that are always postponed are much worse than longer deadlines that are regarded as being firm.

3.59 **Environmental Standards.** There are two kinds of environmental standards which serve quite different purposes in environmental policy.

(a) *Ambient standards* are used to identify areas where policies need to be implemented in order to improve environmental conditions. They are a simple method of establishing priorities since areas (or stream lengths) which comply with the relevant ambient standards are considered to require no further intervention, while other areas may be ranked by the extent to which exposure levels exceed the ambient standards. It has been usual to establish an ambient standard for a pollutant by reference to the health effects of different levels of exposure (as discussed in the first sections of this report), although certain countries have been moving more recently toward ambient standards based on the capacity of natural ecosystems to absorb environmental pollution.

Ambient standards represent a simple decision framework to guide policy making. They require an explicit agreement on the environmental quality objectives that are desired, and the costs that society is willing to accept to meet those objectives. Because ambient standards can be set at different levels for different locations, it is possible to use them to protect valuable ecosystems in a way that would not be possible by only focusing on emissions.[7] Historically, ambient standards in the rich market economies have been continually tightened as medical evidence has become stronger regarding the impact of certain pollutants, and as the demand for better environmental quality has increased.

(b) *Emission standards*[8] are instruments of policy which are a central element of most CAC approaches to environmental management. They may be established by reference to what can be achieved using the "Best Available Control Technology" (BACT) or some variant of this concept. Alternatively, emission standards may be set by trying to estimate, using a more or less detailed dispersion model for either air or water pollution, the volume or concentration of a pollutant in exhaust gases or wastewater discharges that is compatible with ensuring that areas around the plant meet the ambient standards that are defined for the pollutant. In many regulatory systems this approach links up with the process by which emission permits are issued. To obtain such a permit a plant may have to show that emissions will not raise typical exposures above the level prescribed by the ambient standard. By default, a plant which meets the emission standard is regarded as satisfying this condition, unless it happens to be located in an area that already suffers from serious pollution. Finally, there is a link to the manner in which pollution charges are levied in the region. These are generally collected via a system of fees and fines. Fees have to be paid on the total volume of emissions from a plant, while fines apply only if the level of emissions specified in the plant's emissions

7/ An example of this differentiation is the setting of "critical loads" for acidic depositions in different areas of Europe. Critical loads are a specific application of an ambient standard designed to protect vulnerable ecosystems from the damage caused by acid rain. They illustrate that it may be desirable to set joint ambient standards for several pollutants which interact or reinforce each other. Another example is the joint ambient standard for particulates and sulfur dioxide that has been adopted by the EC.

8/ In some CEE countries, the term "emission limits" is used, to indicate that the emission standards are only in reference to physical emissions from the plant, regardless of the technology used. In contrast, Western emission standards often imply the requirement of a type of technology.

permit is exceeded. For countries such as Bulgaria and Hungary the fees have, until very recently, been zero whereas fines may be significant.

3.60 New Source Performance Standards (NSPS) are specific emission standards -- always based on BACT -- in which the *emission standard is only applied to new plants*. They are a special and very rigid form of grandfathering since emissions from existing plants are treated differently from emissions from new plants. If it is costly for a plant to install the controls necessary to meet NSPS, they have the effect of prolonging the economic life of existing plants by imposing a cost handicap on new plants -- of course subject to the influence of other economic and technological factors.[9]

Environmental standards in the European Community (see also Annex 9)

The EC framework of environmental standards is more than simply a set of specifications of ambient and emission limits. *It involves targets (some of which are not specified in numeric terms) which need to be converted to workable objectives to be implemented over specified periods.* To the extent the EC has established specific standards, these are usually associated with a lengthy phasing-in period with intermediate targets. In other words, the EC framework is *as much a process as a product. In most EC countries, this process was initiated in the early 1970s, and there has been a 20 year planning horizon to achieve compliance with intermediate targets depending upon the industry and on investment requirements.*

There are few EC emission standards and *those are subject to exemptions.* For example, lignite-fired plants may exceed emission limits if it is determined that lignite is an essential fuel and implementation of controls would entail excessive costs. This would allow some of the lignite-fired power stations in the region to continue operating. At a more general level, the *directive dealing with emissions from industrial plants recommends the adoption of BACT provided that this does not entail excessive economic costs.* This approach to standard setting should be carefully distinguished from the way in which it has been applied in some of the richest EC member countries which have developed *ambitious sets of emissions and ambient standards that are very costly to implement.*

Countries in Central and Eastern Europe which seek to meet EC standards should embark on this process now. The main issue then is to determine appropriate intermediate targets. One of the principal benefits of this *approach is the opportunity that it provides to abolish the present unworkable ambient standards,* which might perpetuate a disregard for the law because they are mostly too strict and not enforceable.

3.61 A number of governments in Central and Eastern Europe have expressed their intention to move towards adopting European Community "standards." The Box shows that the EC framework of standards is much more complex than is usually understood. It implies that CEE governments could, in principle, immediately adopt the framework of EC environmental directives and abolish their existing sets of standards -- with the exception that the dates for conformance with certain specific EC directives

9/ In addition to ambient and emission standards, fuel quality standards should be mentioned. Throughout Western Europe, there are national and EC standards for maximum permissible sulfur content in different types of fuel oil as well as in coke and coal. In some countries, the use of low-sulfur fuels is required in special urban protection zones. Most countries and the EC also have health-related standards limiting the benzene content and the lead content of fuel for motor vehicles, and either limiting or outright prohibiting certain types of leaded fuel.

should be extended. Alternatively, those countries which have recently adopted their own new emission and/or ambient standards could choose to make modifications in the required adaptation periods, to assure that compliance can realistically be achieved. In deciding how rapidly to implement EC directives or equivalent national regulations, the CEE countries may wish to set intermediate targets which are contingent upon the transfer of appropriate technologies (subject to normal licensing arrangements) to local manufacturers, joint ventures or enterprises established by foreign investors. Over the next 20-30 years, it is in any case likely that Eastern and Western standards would gradually converge, and that there will be significant changes on both sides (e.g., a gradual introduction of a modified form of BAT standards in the EC). Annex 9 provides a comprehensive overview of the major aspects of current EC air and water pollution standards.

3.62 *Ambient standards* for air quality in most Central and Eastern European countries are considerably stricter than EC ambient standards, and the number of pollutants for which ambient standards have been promulgated tends to be greater than is common in EC/OECD countries. Given the limited resources for monitoring, it is difficult or impossible to track all of these pollutants. Indeed, ambient air quality monitoring for many of these pollutants has not been sufficiently established in Western countries to provide reliable data. Nor, in some cases, have health criteria been established to protect the general public with an appropriate margin of safety.

3.63 The situation is less clear with regard to ambient water quality. EC ambient standards have been mainly concerned with drinking water, while some Central and Eastern European countries attempt to specify ambient standards for many pollutants in rivers and lakes.

3.64 *For all media, it would be better to adopt a simpler set of ambient standards which reflect current analytical capacity as well as the most important threats to health or ecosystems. This capacity will increase over time, so that ambient standards for other pollutants could be temporarily suspended rather than repealed.* A regular process for reviewing ambient standards and monitoring arrangements could then be implemented as a basis for deciding whether or when to extend the list of pollutants which are regularly monitored and how this information should be taken into account in formulating policy.

3.65 *Emission standards* should be gradually introduced over the next 10-20 years in line with the process of economic transformation, industrial restructuring and capital turnover with a view to ensuring that the desired ambient standards are met, as well as conforming to international conventions on transboundary pollution flows. Because this may imply substantial variations in emission standards for different locations and sources (depending on the number of existing sources and natural factors), environmental policy should rely as little as possible on emission standards at a country-wide level. Instead, regional authorities -- with suitable assistance and supervision from the national environmental authorities -- are in a better position to negotiate efficient ways of complying with ambient standards. This can be achieved, for example, by adopting *sets* of new source standards at the local level that depend on local ambient conditions. In the process, regional authorities would have the right to set local ambient standards that are stricter than the national ambient standards if this is warranted and affordable. Concurrently, the quality of data on current emissions needs to be upgraded, and ambient monitoring expanded and improved (this would also provide the basis for a more accepted and reliable system of environmental charges).

3.66 Achieving a particular set of ambient standards implies a cost which becomes increasingly greater as the standards are made stricter. In setting ambient standards, a simple cost-benefit analysis should be carried out of the damage caused by different pollution levels and the costs of reducing the

> **Tough standards can backfire**
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> In the late 1960s France experimented with a law that required zero discharge and imposed severe penalties for violations. The result was that the law was never enforced because it was universally viewed as unreasonable. Less control was accomplished under this law than would have been accomplished with a less stringent law that could have been enforced.
>
> In the United States, it was estimated in 1972 that over the decade 1971-81, it would cost $62 billion to remove 85-90% of the pollutants from all industrial and municipal effluents. Removing 100% of the pollutants would cost $317 billion, more than five times as much, and this figure probably understates the true cost.
>
> [A.V.Kneese and C.L.Schultze, *Pollution, Prices and Public Policy*, 1975.]

emissions. This is admittedly not an easy task and it is one that has received insufficient attention in Western countries. However, it emphasizes the crucial point that setting standards for environmental quality is not a one-time event. Rather it is an evolving process by which desirable objectives are approached within the limits of the resources available.

3.67 Within this framework it is crucial to set realistic target dates for the implementation of stricter emission standards. Several CEE countries have proposed or adopted emission standards that are based on either EC or German precedents. In several cases -- for example, the Czech Republic and Poland -- the period allowed for the implementation of these standards is less than 10 years and may be as little as 5 years. While the reasons for seeking better environmental performance are understandable in the context of long term goals of joining the EC, experience in Western Europe suggests that such implementation periods are much too short. Industries in Western Europe have had several decades to adapt and even now there are many plants which have difficulty in meeting current emission standards. Lengthy adjustment periods (of up to 25 years) have been provided for new member states of the EC to come into conformity with EC emission standards and even then it is likely that derogations from certain standards -- especially on water quality -- will be to be granted.

3.68 It is sometimes argued that strict emission standards are desirable, even if they cannot be enforced at an acceptable economic cost, as a signal to new investors that they should not count on lax environmental standards in future. In practice, this argument is overstated. Both domestic and foreign investors are in no doubt that environmental standards will be tightened over time and they allow for this in their plans. What they expect is to be treated reasonably and fairly. Unrealistic standards which cannot be enforced provoke suspicion of unequal treatment and undermine the credibility of national or regional environmental authorities.

3.69 *The process of adopting and implementing standards must be done in a transparent manner so that enterprises can and will adapt to the changing regulatory conditions.* For existing enterprises in the private or the public sector, governments should reinforce their commitment to a legally enforceable process of negotiations for phased implementation of emission standards where these are the chosen instrument of environmental policy. A simple permit system involving annual review may be one method for ensuring that enterprises adhere to an agreed program of improvements. However, it is crucial that any such program should be realistic in the light of the resources available and the circumstances of the industry or plant. If NSPS are introduced for new plants, then it is essential to realize that BACT standards as implemented in the richest countries may, in some cases, simply be too expensive in view of the limited resources available.

3.70 Ambient standards and emission limits are only meaningful if they are both enforceable and enforced. In that regard, the current strict or inconsistent ambient standards of most countries in the region tend to hinder rather than accelerate progress towards achieving the desired objectives. There is inadequate money and institutional capability today to enforce international standards, let alone even stricter ones. There are also serious political and social obstacles to enforcing the existing regulations consistently, such as the risk of creating more unemployment. The present arrangements obscure the real objectives and make it difficult to establish a clear, transparent and unambiguous program to bring polluters up to the desired international standards. It is also becoming evident that the current unreasonably strict ambient standards are a serious disincentive to foreign investors who would like a predictable regulatory regime with evenhanded enforcement of whatever standards can be enforced nationally or locally.[10]

3.71 In the past, enforcement was regarded as a marginal activity and lack of clear authority over state-owned enterprises meant that those responsible for enforcement were often put in the position of advising enterprises how to avoid fines or other penalties rather than of insisting that the spirit of environmental legislation should be implemented. Environmental policy makers should, therefore, regard the question of enforcement as a central one that must be addressed in the course of developing new legislation, regulations and other policies. *Without adequate provisions for consistent enforcement new legislation is not credible and may be seen as unfairly putting those who choose to comply at a disadvantage.*

3.72 To minimize costs of monitoring and enforcement, it is important to rely upon self-monitoring by enterprises combined with sufficient random checks to ensure that enterprises operate their monitoring systems in a manner that will generate consistent and reasonably reliable information. Quite apart from the cost advantages of self-monitoring, it is an important mechanism for enhancing environmental awareness among the senior managers and other staff. Internalizing environmental concerns in this manner will reinforce the philosophy that enterprises should, wherever possible, attempt to avoid causing environmental damage rather than leaving matters until they are obliged to take action by external intervention.

10/ Although foreign investors are, in principle, prepared to meet strict standards equivalent to those they face in the West, they are reluctant to accept partial enforcement of those standards in the countries in which they plan to operate.

IV. ESSENTIAL INSTITUTIONAL PREREQUISITES TO SUPPORT POLICIES AND INVESTMENTS

Experience in Western countries shows that successful environmental policy requires the explicit commitment of the whole government, and an open approach to setting priorities and making choices.

The greatest contribution to improved environmental management is likely to come from strengthening local and regional institutions within countries -- in particular, improving their capacity for financial and economic management. National environmental authorities should place more emphasis on policy coordination and create task-oriented teams to work on priority issues. Very substantial savings are possible by making environmental decisions at the level of river basins or air sheds, but this requires institutions that integrate the different local and sectoral interests.

Studies for project preparation and industrial reviews need to be re-thought. They must focus on those areas where scarce investment resources can provide the greatest benefits rather than offering pre-packaged recommendations based on conventional Western technologies. Substantial local participation is essential both to formulate advice that can be implemented and to improve local capacity to achieve better environmental performance from existing facilities. These changes in approach will require much more careful attention to the terms of reference for studies to ensure that the resulting proposals meet clear objectives and address the financial and institutional constraints.

A Commitment to Environment

4.1 Institutional factors may be more important than any other aspect of environmental action. Without a well-functioning institutional system to underpin an environmental strategy, good intentions will never be translated into reality. In industry, an analysis of the most prevalent environmental problems suggests that management improvements alone would solve many of the most serious problems. In this regard, the imbalance between high technical expertise and the relatively weak management capabilities in CEE environmental institutions is a serious handicap. The situation is further complicated by the general lack of incentives for highly qualified individuals to be attracted to national or local government work. These are problems to which there are no easy solutions.

4.2 Since most CEE countries are restructuring their environmental management systems, this is a good opportunity to learn from both the positive and negative experience in OECD countries. Overall, it is now recognized that a country's environmental performance is not principally determined by decrees from its environmental authority. Rather, the environmental authority mediates, facilitates, and leads by persuasion. In the end, *the success of environmental policies is primarily a function of the explicit commitment of the entire government to environmental concerns that affect large groups of the population*.

4.3 **Sustainable Environmental Management: Setting Goals.** Environmental actions should not only deal with existing pollution problems, but should provide a structure of targets and management that can pre-empt problems before they occur, and lead to an improved structure of natural resource use. Environmental management is a relatively new concept, which involves an end-oriented rather than a source oriented approach. It can incorporate consensual approaches which are necessary to involve cooperation from interested parties. Such a process typically involves:

- setting goals (e.g. reduction of air pollution)
- setting targets (e.g. reducing particulate emissions by 20% by 2000)
- sector studies (source of pollution, patterns of emissions)
- costing reduction and examining alternative solutions and technologies
- discussions with sectors concerned

A further pre-requisite for environmental management is accurate information about the environmental situation, both as regards existing resources and pollution levels.

The Dutch National Environmental Policy Plan (NEPP)

The NEPP, published in 1989, is the first part of a national strategy to implement the goals of "sustainable development". It was prepared by task forces that brought together representatives of different government ministries -- Environment, Agriculture, Transport, and Economic Affairs. In the course of this work, the task forces also consulted with industry, environmental groups, and other interested parties. The NEPP describes an integrated approach listing 50 strategic objectives and 228 specific measures to be undertaken through new legislation, through national and local government action, and through negotiation with "target groups" -- different industry sectors, in particular.

The Plan had set a goal of reaching "sustainable development" by the year 2010. This is proving to be an elusive target: Already, the country is falling behind the schedule of interim objectives necessary to meet the goal, and it appears doubtful whether certain target groups will be willing to pay much more, especially if neighboring countries are not seen to be following suit.

The estimated costs in 1994 to implement an enhanced version of the NEPP has been estimated at almost US$8.5 billion.

Even so, there has been substantial popular support for the Plan. The main stumbling blocks appear to have been the very ambitious targets that did not sufficiently take into account implementation and financing constraints. Even in the Netherlands, the institutional capacity to implement the large number of new measures is not available, and industries are still in the process of gearing up their environmental expertise. The lessons appear simple: In order to generate widespread popular support, it is necessary to establish clear objectives. On the other hand, these must be tempered by a realistic assessment of financial and institutional constraints.

4.4 One of the principal messages of this Environmental Action Programme is the need to set goals -- expressed in terms of environmental quality objectives -- and then to identify the most efficient strategy to meeting the goal. Different countries have started to introduce variations of this concept, with differing degrees of success. The Netherlands, for example, has chosen a very ambitious approach, involving a dialogue with all major environmental actors in all sectors, with the aim of reaching "sustainable development" for the country by the year 2010 (see Box). The Dutch initiative has stimulated similar -- though less ambitious -- programs in France and Britain, and the European Community's most recent Environment Action Programme contains elements of the Dutch approach.

Other examples of end-oriented approaches include the Californian air pollution program (which includes the requirement to have an increasing percentage of zero-emission vehicles on the road from 1998); the New Zealand Resource Management Law; and the Japanese quality control approach, which sets upper limits for certain pollutants in urban areas.

4.5 Following the Brundtland report, several countries began publishing regular Green Plans, containing both quantitative and qualitative targets for pollution reduction -- targets which can be verified in succeeding years. Such targeted plans for pollution reduction were drawn up in the late 1980s by Denmark, Ireland, France, Sweden, Canada and most recently Spain.

4.6 There are two very important lessons that emerge from the experience in developing broad-based national environmental strategies:

(i) **Setting clear environmental objectives in the context of a broad participatory approach is a fundamental prerequisite for longer-term successful environmental policy. No amount of enforcement can make up for the lack of a national consensus on environmental priorities.**

(ii) **At the same time, such objectives must be based on realistic assumptions about the availability of financial and human resources. Even some of the wealthiest Western European countries are now faced with having to abandon the goals set in their environmental programs, because of shortage of funds, limited capability of environmental authorities to implement the large number of measures called for, the unwillingness of industry to adapt rapidly to the necessary changes, and the lack of consistency of the government in the face of certain pressure groups.**

This points to the need for cost-effective approaches, and calls especially for a better understanding of the factors that constrain successful implementation of environmental policies and projects -- particularly at the local level, where most of the immediate decisions affecting the environment are taken.

Constraints to Policy and Project Implementation

4.7 **The Legacy of Central Planning.** Closing down central planning institutions has proven to be much easier than obtaining the necessary expertise to identify, prepare, appraise, and implement policies and projects in a decentralized but sound manner. For many officials in Central and Eastern Europe, the routine of centrally controlled resource allocation is so entrenched, that ministries often continue to design investment programs in the hope of obtaining financial support from the West. In some cases, Western donors have tended to reinforce the past practices. CEE countries are now discovering that after several years of "studies", financing for tangible projects has fallen far short of expectations.

4.8 Some of the explanation lies in a lack of understanding of the traditional investment cycle: donors do not understand how the influence of central planning carries over to today, and CEE authorities have difficulty comprehending the arcane concepts related to financing and procurement common in the West. The Box below provides a synopsis of the *investment cycle under central planning*. It highlights the fact that decisions with regard to resource allocation tended to be subjective and politically motivated, and required little concern for efficiency and performance quality.[1] Because of the "soft budget" approach -- combined with sometimes severe scarcity of equipment and materials supplies -- the investment pattern was characterized by (i) easy access to finances; (ii) rapid project design (few studies, amounting to less than 5% of project costs); and (iii) slow implementation. Implementation delays often led to a situation in which incomplete projects were prematurely put into operation, and subsequent deficiencies in operation and maintenance resulted in proposals for new investments as the only solution to the accumulated problems. Frequently, it used to be easier to launch a new investment cycle than to generate internal capacity for improved performance.

4.9 *Significance for current practices.* The legacy from past practices influences current investment behavior in three ways. First, polluters frequently oppose actions except in cases of emergency.[2] Second, they prefer investment-intensive solutions to low-cost improvements (e.g. better house keeping). Third, the perception of centralized investment decision-making on a case-by-case basis (instead of within a broader national or local strategy) slows down the transition of responsibilities from the government to the business community.

4.10 **The Western Approach.** In contrast, the typical Western approach involves a series of incremental steps over a relatively long time period. Often, 20% or more of total project costs are spent on project identification, preparation, design and appraisal. In the case of an industrial enterprise, the process might work as follows:

- review of plant operating procedures and management practices, and/or diagnostic environmental audit to determine the immediate priorities;
- "zero-cost" improvements involving management, maintenance, and "housekeeping" modifications;
- concurrently, the enterprise might undertake very small capital improvements, pending a more detailed environmental audit (can a product be made using fewer or less toxic raw materials? can equipment be redesigned so that the waste can be re-used?);
- the comprehensive audit typically focuses on long-term targets, including projection of likely changes in laws and regulations;
- detailed design study of technological improvements involving control and process changes;
- implementation of these investments over a 5-7 year period; and

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1/ In Bulgaria, for example, sharp fluctuations in the structure of environmental capital investments can be observed between 1980 and 1989. The share of air protection investments dropped from almost 29% in 1980 to only 2% in 1985, and then rose to 20% in 1989.

2/ There are important exceptions. Quite frequently, enterprise managers understand that selected process changes would be in the financial interest of the firm as well as reduce pollution emissions. However, shortages and constraints on the availability of foreign exchange have prevented them from taking the desired action. If (public or private) enterprises are to be responsible for their operation, they must have equal access to financial resources -- whether foreign exchange or domestic finance -- as the government.

The Project Cycle under Central Planning

Identification. The first phase in the investment process consisted of proving that action was economically feasible and consistent with the planning priorities. Although the proposals typically originated at a municipal or enterprise level, most of the process consisted in the project proposal going back and forth between four key governmental institutions: the Planning Committee, the sectoral Ministry, the Ministry of Finance, and the Ministerial Council.

Design. This phase tended to be short. All parties -- the municipality, the sectoral ministry, and the design company -- were equally interested to proceed quickly with the design of the approved construction project.

There was no financial resource constraint at this stage. Typically, 4-5% of total investment costs were allocated to complete the physical design work. This was considered enough even when specific technical or geological problems arose. The specialists undertaking the design work were normally not expected to carry out broader analyses involving a determination of least-cost solutions, changes in scale, etc. Outside consultants were used only on rare occasions. The "economic" analysis tended to be confined to a simple financial statement of construction materials and equipment.

Once the design was completed, the product had to be approved by an investment control office, and by representatives of the municipality.

Implementation. Although financing was available, projects frequently could not proceed because of scarcity of construction materials, building capacity of the designated construction company, qualified labor, necessary equipment, and supporting infrastructure. The consequences were as follows:

- The initial time schedule had to be revised, and a new "start date" requested;
- the construction process proceeded in spurts -- different tasks were carried out according to material and equipment that was available (often necessitating design changes);
- changing government priorities resulted in a gradual reallocation of funding towards other projects, and the amount of funding available fell short of the required amount;
- systematic postponements had a significant negative effect on project quality. Often, project operation was started before completion of construction. Temporary solutions tended to remain for an unlimited time. As a result, the original plans became outdated, and part of the completed works needed repairs;
- because of the poor operating record and other factors, projects could not generate sufficient revenues to be self-sufficient with regard to operation, repair and maintenance. The projects would face budgetary constraints -- especially if hard currency was required -- and further design changes were often made to avoid the need to procure parts with foreign exchange.

Operation and Maintenance. Given the previous history of projects, operation and maintenance -- where practiced -- was often unable to make up for the problems that had occurred during construction and that often seriously compromised project quality. Sooner or later, the deficiencies both from construction as well as from operation and maintenance tended to lead to consideration of new investments as the only solution. It was often easier to initiate a new investment cycle than to generate the internal capacity for improved performance.

- extended phasing-in period of the new technology, including staff training and further small-scale investments to fine-tune and optimize the new process technologies.

It is evident from this example that "studies" in a broader sense make up a significant and important aspect of the whole process of environmental improvement. They represent a learning device causing planners, managers, and workers to interact to identify and solve the problem. Most often, they are a prerequisite for "win-win" actions which can be justified on economic grounds alone, but which also involve significant environmental benefits.

4.11 *Local Participation.* There is a crucial aspect to this process: environmental reviews and consultant studies are meaningless unless they are carried out in close cooperation with the "clients". This is particularly essential in Central and Eastern Europe, where enterprise staff need additional exposure to new approaches, where local financial resources are especially scarce, and where pre-packaged recommendations based on conventional Western technologies may be quite inappropriate.

4.12 Anecdotal evidence suggests that a large number of consultant studies that have been carried out in CEE countries have failed to take account of the particular local circumstances, and have been completed with minimal local participation. Moreover, the nature of international assistance programs has frequently tended to reinforce the old central planning habits, by pushing governments to propose specific projects, at a time when it was not clear how a given problem should best be tackled. A large number of consultant studies in CEE are pre-feasibility studies which in effect "lock in" a particular project (often based on Western technology standards) without providing much scope for possible alternatives that might be more efficient. Moreover, because of the lack of local participation, such pre-feasibility studies often ignore the crucial institutional and financial bottlenecks that must be addressed before project implementation could proceed. As a Baltic Sea Environment Programme document prepared for the March 1993 Conference on Resource Mobilization in Gdansk points out:

> Often there are significant problems due to a failure to examine alternative or complementary approaches to the proposed project and to comprehensively examine the issues related to a project. For example, studies have been prepared which only evaluate a proposed wastewater treatment plant without analysis of actions which could be taken to reduce wastewater flows in order to allow for a reduced size, or to examine needs for industrial pre-treatment and its implications to project cost, system operation, and sludge management.

4.13 The major conclusion from this is that *much more emphasis must be placed on the front-end of the project cycle.* The crucial early steps are as follows:

- establishing a clear objective as to what environmental problem is to be solved, and why;
- identifying among a range of institutional, policy and technological options the most efficient solution (for such an analysis, see for example the Box describing wastewater management in the Nitra River Basin), or a solution that generates a financial payback (e.g. "win-win" investments involving energy conservation);
- working through in detail the necessary implementation arrangements and the relationship to the prevailing policy framework -- institutions involved and relative responsibilities, assured sources of funding for project implementation, sources of recurrent cost financing, procurement procedures, legal impediments, etc. These are issues that can only be addressed at the enterprise and/or local government level, but that may require significant assistance.

Only after these steps have been taken is it meaningful to proceed to technical (pre-)feasibility studies. Donor countries and institutions may wish to provide special support for project identification and for the necessary local expenditure requirements to launch such work with substantial local participation (see chapter VII). Where consultants -- whether international or local -- are involved, terms of reference should be carefully agreed among all parties, and the work carried out in continuous and close collaboration.[3]

Reshaping the Environmental Policy Agenda in Central and Eastern Europe: Legislative and Institutional Reform

4.14 **Environmental Legislation.** In the past, all Central and Eastern European countries had developed stringent, but not enforceable environmental legislation. In many of these countries, the new governments face the need to downgrade some of the legal environmental requirements, especially the existing ambient standards for water and air pollution. Such a weakening of environmental standards would, however, be seen to be putting the former communist governments in a better light from an environmental perspective. This creates a political constraint to realistic revisions of the inherited legislation.

4.15 While being reluctant to soften their environmental standards, most of the CEE countries have expressed strong interest in redesigning the system of environmental management through legal reforms, starting with comprehensive environmental laws. These laws would aim to formulate the institutional, regulatory and executive policy framework, responding to the requirements of the transition to a market economy. In most cases the key legal innovations include defining the status and the functions of the central environmental agencies (Ministries of Environment or their equivalents) and the local environmental authorities; introducing the polluter-pays-principle; designing specific regulatory command-and-control and market oriented instruments; instituting environmental impact assessment reviews; and opening access to environmental information.

4.16 The uncertainties in the overall legislative environment resulting from the ongoing social and economic changes impose two *constraints to the effectiveness of these comprehensive laws*. If they are more ambitious and up to the established standards for such laws, the turbulence of transition may undermine their implementability. If, on the other hand, they are written in a flexible manner, their implementation requires a series of Ministerial Ordinances or Regulations to specify the general definitions. Changes in government often put at risk the continuity in the policy process and increase its vulnerability -- a very undesirable situation from an enforcement perspective.

4.17 The existence of comprehensive environmental laws reduces the attention legislators pay to *integrating environmental concerns in the economic reform laws*. A shortage of qualified environmental specialists and lawyers, and a lack of tradition of transparent legal processes may lead to the introduction of key reform laws with little or no consideration to environmental issues.

4.18 **Decentralization and its implications for environmental management.** Throughout the region, the central political and administrative authorities are devolving the responsibility of administration to local governments (though the financial system has not been adjusted accordingly). Simultaneously, central funding has been drastically reduced and most local authorities are now dependent on the limited funds that they can raise locally through taxes or other tariffs. This weak institutional capability can provide the opportunity for unrestrained exploitation of the natural resource base at a time when the legislative framework is in the process of radical restructuring.

3/ This does not imply that special preference should be given to local consultants. If the latter are to meet international standards, they should, in general, compete with international consultants. On the other hand, governments and enterprises should insist much more on joint activities between international and local consultants, with clear terms of reference based on a strategic approach, and with careful supervision.

4.19 The concept of planning is now synonymous with centrally planned economies and is anathema to present land use strategy. Consequently, development master-plans are drawn up that often ignore any previous concept of planned control. Instead, they seek to maximize what potential the locality may offer, in order to raise living conditions and maintain an already frayed infrastructure.

4.20 In this situation, natural resources are especially vulnerable, and often the most vulnerable are those found in protected areas which are relatively unexploited. There is a growing number of instances, notably in Russia, where logging restrictions have been waived over forests both within and outside protected areas.

4.21 CEE countries have an opportunity to learn from mistakes in OECD countries and to develop more responsive institutions. In practice, this means above all *strengthening the integration of sectoral and environmental institutions* responsible for industrial development and energy on one hand, and agriculture and forestry, land privatization, tourism, and transport on the other hand. Environmental agencies should avoid becoming over-extended and instead focus their attention on a limited set of policy objectives that have the potential for having a significant impact on the policies implemented by the sectoral ministries.

4.22 **Institutional adjustments.** In all CEE countries, institutional reform in the environmental sector is required in order to develop the new laws and to achieve an efficient system of environmental management. The experience so far indicates that institutional changes should have top priority in three areas: (i) shifting responsibilities for environmental management from central to local authorities; (ii) improving the functional capacity of the environmental ministries; and (iii) increasing the inter-ministerial coordination on environmental issues.

4.23 **Shift in responsibility for environmental management from central to local authorities: demonopolization, deconcentration and decentralization.** Reforming the system of environmental management in the transition from centrally planned to market economies requires a redesign of the hierarchical structure and the division of responsibilities between the different institutional levels. A key factor in this process is demonopolization of decision-making and executive functions, now still highly concentrated in the central environmental agencies (usually Ministries of Environment). Demonopolization includes two steps: (i) deconcentration, which takes place when the central environmental agency creates and/or strengthens its regional offices (vertical transfer of functions); and (ii) decentralization, which directs a reassignment of responsibilities to the offices of the local authorities (both vertical and horizontal transfer).

4.24 *Administrative and political decentralization* is occurring at different speeds in all Central and Eastern European countries. In most cases it has resulted in significant increases in the responsibilities of local governments for environmental management. This includes solid waste management, water and waste water treatment, land use planning and the definition and enforcement of environmental standards. The process of decentralization is stronger when it is supported by a transfer of environmental infrastructure assets from central to local governments. This assets transfer increases the decision-making power of the local authorities in project formulation and implementation. It is also an important factor in improving public access to project information and stimulates the public awareness on environmental issues.

4.25 The administrative and assets decentralization is *still not accompanied by adequate adjustments in the financial system.* The ability of local governments to levy their own taxes remains very limited, although they are crucially dependent on what little they can raise locally. In many cases tariffs are controlled by the central government even though the responsibility for the management of specific environmental services has been transferred to local authorities. Even when no official constraint on setting tariffs at a local level exists, locally provided environmental services tend not to meet full cost

The French River Basin Agencies: An Example of Regional Water Management

There has recently been an important change in the system of water rights in France. A law of 3 January 1992 considers water as a common heritage and thus closely associates the users of the country's six hydrological basins in its management. It is based on an integrated approach with a dual objective: satisfaction of user needs and conservation of the natural environment.

The central Ministry of Environment establishes basic water policy, lays down regulations and organizes overall planning in consultation with, and assisted by, the Interministerial Water Council. Specific aspects of water management are entrusted to technical ministries. The "prefets", aided by territorial public services, are responsible for local control of water and fishing. They authorize uses and discharges, apply legislation specific to pollution or dangerous installations, enforce compliance with ambient water quality standards and approve water and fishing related project design documents.

The Law encourages consultation between all water users -- whose needs may be contradictory. This is accomplished by means of a planning system that designates legitimate water use, the so-called Water Development Scheme (SAGE). This planning tool is prepared at the local level by the local Basin Committee, and covers a catchment area or river. The local authorities may provide financial aid for planned developments.

Overall coordination at the level of a major hydrographic basin is ensured by the Main Water Development and Management Scheme (SDAGE) as drawn up by the Basin Committee and approved by the national authorities. The Basin Committee is a de facto "Regional Water Parliament". It organizes meetings between representatives of users, associations and local authorities, who form the majority, as well as State representatives. It defines the policy and management of the catchment area in an interactive manner. It evaluates and judges the charges and programs put forth by its executive agency, the Water Agency.

Since 1967, each of the six major hydrographic basins of the country has its own "Water Agency". By means of financial incentives, the agencies support anti-pollution projects for domestic, industrial or agricultural effluents with a view to reclaiming rivers, protecting coastlines and conserving groundwater. The agencies also contribute towards the utilization and protection of inland water resources so as to satisfy the needs of all water users with due consideration towards the natural environment.

The Water Agencies draw their resources from levies collected from users in proportion to the quantity of water drawn or consumed, pollution discharged or affecting the natural environment. The levies are fixed by each Agency in accordance with the priorities specific to each catchment area and after consultation with the Basin Committee. The levies are redistributed as aids to local councils, industrialists and farmers to enable them to make the necessary adjustments to ensure water resource conservation and protection. The Water Agencies do not act as project managers for work carried out in this context.

Each Agency implements a five-year plan after its adoption by the Basin Committee and approval by the Government. It defines priorities, determines the nature of the work to be carried out, and identifies the amount of financing required.

Each Agency manages a network of measuring units and data banks and has a catchment area observatory. Data is collected on water quality and on human activity in the catchment area, land use, and other environmental parameters. The Agencies also contribute toward research efforts, including on the question of pollution by nitrates and pesticides, management of rainwater, accidental pollution, unique ecosystems, etc.

recovery, since local officials are more sensitive to income distribution, especially in economically depressed areas.

4.26 Another obstacle to decentralization in environmental management is the *threat of policy fragmentation*. In Hungary, for example, the adoption of a decentralization law doubled the number of municipalities to 3,200. This resulted in a very small average size of a municipality both in population and in territory. This miniaturization of the policy scope and scale often contradicts the scale of required environmental actions (bigger than the territory of the municipality). Since all cross-regional connections used to be directed trough the center, there is very limited capacity to create joint programs and implement appropriate environmental management functions. As a consequence, scarce resources are used in a less efficient way, without proper coordination between priorities and actions in neighboring regions.

4.27 Most important is the need to create or strengthen *river basin management institutions* that should be provided with appropriate autonomy. As the example of the Nitra River suggests (see Box), a system-wide analysis of priorities with regard to wastewater management alone has the potential for reducing costs by 80%. Creating river basin authorities by themselves is only part of the picture, however. Attention must be given to linkages with central, regional and municipal authorities. Financing mechanisms and channels have to be developed, and the responsibility for standard-setting established. At what government level(s) should different water-related permits be issued? What should be the role of the private sector? The French system of river basin agencies may provide some interesting lessons to CEE countries developing their own systems (see Box).

4.28 This suggests the need for the following institutional improvements:

- Define the functions and responsibilities of the three main levels of environmental management -- the central environmental agencies, their regional offices and the environmental divisions of the local authorities (regional and municipal);
- Require that ministries of environment develop procedures which explicitly transfer and delegate decision-making power to lower managerial levels;
- Design a consultancy unit to serve the reforming local authorities on environmental management issues, operating on a "travel-to-client" basis;
- Increase the training support for local governments (especially through donor-supported environmental management and training centers);
- Focus further steps in local government reform on financial issues;
- Improve the horizontal links between the environmental divisions of the local authorities sharing a particular environmental system (e.g. a watershed or an "airshed").

4.29 **Strengthening environmental ministries.** Most of the countries of Central and Eastern Europe have ministries of the environment at the national level, together with an array of local and regional agencies. The latter are primarily responsible for implementation, monitoring, and enforcement, while national authorities are responsible for coordinating and setting overall environmental policy and objectives. Regional institutions are also sometimes charged with environmental management which goes beyond local political boundaries, as is the case with River Basin Boards in Czechoslovakia and Poland. Many countries have recognized also the value of separating regulatory responsibilities for natural resource management from resource exploitation functions (e.g., by placing regulatory responsibilities in a ministry of environment to avoid compromising environmental protection for resource extraction and development).

4.30 Being relatively new, the central environmental authorities still need to improve their structure and functions. This process is complicated by the ongoing decentralization in environmental management, which suffers from occasional tendencies to be reversed in reaction to local managerial failures and strong traditions in central control. It is, therefore, necessary to strengthen the central environmental ministries while at the same time encouraging further decentralization.

4.31 *Institutional Strengthening*. Because ministries of environment typically play an important role in coordinating -- both internally and externally -- the numerous activities related to the environment, it is important that they be equipped for this task. *Organizationally*, this suggests a structure which places emphasis on policy and coordination, rather than implementation (which is better left to regional and local institutions). In this regard, consideration might be given to creating a senior position to deal with policy issues. It might also be useful to take into account the experience in countries which are establishing administrative structures to take an approach to environmental management which considers the effects on all media (air, water, wastes, etc.). An example is found in The Netherlands, where the Ministry of Environment has created two sets of staff teams; one organized around clusters of issues (acidification, chemical hazards) and the other around target groups (refineries, farmers, builders). A staff member is a member of a team in addition to his/her media-based responsibility. The cross-channels of communication and responsibility fostered by these teams give the ministry the character of a matrix organization and enhances integration at the policy level. Special emphasis should be given to establishing a close working relationship with ministries of health, many of which traditionally have been responsible for ambient environmental monitoring, and which should help establish the vital link between health objectives and environmental policies and investments.

4.32 In addition, many countries are considering an integrated approach to industrial pollution prevention and control (IPPC). An example is found in the U.K. where enterprises need only apply for a single authorization from a single authority -- Her Majesty's Inspectorate of Pollution (HMIP) -- within a single regulatory framework. HMIP was established in 1987 as a new, integrated pollution regulation body formed from a number of media-specific inspectorates, and in 1990 legislation was enacted to establish a system of integrated pollution control. The integrated approach is designed to implement a strategy which causes least damage to the environment as a whole; and its essential starting point is pollution prevention or, where prevention is not possible, the minimization of the quantity and harmfulness of the waste created.

4.33 The foregoing suggests the need for institutional improvements along the following lines:

Cost-effective Wastewater Management in a River Basin: The Nitra River in the Slovak Republic

The Nitra River in Slovakia is of rather poor quality, especially under low-flow conditions. This Box illustrates the major features of the different policies that could be applied to improve water quality, and shows how their costs (and related ambient quality effects) can differ. The Nitra is a tributary of the Vah river, which enters the Danube downstream of Bratislava. Its catchment area is about 5,000 km^2, with about 600,000 *inhabitants. Its length is about 171 km, and its mean flow at the mouth is 25* m^3/s. *The overall BOD* discharge to the river system is above 10,000 tons/year, approximately 70% of which is of municipal origin.

Six different municipal wastewater treatment alternatives are considered (see box in chapter V):

M	mechanical only;
CM	chemically enhanced mechanical;
B	biological;
BC	biological with the dosage of chemicals;
BCN	biological-chemical with de-nitrification.

Dewatering and anaerobic sludge treatment are assumed for sludge treatment for all alternatives. A cost summary for the different options is provided in the Box on treatment alternatives in chapter V.

Four different types of control policies are considered:

- Minimum discharges, roughly equivalent to imposing EC standards on all municipal treatment plants.
- Uniform percentage reductions in discharges to meet an ambient standard set uniformly along the river.
- Constraining total regional discharges to meet a uniform ambient standard.
- Regional least-cost strategy to meet a uniform ambient standard.

Economic incentives are not considered in this analysis.
The results of the analysis are shown in the table opposite and can be summarized as follows:

1. The improvements are achieved by focusing entirely on municipal wastewater treatment (70% of BOD load), indicating that *very substantial improvements are possible through control of municipal wastewater treatment alone, even assuming no control of other point sources.*

2. The costs from imposing EC emission standards on all municipal plants, corresponding to the minimum-discharge policy, are very high (capital costs of near US$65 million, and annualized costs over US$14 *million). Of course, water quality improves markedly (e.g., minimum DO concentration rises to* almost 7 mg/l). This result provides an upper bound on costs and water quality improvements.

3. *Substantial savings are possible using a least-cost policy*. For the 4.0 mg/l standard (the limit for second-class water in many European countries), the *least-cost policy has capital costs that are one fifth that of BAT (a savings of over US$50 million in capital costs)*, roughly 40% less than the uniform percentage reduction policy, and more than 50% less than a limit on total regional BOD emissions. The region could save almost US$10 million in capital costs by using the least-cost policy, as compared to the next most efficient policy. While the potential savings are slightly smaller for the 6.0 mg/l standard (limit *for first-class water), the least-cost policy for that standard still represents savings of almost US$8 million* in capital cost and US$2 million in annualized costs compared to the next most efficient policy. As ambient standards become stricter, all control policies will approach the minimum-discharge policy in their costs and ambient quality effects.

Control technologies. The minimum-discharge policy utilizes BCN techniques exclusively. There is considerable variation in the mix of treatment techniques for the least-cost policies. For DO>4.0 mg/l, a mix of CM, B, and no treatment is employed, depending on the dischargers' size and location. For DO>6.0 mg/l, the mix shifts to B and BC, since the latter is more effective than CM in removing BOD. The least-cost *policy for TP<0.7 results in most sources moving to CM methods, while for TP<0.5, one source adds* biological-chemical treatment (BC). Constraining TN<6.0 results in a least-cost solution which employs mostly BCN (although one source uses only mechanical treatment). The least-cost solution for DO>6, TP<0.5, and TN<6.0 forces about half of the plants to BCN while the rest employ BC methods. As with the cost differences, the choice of treatment technology varies considerably with the ambient standards and region-specific considerations. The ambient quality which results from the least-cost policy is very similar to that which results from the minimum-discharge approach.

Results from Policy Analysis for Dissolved Oxygen (DO), Total Phosphorus (TP), and Total Nitrogen (TN)

Ambient Quality Standard	Control Policy	Capital Cost (US$ million)	Annualized Cost (US$ million)	Min. DO Conc (mg/l)	Max. TP Conc (mg/l)	Max. TN Conc (mg/l)
None	Base case	0	0	0.7	1.8	7.8
-	Minimum Discharges (BAT)	64.7	14.4	6.9	0.4	4.1
DO ≥ 4	Uniform % reduction	23.4	5.7	4.3	0.6	6.5
DO ≥ 4	Cap on Regional Discharge	28.8	6.9	4.3	0.8	6.7
DO ≥ 4	Regional least-cost	13.2	2.8	4.0	1.3	7.3
DO ≥ 6	Uniform % reduction	40.7	10.4	6.9	0.4	6.0
DO ≥ 6	Cap on Regional Discharges	33.8	8.6	6.2	0.4	6.3
DO ≥ 6	Regional least-cost	25.6	6.6	6.0	0.7	6.7
TP ≤ 0.5	Uniform % reduction	31.5	7.9	5.6	0.5	6.1
TP ≤ 0.5	Cap on regional discharges	36.5	9.3	6.2	0.4	6.2
TP ≤ 0.5	Regional least-cost	27.2	6.5	5.1	0.5	6.4
TP ≤ 0.7	Uniform % reduction	23.4	5.7	4.3	0.6	6.5
TP ≤ 0.7	Cap on regional discharges	22.9	5.3	4.3	0.6	6.6
TP ≤ 0.7	Regional least-cost	22.6	5.3	4.0	0.6	6.6
TN ≤ 6	Uniform % reduction	42.4	10.5	6.9	0.4	5.9
TN ≤ 6	Cap on regional discharges	40.7	10.4	6.9	0.4	6.0
TN ≤ 6	Regional Least-cost	35.3	8.2	4.8	1.2	6.0
D.O. > 6 TP < 0.5 TN < 6 (least cost)		41.9	10.2	6.1	0.5	5.8

- Create a First Deputy Minister (or equivalent senior) position for Environmental Policy and Regulations to shift attention from technical to economic policy issues, and from day-to-day control to strategy development and policy implementation;

- Design task oriented (rather than sector oriented) teams under the new Deputy, to connect existing Departments and to provide inter-ministerial links;

- Create financial analyst and economist position(s) to develop new concepts for environmental financing without ministerial participation (in connection with the reforming banking sector); and

- Develop programs for mid-level officials and business executives from Western institutions to work both in the central ministry and in the regional offices.

4.34 **Improving Ministerial Cooperation.** Effective environmental policy requires commitment to coordinated actions between economic and sectoral ministries. The central environmental agencies in Central and Eastern Europe have tended to have a weak dialogue with other central authorities. Their policy message often is not delivered forcefully to the governments and the parliaments in these countries and as a result, macroeconomic goals and policies are set with little or no consideration for their potential environmental impact. Even when the environmental authorities have been more successful in having their concerns transferred into policy actions taken by other government institutions (energy agencies or ministries, ministries of industry, ministries of finance, privatization agencies, etc.), the overall experience confirms the necessity of formal mechanisms for cooperation between the environmental agencies and the above institutions. (E.g., the UK has created a "Green Ministers" Cabinet Committee.)

4.35 The following institutional improvements are therefore desirable:

- Constitute cabinet-level committees for environment and development, bringing together the ministries of environment and all economic and sectoral ministries;

- Establish temporary task forces of high-level officials to prepare the work for these cabinet-level committees, and provide for career and other professional incentives to encourage participation;

- Designate staff from the ministry of environment to participate in strategy development in all sectoral ministries, and invite staff from these ministries in Working Groups in the ministry of environment on relevant issues; and

- Within the ministry of environment, create capacity and better analytic tools for sectoral policy evaluation (especially for industry, agriculture and infrastructure) with long-term targets for key environmental indicators.

Management Capacity, Training and Education

4.36 The countries in Central and Eastern Europe have well developed educational systems and a highly qualified labor force. For several years, environmental education has been incorporated at all teaching levels, from pre-school to university. However, the emphasis was consistently placed on technical skills, as opposed to management and policy-making skills, or general public awareness. Nation-wide programs addressing the public are needed in order to overcome the lack of experience in active public involvement in making and implementing environmental policies.

4.37 All of the institutions responsible for environmental management in CEE require strengthening, and the need for many different types of training activities cannot be over-emphasized. The greatest training needs are in administrative, financial, and economic management, and in implementation of multi-sectoral environmental strategies and programs. Such training is not only called for in environment ministries, but also in public and private industry (e.g., water supply and sewerage utilities, district heating enterprises, and industrial plants) at national, regional and local levels.

4.38 Local capacity for implementation and environmental management of local functions (e.g., in water supply, sewage treatment, and solid waste disposal) should be strengthened as much as possible since, without this, money targeted for environmental investments might fail to achieve the desired improvements in environmental quality. For example, as the potential for tourism and recreation increases in the region, improving local management capability in tourist areas (e.g., national parks, protected areas, and coastal zones) will be especially important, along with tourism planning at the national and regional levels. Even superior national and regional planning will not suffice unless more resources are devoted to improving resource management at the local level where implementation most often occurs.

4.39 Western donors are active in providing financial and logistic support for environmental education, training and collaborative East-West research. The TEMPUS program specifically promotes inter-university links between Eastern and Western institutions -- among other things in the environmental field. Educational assistance is available through the Regional Environmental Center in Budapest, and through a US EPA incentive for developing training courses, as well as environmental management and training centers in some countries in the region. With support from the TEMPUS Program of the Commission of the European Communities and collaboration of ten Western and Central European educational and research institutions, a European Masters Degree Course in Environmental Science and Engineering was hosted in Budapest, offering a one year environmental engineering and management masters degree program specifically designed to meet the needs of the Central and Eastern European countries. UNEP supports Post-Graduate Courses in Environmental Management together with Germany and UNESCO, and a Training Programme in Environmental Management for Industrial Managers from CEE. These and other incentives, however, often are not well coordinated both from the donor and from the recipient side.

4.40 Progress in using environmental education and training as low-cost and highly efficient method for addressing the environmental problems in Central and Eastern Europe varies substantially from country to country. There are, however, a number of common problems in all countries of the region:

- Lack of coordination between various ministries dealing with development of environmental education and training (e.g. ministry of education, ministry of environment, sectoral ministries with responsibilities for highly polluting industries), as well as between institutions, delivering this education (schools, universities, research institutes, training centers);

- Demand constraint to expanding environmental education and training (especially on a university level) due to relatively low priority of environmental issues, and lack of willingness from the government to commit financial resources for creating a supply driven environmental segment of the labor market;

- Slowness in creating an adequate infrastructure for efficient all-level training (curriculum development, teaching materials, textbooks, teacher-training programs, educators' network);

- Lack of active interest among the general public, leading to low circulation of environmental publications and to limited involvement of the media in delivering environmentally related programs;

- Resistance to environmental training by managers and governmental officials not involved directly in environmental management, but with strong influence over the economic reform process (e.g. ministry of finance employees, factory managers, municipal authorities);

- Lack of Western experience in managing environmental training and research, leading to an inadequate (from Western donors' perspective) use of available technical and financial assistance, and therefore a reluctance to increase support for these purposes.

4.41 In order to promote efficient environmental education and training, the countries in Central and Eastern Europe need to define their national strategies through close collaboration between the various competent ministries and institutions. Four sets of actions are required: (i) to survey the existing institutions, involved in environmental education and training and identify actions needed to optimize their performance; (ii) to review and redesign the teaching programs at all levels; (iii) to develop teaching techniques, tailored to the particular audience; and (iv) to evaluate financial needs, available sources, and funds management.

4.42 An educational training program should be developed and implemented for high level decision-makers at national and local levels. It should be designed in two formats -- for top-level ministerial and business staff (ministers and deputy ministers, and managers of big enterprises) in a workshop format, and for middle level staff (ministerial, municipal and business experts) in formal training sessions. Particular emphasis should be placed on providing training for enterprise managers in business planning, marketing and management skills. Enterprise managers should, at a minimum, be well equipped to understand and tackle "win-win" options involving energy and water conservation. Tailor-made decision-making simulations could be used to help the middle level experts in adjusting to their more active role resulting from the ongoing decentralization.

4.43 The governments in Central and Eastern Europe should promote a network of national institutions proficient in environmental training. The environmental priorities of each country should be integrated into educational and training strategies, and transferred through the educational network in action plans. Institutional links should be established on a medium and long term basis with appropriate Western partners. The participating Central and Eastern European institutions should be encouraged to transfer know-how in management, fundraising, and product diversification.

4.44 Environmental training components could be incorporated in all technical and financial assistance projects with environmental impact. Elements of environmental education could also be integrated in training programs in a variety of subjects, such as in economics and management; local government and administration; public finance and taxation; privatization programs; and economic restructuring.

4.45 Increasing the public awareness and commitment to active environmental policy should be a major educational and training target. It requires broad involvement of professional educators, NGOs and the media. The NGOs in Central and Eastern Europe should be assisted in developing core teams for providing leadership, fundraising capacity and logistic support in this area.

Environmental Monitoring and Information Systems

4.46 **Environmental Information and the Transition Process.** A substantial amount of information on environmental conditions is available in many of the CEE countries. However, much of it is scattered, is of variable quality and accuracy, was collected for differing purposes and is often not comprehensive in coverage nor historical record. At the same time, the transition to democratic, market-based societies is fundamentally altering public and private sector expectations of, and demands for, such information.

4.47 In the new context, environmental information is no longer a tool for use in the preparation and implementation of state plans. Instead, the objectives underlying the collection, analysis and dissemination of environmental information will focus on priorities; monitoring and enforcing compliance with regulations and environmental policies; promoting policy integration; and communicating with, and informing decision-makers, the public, the private sector, NGOs and interest groups.

4.48 Restructuring environmental information systems in the transition to a market economy requires a series of interrelated tasks: redefining priorities; redesigning the technical basis of the system; reformulating and strengthening the institutional arrangements, including training of personnel; and integrating national systems more firmly with broader international efforts.

4.49 **Reformulating Priorities.** The restructuring of environmental information systems in CEE countries requires a framework with clear objectives based on users' needs. The challenge is to redesign existing systems, upgrading the quality of existing arrangements where necessary, dropping or re-assigning elements which do not meet users' needs or which are not cost-effective, and progressively filling in the most important gaps.

4.50 In the transition period, priority should be given to strengthening the availability of quality information in those areas with the greatest risks to human health and of irreversible environmental change. A balance must be struck between monitoring ambient environmental levels and emissions, as well as "peak" concentrations involving exposure to sensitive populations, such as with air pollution in some cities.

4.51 In accordance with priorities and resource availability, environmental information systems should be expanded gradually. The foundations for developing sound environmental information systems in the future exist in some of the CEE countries. At the same time weaknesses in the coverage of their environmental information systems are apparent. OECD reviews of environmental information systems in CSFR, Hungary and Poland identified some common weaknesses (which, it should be noted, are not always well dealt with by some OECD countries). These include:

- limited coverage of some parameters for measuring water quality (e.g. biological indicators, phosphorous and heavy metal levels);

- in the marine environment, limited data on pollutants originating from the coast;

- little data on pesticide use on arable and crop land;

- gaps in air quality data and in estimates of national carbon monoxide and hydrocarbon emissions, lead emissions and CFC usage;

- deficient data on population exposure to noise from traffic, airports and other sources;

- lacking wastewater treatment information concerning the numbers of population connected to sewage schemes, capacity of treatment systems and degree of treatment prior to disposal; and

- solid waste and hazardous waste data frequently do not specify volumes and sources.

Moreover, in some other CEE countries, there appear to be large apparent gaps in the availability of natural resources data (though it is possible that much information remains hidden for a number of reasons).

4.52 Another priority in the transition period is to ensure that reliable environmental information is available for foreign and domestic investors. For example, investors interested in acquiring industrial sites will require information about the environmental conditions at and around such sites, particularly when hazardous substances have been used or discharged. More generally, attention should be paid to how environmental information can support a strengthening of sector policy integration, particularly in sectors like energy which are implicated in some of the most serious environmental problems. Objective, credible information can support dialogue between, and coordinated policy actions by, environment and sectoral ministries. Attention should not be limited to environmental conditions and trends: data bases on techniques for pollution prevention and control, or on alternative technologies, also can provide valuable information for plant managers and sector ministries.

4.53 **Technical Design of Information Systems.** Once the framework and priority elements of the environmental information system have been established, attention should focus on the methods used to collect data. In many CEE countries, questionnaires and calculations based on the characteristics of production processes provide a sizeable fraction of environmental data. For example, in Poland 90% of environmental data is collected this way, and only 10% by monitoring. In these circumstances, extending monitoring networks is a priority, ensuring compatibility, comparability and reliability of the data collected. The tendency for state-of-the-art technology to "drive" the system should be resisted. Statistical methods will continue to be important and, in those cases, sample surveys should replace more costly census methods.

4.54 After years of relative isolation, there is also a need to strengthen links between CEE countries' environmental information systems and international arrangements. The need for objective, comparable information at the European regional level underlies the request by Environment Ministers at Dobris to request preparation of the first pan-European report on the state of the environment. Some steps have been taken to link national and international systems, e.g. UNEP/GEMS and UNEP/GRID, as well as UNEP/IRPTC. In the framework of regional agreements such as the Baltic Convention, some upgrading and harmonization of monitoring systems has been achieved. Work with international organizations like GEMS, GRID, UN/ECE, Eurostat and OECD has helped improve the comparability of environmental information. These efforts should continue and should receive further impetus from the establishment of the European Environment Agency.

4.55 **Institutional Arrangements.** Restructuring environmental information systems also requires extensive training and institutional strengthening. In many CEE countries, there is a well-educated workforce, with good technical skills. However, the extension of monitoring systems, and the development of information systems more generally, will require training at all levels, and systems for managing data (including quality control) and information flows. Preliminary suggestions have been made for horizontal integration of environmental concerns between different sectors (through the creation, e.g., of policy teams to address air emissions, biodiversity concerns, etc.) and for the holding of regular round tables at national, regional and local level with the private sector (commercial and NGOs).

4.56 As the role of the state has shifted from architect to regulator of economic activity, the main responsibility for producing environmental information in CEE countries has shifted from central statistical offices to environment ministries. This has important implications for environmental information systems: the objectives they serve, how information flows and to whom, the methods which are used. Environment ministries must now establish frameworks which coordinate information flows horizontally and vertically, and which address the needs of the new users of environmental information.

4.57 Horizontally, the various ministries with responsibilities for sectors placing pressure on the environment (e.g. energy, industry) should be more directly engaged as should ministries such as health which can help to identify the environmental consequences of industrial activities. Research institutes have, and should continue to, play an important role in collecting environmental data. With time, opportunities will emerge to work with the private sector and NGOs.

4.58 Decentralization of power is an integral part of democratization in central and eastern European countries. As a result, debates about centralization versus decentralization of environmental management are emerging, often centered around the appropriate mix of decision-making powers between different levels of government. Ensuring that local needs are balanced against national needs in a coherent, comprehensive environmental information system is a particular concern. Equally, organizing cooperation and flows of information vertically, between the center and local/regional levels of government, is a priority issue.

4.59 Whatever institutional arrangements are established in a particular country, at minimum, a national environment ministry should focus on:

- trans-frontier or global environmental issues, together with issues concerned with international environmental policies;

- ensuring that local monitoring networks are established and operated in a compatible manner so that their objectives and outputs are well adapted to the environmental issues involved and to national policies;

- ensuring full use of the outputs of local monitoring networks to contribute to the assessment of national environmental policy implementation and to make sure that all potential users make optimal use of data and the results of local monitoring schemes; and

- recognizing, establishing and in some cases implementing monitoring schemes related to new or emerging environmental issues.

4.60 The redesign of environmental information systems must take place within the perspective of their costs and benefits. This is not easy. The costs of acquiring additional information usually can be calculated whereas the benefits of future decisions taken on the basis of that information, or of informing the public, are much more difficult to ascertain. The polluter-pays principle suggests that when the need for monitoring can be linked to specific polluting activities, the polluter(s) should pay. This will be the case for emissions from large, stationary sources. However, experience from OECD countries suggests that opportunities to allocate costs in this way are limited and monitoring of ambient environmental conditions generally are financed by public sources. Cost allocation between central and local government may also require attention, and transfers to the local level may be justified in order to help establish and operate a coherent national system.

4.61 Bilateral and multilateral programs have already provided financial and technical support. Activities have included establishing model air and water quality monitoring systems in the most severely polluted regions, assistance in setting up and using environmental data bases, equipping regional laboratories, promoting staff secondments to work in western countries and international organizations and funding participation by country representatives at international meetings. Generally, the greatest needs appear to be for technical assistance, training and exchanges of personnel, especially at the local level.

4.62 **Diffusion of Environmental Information.** One of the major forces for environmental improvement in OECD countries over the last 20 years has been increased public awareness and pressure. This contrasts starkly with the situation in CEE where information on environmental conditions was often a state secret. When data was disseminated publicly, it was sometimes subject to distortion and falsification.

4.63 It is crucial that the re-design of environmental information systems in CEE address the issue of information diffusion. In practical terms this may mean producing regular state of the environment reports; developing environmental indicators; using multi-media communication techniques to reach a wide audience range; preparing "user friendly", summary-type brochures on specific resources and their management; promoting information-sharing arrangements with key groups, such as professional bodies, business, NGOs and labor unions; and providing environmental information/fact sheets targeted, for example, on specific regions, investors, managers in different industrial sectors, etc. Western assistance would be particularly useful in this regard given of the lack of experience with such approaches in CEE.

4.64 The diffusion of environmental information should be seen as part of a longer-term strategy to foster public awareness and education. Links also should be established with education ministries and institutions, ultimately with a view to establishing environmental education on curricula at all levels. Private sector groups, NGOs, trade unions and professional bodies should also be encouraged to contribute to this broader goal.

4.65 **Pollution Monitoring.** All of the countries of Central and Eastern Europe have fairly extensive monitoring systems with usually hundreds of ambient air and water quality monitoring stations in each country. However, their operation is sometimes inefficient since measurements are not always taken regularly or systematically, and unevenly coordinated since monitoring is often carried out by both government agencies and scientific research institutes. At many monitoring sites for air and water pollution, monitoring equipment is either not operating, poorly maintained, or being operated by people with inadequate training. Calibration of existing monitoring equipment is also poor, and the use of manual equipment further compromises the consistency and reliability of monitoring data.

4.66 Much can be achieved by promoting self-monitoring of continuing compliance by enterprises, with random spot-checks by the authorities. As part of this process, the linkage between monitoring and enforcement can be tightened. One way that has been recommended in several countries involves *making the future frequency of monitoring or spot-checks depend on the past record of compliance* (e.g., sources found in violation twice in a row could be put on a watch list for frequent audits). With appropriate penalties for violations, it has been demonstrated that high rates of compliance are possible even with tight budgets.

4.67 Prioritization of resources for ambient monitoring vs. monitoring of point sources will not be an easy task. Ambient monitoring is more indicative of the potentially adverse health impacts of pollution, even though it cannot measure the amounts of pollution emanating from individual sources. Conversely, plant specific monitoring and enforcement of emission and effluent limits could be done so as to ensure that ambient standards are met, but the costs of monitoring individual sites will be high unless it is restricted to major polluters.

4.68 In any event, careful consideration to the number of monitoring sites and stations should be given. Areas with the highest ambient levels of pollutants which damage human health should be given priority, even if it means transferring air and/or water pollution monitoring stations from other parts of the region. It is better to have fewer but well-operating monitoring stations than many poorly operating ones. This is especially true since these monitoring stations will be collecting the information upon which future environmental policy, planning, and management decisions are based. For example, successful implementation of pollution charges and fines is predicated upon accurate information and sound monitoring, and eventually reaching agreements on transboundary pollution issues in the region will also depend on more reliable monitoring.

Environmental Science, Technology and Research

4.69 The expenditures for industrial research and development in the 1980's in the OECD area were in the order of one and a half to two percent of gross domestic product. Some countries reached nearly three percent. The largest ten firms in Japan, The United States, and Germany spent about six percent of total sales income for research and development in 1991, amounting to a total expenditure of nearly US$80 billion. The objective of these investments generally was to improve competitiveness.

4.70 There are more technically trained personnel in Central and Eastern Europe as a proportion of the total population than anywhere else in the world. The quality of scientific and technological research and the implementation of its results are the equivalent of that in the OECD area. As a major priority, challenges must be provided for this community of scientists in order that the scientific and technological base in eastern Europe does not suffer a massive brain drain.

4.71 For example, research could be encouraged in the areas of energy efficient technologies and renewable energy resources. Major concerted research efforts are needed in this area in order to provide new products and markets for CEE countries and also to help make their own industries more energy efficient. Similarly, efforts could be mounted to develop technologies to reduce the wasteful extraction of natural resources such as petroleum and metal ores in the region.

4.72 In many areas of Central and Eastern Europe -- especially the former USSR -- there are factory laboratories attached to enterprises. These can be maintained and improved. A new research program could be established which is oriented towards the development and implementation of clean technologies and clean products. This would include actions to reduce harmful components from products, environmentally sound disposal of residuals from production, design research to improve product durability and life-times, and research and technological development devoted to efficient means to recover resources and recycle and re-use materials.

Strengthening Environmental and Nature Conservation Organizations[4]

4.73 **Historical Role of Environmental NGOs.** In Central and Eastern Europe, nature conservation organizations existed for many years. They restricted themselves primarily to nature conservation and education, and did not address the relationships between the environment and economic development, or between environmental degradation and its effects on public health. Indeed, these organizations did not enjoy the liberty to consider broader issues. Critical analysis was mostly confined to scientific circles.

4.74 In the 1980s, environmental pollution and its effects on human health were increasingly recognized as a serious problem. Stimulated in part by a perception that progress was being made in the West in effectively addressing pollution problems, people in a number of CEE countries started to speak out about environmental problems, and began to organize themselves as independent environmental organizations. Groups formed initially in Poland and Hungary. In the Soviet Union, the Chernobyl disaster caused a sudden outburst of citizens' initiatives -- a process that could no longer be stopped by the authorities.

4.75 By the end of the 1980s, most CEE countries had independent environmental organizations, legally or illegally. In several countries, they acted as a focus of civil reaction against the old regimes. The environment was sometimes used as a vehicle for expressing more general social discontent. Many of the environmentalists played a role in the political transition in 1989.

4.76 As a consequence, environment was high on the political agenda of the first democratic governments and in several cases, environmentalists became part of the new administrations and/or representative bodies. On the other hand, the traditional nature conservation organizations in most countries suffered from the transition. For them this transition meant loss of a privileged status.

4.77 As a result of the alarming information about the state of the environment in CEE, environmental organizations in the region got a lot of attention and support from western colleagues, foundations and governments. NGOs from Central and Eastern Europe quickly developed international contacts and started to participate at international meetings.

4.78 Soon after 1990, the economic and social problems resulted in a more difficult situation for environmental organizations. It was difficult to keep people involved because of economic pressures. Moreover, the environmental issue was no longer useful as an argument regarding the failure of the old system; now it had to be considered against other priorities. Finally, the environmental organizations had to develop strategies and perspectives responding to the economic and political transition for which there was no precedent.

4.79 **The Current Importance of Environmental NGOs.** Western experience shows that citizens' groups contributing to nature conservation and environmental protection can play an important role. Environmental NGOs raise public awareness, stimulate authorities and business and other interest groups to change public attitudes and policies, put forward viable alternatives and often implement them to set an example.

4.80 In CEE, this role is even more important at the moment than in the West, for the following reasons:

4/ Section provided by representatives of environmental Non-Governmental Organizations.

(i) A strong environmental movement ensures that environmental issues remain on the political agenda.

(ii) The transition period in principle provides a unique opportunity to establish the basis for sustainable development, by avoiding the mistakes of the West. Environmental organizations can play an important role in this regard, drawing in part on the information available to them from colleagues in the West.

(iii) Environmental organizations can contribute substantially to strengthening the fabric of society. They can mobilize the population for positive goals and motivate people to take on special responsibilities.

4.81 **Conditions for a Strong Environmental NGO-Sector.** Authorities and business need to recognize the role and importance of environmental NGOs as full participants in the public debate about sustainable development and the formulation and implementation of practical policies. NGOs should be invited to the relevant advisory boards, delegations, negotiations, etc. This should not be restricted to pure environmental and nature conservation issues, but extended to all the areas that are related, especially economic questions. Western governments, multinational institutions and western business should recognize CEE NGOs as regular discussion partners for their activities in and related to the region.

4.82 In particular, *CEE governments should provide full access to environmental information and the right to participate in environmental impact assessments.* As there are quite different levels of these rights in the world, it is proposed to follow U.S. legislation and practice concerning access to information, and Dutch legislation and practice concerning environmental impact assessment.

4.83 **The Need for Support to Environmental NGOs in CEE.** Environmental organizations basically rely on volunteers. This is true all over the world. Working on a voluntary basis in CEE has become difficult because of the severe economic constraints. In any case, environmental organizations need a professional nucleus and financial resources for activities. It is unlikely that in the short term the environmental organizations in CEE will be able to build a strong financial base from membership and individual donations. Governments should consider financial support to such NGOs in order to assist them to play the necessary roles described above (as is being done by some western governments in their own countries, as well as by the European Community).

4.84 Taking into account the financial constraints of the governments in CEE and the enormous challenges for the environmental NGOs, continuation and strengthening of western support is welcomed. The bilateral and European Community support to institutions like the Regional Environmental Center or the Dutch Foundation for Environmental Contacts with Central and Eastern Europe, needs to continue. Through these and other mechanisms, environmental NGOs can be supported in the region, especially those based on open membership. In addition, a number of Western and international NGOs have programs in CEE countries that are of crucial interest to CEE-NGOs. Continuation of their involvement needs to be ensured by continued financial support. Western governments should consider directing a meaningful portion of their support to CEE through NGOs in their own countries or organizations in CEE which are run by NGOs.

V. IMMEDIATE EXPENDITURE PRIORITIES TO ADDRESS SHORT- AND LONG-TERM CONCERNS[1]

While market reforms will eventually take care of a large part of the emissions causing the most serious health and economic damage in the region, public investments will be needed to speed up the process of environmental improvement. This should be complemented by two other categories of expenditures required to make best use of the available resources. These are

- *Funding to cover the operational and maintenance costs of existing public environmental services, especially the treatment of drinking water and sewage, the collection and disposal of municipal waste, and maintaining inventories of and monitoring the disposal of hazardous, toxic and nuclear wastes.*
- *"Win-win" investments which can be justified on economic grounds alone but which bring substantial environmental benefits. Energy conservation, low input and low waste technologies all fall into this category as do expenditures on "good housekeeping" and minor plant improvements which reduce spills, leaks and material use.*

The priority categories for environmental expenditures are :

- *Immediate investments to address the health problems identified in Chapter 2. In areas with poor air quality the initial priorities should be better dust controls for non-ferrous smelters and steel plants and the substitution of gas for coal in district heating plants and households. Pre-treatment of industrial wastewater where heavy metals or toxic chemicals threaten the quality of ground or surface waters and measures to reduce excessive levels of nitrates in rural drinking water supplies are the priorities in the water sector. For hazardous wastes the priority must be to ensure that leachates from disposal sites do not contaminate ground or surface water sources.*
- *Measures to deal with specific country problems. These include wastewater treatment to protect valuable coastal, tourist and ecological resources, the phased completion of incomplete wastewater treatment plants where this will have the most impact on water quality, and programmes to prevent irreversible damage to important ecosystems.*
- *Support to reinforce and accelerate environmental investments by enterprises in response to new environmental policies such as the reduction of saline water discharges by mines, industrial wastewater treatment in pulp, textile and chemical plants, and measures to reduce discharges of toxic materials from chemical and petrochemical plants.*
- *Low cost measures to address long term environmental priorities where prompt action can avoid the need to spend much larger sums in future. Phasing out leaded gasoline and reducing vehicle emissions, funding applied research on the protection of ecosystems, and the development of systems to collect, interpret and disseminate environmental data all fall into this category.*

1/ Transboundary and global problems and action required are mostly dealt with in chapter VI.

5.1 Market reform, economic and industrial restructuring, and environmental incentives and regulations should gradually deal with a large part of the emissions causing the most serious health and economic damage, especially those originating from large industrial plants. Moreover, pollution charges and stricter environmental regulations will direct private investment towards more efficient and less polluting technologies. Thus, the role of public investment should be either to speed up the process of environmental improvement in the industrial sector or to ensure that stricter emission limits are set than might be possible if enterprises were required to cover all of the associated costs.

5.2 In the case of larger sources, mainly industrial plants and power stations, a key question concerns the financing of immediate investments to improve their environmental performance. Requiring that enterprises bear the cost of meeting environmental standards or of any pollution charges is a crucial element of the general program of economic transformation and industrial restructuring, since this may be critical in determining which enterprises survive and which have to contract or close altogether. However, the poor financial state of most industrial enterprises, even those which are likely to be viable in the longer term, makes it difficult for them to find the resources for environmental investments and inhibits the authorities in pursuing active policies to reduce environmental damage.

5.3 As a general principle, any government assistance to environmental investments in such enterprises should be conditional upon the enterprise or plant making some contribution to the cost of the investment and upon a judgment that the cost of the investment can be recovered over the remaining economic life of the plant. In effect, the latter condition means that investment resources should not be allocated to plants which are hopelessly unviable at world prices and which ought to be closed down as rapidly as is feasible.

5.4 However, there is a case for extending short term government (or external) support during the transition that is occurring in all formerly centrally-planned economies to fund the installation of enhanced pollution controls in a number of highly polluting industries. The inheritance of out-dated and polluting technology has to be regarded as a sunk cost along with many other elements of the old industrial structure. The question that must be asked for each plant is whether the stream of future income from the plant has a positive present value if we treat the value of its existing capital equipment as zero on condition that it undertakes immediate investments to reduce emissions to an acceptable level. Provided that condition is satisfied, it would, in principle, be possible to privatize the plant with the obligation to reflect the necessary environmental investments in the value of the assets being sold off. However, privatization is proving to be a slow process and many schemes bring little or no new money into the enterprises, while private capital markets remain very underdeveloped. While there may be circumstances in which assistance might be provided in the form of grants (based on the revenue from fees), the general presumption should be that it will take the form of loans paying realistic real rates of interest which must be repaid over a period of 5-8 years.

5.5 Plants with negative net worth on this basis might still be kept open temporarily if a sufficient premium were attached to maintaining employment or output in the industry or locality. There would then be a trade-off between the amount spent on environmental improvement and the length of time that the plant is permitted to operate. A simple system of categories could be established which takes account of the damage caused by the plant. Those in the worst category might be required to close down within two years, while those causing less damage might be allowed to continue to operate until 1996 or 1998. By suitable measures, plants could move themselves into a higher category and thus extend their permitted life, even if they had no permanent future. Again, government loans can be justified in the context of the uncertainties and other factors which limit access to capital markets.

5.6 In the medium term, the primary focus of government investments should lie in dealing with emissions from small industrial units, the service sector and households. In essence, this means moving away from the burning of coal in small boilers and houses, encouraging energy conservation in the household sector and finding low cost methods of treating the large volumes of sewage that pollute rivers and groundwater. These are measures which are *not* promoted by economic transformation and which typically require intervention by the public sector.

5.7 Most small scale users of coal are very happy to switch to gas, even if it costs more, because of the convenience and labor-saving that it allows. The major constraint is the availability of capacity in local gas distribution networks to meet a widespread demand for household heating by gas. In Bulgaria, gas supplies were restricted to large industrial consumers, so a new distribution system will be required. In Poland, local pipelines were designed to meet household demand for cooking but not heating. Thus, a substantial investment program spread over a decade or more will be required to develop the infrastructure required to enable households to switch away from coal to gas. Priority should clearly be given to the distribution of gas in areas where exposure to particulates and/or sulfur dioxide is especially high and the burning of coal is a major contributor to this air pollution.

5.8 As far as possible, such public investments should be designed to act as catalysts which stimulate private responses to the incentives provided by policy reforms and mobilize private investment resources to bring about economic changes that have environmental benefits. There is also a more traditional role for public investment to finance high priority projects in those sectors which require collective action to provide basic environmental services -- for example, infrastructure services such as waste collection and disposal, management of water resources and quality as well as nature conservation, information services and research.

Overview

5.9 This chapter focuses on *environmental expenditures and investments* whose primary purpose is to mitigate the environmental damage caused by past or current practices, though they may bring simultaneous economic or other benefits. Further, it identifies only those expenditures which address the immediate environmental priorities identified in Chapter 2 over a period of 5-8 years. There are other environmental investments which will move up the priority ranking later in this decade if the elements of the Action Programme are implemented and lead to the anticipated decline in environmental damage associated with problems that currently have the highest priority. Thus, the exclusion of particular investments from the list of priorities discussed below does not imply that the relevant problems and investments are unimportant, but rather that they are less urgent in present circumstances and should have lesser priority in the allocation of scarce resources for environmental improvement.

5.10 Public investment in environmental improvement must be complemented by three other categories of expenditure which are required to make the best use of the available resources. These are:

- Funding to cover the operational, maintenance and repair costs of existing public environmental services, especially the treatment of drinking water and sewage, the collection and disposal of municipal waste, and maintaining inventories -- and monitoring the disposal -- of hazardous, toxic and nuclear wastes.

- "Win-win" investments which can be justified on economic grounds alone but which bring substantial environmental benefits. Energy and water conservation, low input and low waste technologies all fall into this categories as do expenditures on "good housekeeping" and minor plant improvements which reduce spills, leaks and material use.

- Funding for training, internship, and exchange programs, for the development of environmental education curricula and other awareness building efforts, and any other activities which raise the capacity for effective decentralized decision making.

5.11 As discussed in Chapter 2, the process of capital renewal associated with industrial restructuring and recovery from economic recession will lead to the replacement of out-date and polluting technologies by modern industrial processes with much improved environmental performance. This will, however, take place over a period of 15-20 years because the countries of Central and Eastern Europe cannot afford to replace their capital stock in a much shorter period. The industrial investments outlined below address the intervening period with the objective of mitigating the impact of continuing to rely upon old capital equipment or of bringing forward investment in less polluting technologies. Nonetheless, the limited resources available mean that capital renewal will remain the most powerful agent of environmental improvement in the medium and longer run. It follows that environmental concerns reinforce economic and social considerations in stressing the need for effective economic reforms and good economic policies that will bring strong economic growth and investment in future.

5.12 Investment is only one part of the story and may not even be the most important part. The case studies reported below and many other examples consistently emphasize the importance of "good housekeeping" and of plant hygiene. This is a management issue. No amount of investment in better processes or environmental controls will solve the environmental problems of Central and East Europe countries unless it is backed up by effective supervision and maintenance. On the other hand, major improvements can be made with minimal resources, simply by ensuring that plant and equipment is properly maintained, that environmental controls operate according to specification, and that leaks and spills are promptly dealt with. In large part this is a matter of commitment to and pride in achieving a better environmental record. Thus, trivial but symbolic steps such as publicising the achievement of plants or work groups which make significant environmental improvements can produce surprisingly large benefits. It follows that investments must be reinforced by expenditures on management and worker training and other programs to ensure that they bring the best possible returns in terms of improvements in environmental quality.

5.13 **Immediate Public Investment Priorities.** Initial comparisons of the costs and environmental benefits of various investment programs carried out in the course of preparing the Action Programme indicate that the following sets of measures should receive priority in the allocation of investment resources for environmental improvement over the next 5-7 years :

(a) The installation of dust collection systems and filters to non-ferrous metal smelters which are located within 5 km upwind of significant centers of population. Priority should, in particular, be given to lead, zinc, copper and aluminum plants. (See para. 5.22-5.30)

(b) The installation of equipment to reduce emissions of dust, smoke and soot, and carbon monoxide from iron and steel plants, especially those relying upon open hearth furnaces. (See para. 5.31-5.36)

(c) Investments either to replace coal by gas or to permit the burning of smokeless solid fuels in district heating plants, commercial premises and households in those towns and cities where the average level of exposure to particulates during the winter months exceeds 150 $\mu g/m^3$. (See para. 5.37-5.42)

(d) The provision of facilities to pre-treat the wastewater discharged by small and medium-sized industrial plants where contamination of groundwater and rivers by heavy metals is a significant problem, for example in towns and cities with a concentration of tanning, electroplating and other metalworking plants. (See para. 5.43-5.47)

(e) Assistance to facilitate the installation of domestic septic tanks and the appropriate disposal of manure from intensive livestock operations in rural areas where levels of nitrates in drinking water drawn from shallow wells typically exceed 10 mg of nitrate-N per liter[2]. (See para. 5.48-5.52)

(f) Measures to ensure that the disposal of domestic, toxic, nuclear and other hazardous wastes is carefully monitored and that leachates from disposal sites do not contaminate ground or surface waters, especially sources used for the abstraction of drinking water supplies. (See para. 5.53-5.55)

5.14 **Country-specific Investments.** These priorities apply generally to all of the countries in the region, though the size of each problem differs from country to country according to their patterns of industrial production and of fuel consumption. There are, in addition, other areas for investment which should receive priority in individual countries because the environmental problems concerned are particularly damaging in specific circumstances. Among the investments that might be undertaken on this basis are:

(g) The installation of municipal wastewater treatment plants in towns and cities close to important tourist or wildlife areas, especially on the Adriatic, Baltic and Black Sea coasts, Lake Balaton, the Mazurian Lakes and the Carpathian and Rhodope Mountains. (See para. 5.56-5.68)

(h) The completion of partially constructed wastewater treatment plants either in the upstream sections of seriously polluted rivers or where the bacteriological quality of water downstream of major towns and cities is particularly poor or where discharges are causing an

2/ The proposed threshold is based on the standard WHO guideline, which is identical to US guidelines for the quality of public drinking water. The threshold allows a considerable margin of safety so that a less strict threshold of 20 mg/l of nitrate-N would prevent almost all cases of methaemoglobinaemia. The EC drinking water standard specifies that nitrates should not exceed 50 mg/l of NO_3 which is equivalent to 11 mg/l of nitrate-N.

unacceptable decline in the quality of water in rivers or lakes from which drinking water is abstracted. (See para. 5.56-5.68)

(i) Implementation of sustainable rural development projects in defined areas of high biodiversity and great ecological importance that are under threat. Such projects should combine better management of protected areas with ecologically benign agricultural/forestry, tourism and other activities. (See para. 5.69-5.77)

5.15 **Enterprise Investments.** A substantial amount of the necessary expenditure on environmental improvement should be financed by enterprises acting in response to regulatory and/or economic incentives to reduce emissions and wastes and to improve their general performance. The next set of examples (below) represents cases where it is essential that governments should impose pollution charges that fully reflect the damage caused by emissions. So long as the charges are actually collected, they would provide the necessary incentive to induce enterprises to invest in order to cut their emissions very substantially. However, a lack of internally-generated funds combined with the poor state of the domestic banking system may mean that enterprises face difficulties in raising the necessary resources to finance the requisite expenditures. There may, then, be a case for making special loans available to such enterprises -- for example, via a National Environment Fund -- provided that the loans carry normal (real) rates of interest and repayment terms, and that it is made clear that the loans will certainly not be written off[3]. An alternative approach would be to place such enterprises high on the list of candidates for privatization, with information being provided to potential purchasers about the likely cost of the environmental improvements required to reduce the cost of pollution charges. The main priorities for such action include (see para. 5.78-5.80):

(j) Investments to mitigate discharges of saline water from mines in countries such as the Czech Republic, Poland and Ukraine, provided that the costs of such investments are recovered over the long run from the mines responsible for salt water emissions.

(k) The provision of industrial wastewater treatment facilities in plants -- for example in the textile and pulp and paper industries -- which discharge heavy loads of BOD and other pollutants into receiving waters that are relatively clean and that lie upstream of major centers of population.

(l) The installation of equipment to reduce leakages of heavy metals, toxic gases and discharges of toxic wastes -- to the air, in wastewater

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3/ Poland's National Fund for Environmental Protection and Water Management provides soft loans as its main form of assistance for environmental investments. There is a risk that this will encourage the adoption of relatively capital-intensive methods of control rather than lower cost measures which rely more upon improvements in management and operating practices. The Fund is able to tailor the terms of any loan it makes to the circumstances of the enterprise including the environmental benefits of the project and its relationship to national environmental priorities, the financial state of the enterprise, its share of the project's financing and the impact of the project on the economic prospects of the enterprise. These are all important consideration but care will be needed to ensure that the Fund does not drift into providing indirect subsidies to what may be fundamentally unviable enterprises.

or in solid wastes -- from petrochemical and other chemical plants, especially those located close to substantial towns and cities.

Note that in cases (k) and (l) evidence that effluent discharges are contaminating groundwater sources that are used for the abstraction of drinking water with heavy metals or toxic chemicals is sufficient reason to move the issue into the category of problems deserving immediate attention.

5.16 **Measures to address longer-term environmental problems.** To complete this list of short term investment priorities, there are certain longer term environmental concerns whose future cost can be greatly reduced by relatively inexpensive measures including investments and expenditure on research, training and management. The most important of these longer term priorities concerns the prospective deterioration of urban air quality caused by the growth in traffic that will take place when the economies of Central and Eastern Europe start to grow again. Pollution from mobile sources is not currently a primary concern in most towns and cities because of the high level of exposure to lead, particulates and other air pollutants from stationary sources. However, in cities such as Budapest, Sofia and even Warsaw, traffic is already or will soon be one of the main contributors to the moderate or sometimes high ambient levels of air pollution that they experience. The following expenditure would have a high return both by reducing current emissions and avoiding much worse problems in future (see para. 5.81-5.84):

(m) The establishment of vehicle testing stations combined with facilities for better vehicle maintenance in order to enforce reasonably strict emission standards for the commercial diesel vehicles -- buses and trucks -- which are the major mobile source of particulate emission.

(n) A program to phase out leaded gasoline and to require that new vehicles (automobiles, buses and trucks) should, from some appropriate future date, meet the emission standards laid down by the EC. Most of the cost of these measures will be borne by refineries, automobile manufacturers and their customers, but resources for technical assistance and to deal with special transitional problems would speed up the implementation of these programs.

(o) Resources to fund applied research into a number of environmental problems for which solutions may be very costly (e.g., treatment of nitrate pollution) or where implementation of remedies has been difficult. Such research could focus on ecologically acceptable agriculture and forestry practices -- especially their economic costs and benefits. Support could also be channelled to specialized research institutions engaged in crucial conservation (e.g., botanical gardens); and to undertake well-defined studies on the ecological damage caused by large-scale development projects such as dams, canals, and major tourism developments.

(p) Resources to strengthen the collection and dissemination of data on the state of the environment and natural resources. Particular attention should be paid to the forms of environmental damage and related issues which define the main priorities in this Action Programme.

Immediate Public Investment Priorities

5.17 **The Industrial Sector.** The industrial sector in Central and Eastern Europe uses technologies and produces a composition of output that were characteristic of the industrial market economies 30 or more years ago. Over the last 20 years the Western countries have invested in *capital deepening*, adopting more energy efficient and less polluting technologies which make better use both of their capital resources and the skills of their work forces. On the other hand, the formerly centrally-planned countries concentrated on *capital widening*, achieving higher levels of output by building more and/or larger plants rather than by improving the level and quality of output from existing plants. New technology was introduced in a discontinuous manner, often by licensing or imitating Western know-how, in the form of new plants. There is little evidence of the continuous growth in factor productivity associated with both learning-by-doing and investment in small-scale enhancements to both physical and human capital that has proved to be the mainspring of economic growth in market economies.

5.18 The environmental performance of the region's industries reflects the general weaknesses of their record. A much higher proportion of iron and steel output in Eastern Europe is produced from open hearth furnaces, which are inherently more polluting than the basic oxygen or electric arc furnaces used in Western Europe. Even so, these plants emit more pollution per unit of output than do comparable plants in industrial market economies. Where environmental controls were initially installed, they have been allowed to deteriorate over time so that filters with a design specification of 98% removal of dust may only be operating at a 90 or 95% removal efficiency. In other cases, the original environmental controls may have been primitive and they have not been upgraded over time as has happened in the West.

5.19 As concern about the damage to human health caused by industrial emissions has grown, industries have responded by developing plans based on large investments in new technology and sophisticated controls. However, the resources to fund such investments have not been available and it is, in any case, often not clear whether the general economic performance of the industries concerned would warrant the commitment of the capital that is envisaged. Attention must focus instead on a number of smaller and more manageable steps which might make a substantial improvement to the environmental performance of heavily polluting industries.

(i) *Standard "good housekeeping".* Energy and environmental audits can identify a range of managerial and process changes which would reduce energy consumption and emissions at negligible cost. The installation of thermostats and other simple controls can improve combustion efficiency and reduce waste of raw materials or heat losses. Increasing energy and raw material prices or the imposition of pollution charges provides a strong incentive for managers to focus on the financial benefits of such measures and to spend the money on any equipment and training that may be required.

(ii) *In-plant improvements of process technology or to control emissions.* The standard example of such measures is the installation of better dust filters in metallurgy or metal-working plants to reduce the discharge of metal dusts in flue gases. A range of non-ferrous metal smelters in Central and Eastern Europe are notorious sources of lead, zinc, nickel, cadmium and other metal dusts which damage the health of the population living in surrounding areas. One of the worst examples is the lead smelter up-wind of Plovdiv in Bulgaria which causes elevated levels of blood lead for a population of over half a million people. By contrast, dust filters and other controls in United States lead smelters are able to ensure that those living no more than 1 km from the source do not have significantly higher levels of blood lead than those living at a much greater distance. Similar patterns can be found for emissions of benzene and other toxic organic chemicals from oil refineries, petrochemical and other chemical plants. While it may not be possible to achieve such high levels of emission reduction without large investments in redesigning plants or processes, major improvements can typically be made at low cost.

(iii) *End-of-pipe controls with a modest cost* that can achieve a substantial reduction in the concentration and volume of emissions. The main examples of such investments are found in the area of industrial wastewater treatment. Simple chemical or biological treatment may allow a much higher proportion of water to be recycled within the plant -- reducing the volume of discharges -- or may cut down the quantity of suspended solids and organic waste that is discharged into rivers. Recovery techniques can also be applied to solid wastes from metallurgical plants, power stations and mines.

5.20 There has been no systematic assessment of the scope for reducing environmental emissions through such low-cost measures, or of the total cost that might be involved if all of the countries in Central and Eastern Europe were to require all plants above a certain size to improve their environmental performance by implementing such improvements. There are also a variety of issues concerning the way in which such investments should be financed that need to addressed.

5.21 One issue that recurs in various forms concerns the time, expense and difficulty involved in trying to produce technical and economic evaluations of potential environmental investments in the industrial sector. As emphasized earlier, the industrial sectors of the CEE countries are undergoing major structural changes, so that the prospective competitiveness of and demand for the output of many plants is highly uncertain. However, few sectors will experience a medium term decline in demand of more than one-half, so it is possible to devise a simple ranking mechanism which could be used to identify those plants which would be eligible for immediate environmental investments. A scheme along the following lines could easily be introduced:

(i) Establish a fund to finance environmental investments in the most polluting industrial sectors: metallurgy, chemicals, pulp & paper, non-mineral metal products. The fund would provide a combination of grants and loans amounting to not more than $2.5 million to

Dealing with large, old industrial plants

Whether to invest in pollution control in the large old industrial "dinosaurs" depends on economic factors. The choices are (i) to close down such plants as rapidly as possible on both economic and environmental grounds; (ii) to permit them to continue to operate for a limited period as in the past; and (iii) to permit them to continue to operate provided that environmental improvements are implemented. In almost all cases, modest environmental investments could generate a good return within 2-3 years. For these, the crucial point is that the choice should be restricted to (i) and (iii). If the government (or the enterprise) is unwilling to finance such improvements, then this amounts to a decision that the social benefits of keeping the plant open do not outweigh the costs, and the plant should be closed.

Where no such opportunities are available, then the government should fix an absolute maximum term for the continued operation of the plant under (ii) which is substantially less than the payback period for potential environmental investments.

This approach provides clear guidelines for action which allow governments to make their own choices about the trade-off between the social costs of unemployment and of continuing environmental damage. It suggests, further, that all public enterprises should be subject to a gradual tightening of environmental conditions for continued operation under which managers are held accountable for making progressive improvements in environmental performance while they continue to receive government financial assistance.

finance high priority environmental investments[4].

(ii) Enterprises should be eligible for financial assistance from the fund if they are in the top 50 percent of all enterprises in their sector on both of two criteria -- their profitability expressed as the value of revenues minus material and labor costs expressed as a ratio of total revenues, and the average age (more strictly, youth) of their capital equipment.

(iii) The fund should retain consultants who would carry out a rapid environmental audit of any plant where an investment has been proposed by an enterprise satisfying the criteria in (ii). The consultants should be asked to assess whether the proposed investment will have the effect of substantially reducing emissions of pollutants which threaten the health of those working in or living near to the plant and whether the proposal is a cost-effective method of reducing such emissions[5]. Such an assessment could be completed within a month and the proposal should be approved if the report is positive.

4/ If budgetary constraints are severe, then this upper limit could be reduced to ensure that no grant/loan exceeds 5-10 percent of the fund's total resources.

5/ In ecologically sensitive areas the environmental audit could be extended to cover an assessment of whether the investment would contribute to the prevention of irreversible damage to local ecosystems.

(iv) Enterprises should be required to match finance provided by the fund on a dollar for dollar basis from their own investment resources. Most of the finance should be provided in the form of loans repayable over 5 years at modest real rates of interest – say 5 percent per year.

(v) External donors could assist the operations of the fund by contributing to the fund itself and by seconding staff for periods of 6 months or more who could train those responsible for carrying out the rapid environmental audits and for vetting the financial status of enterprises.

Institutionally, a fund of this kind should report to the Ministries of Environment and Industry. To avoid conflict it could come under the National Environment Fund or be established as an independent entity with the National Environment Fund taking on responsibility for investments outside the industrial sector.

5.22 **Non-ferrous metal smelters (a).** Highest priority should be given to eliminating the bulk of dust emissions from lead, lead-zinc and copper smelters where there are towns or cities that are located within the dispersion zone around the plants. Examples of such smelters can be found in most countries but those near Plovdiv in Bulgaria and Copsa Mica in Romania have been particularly bad. There is also a case for tackling fluorine emissions from aluminum smelters but the necessary measures are substantially more expensive.

5.23 The dust from lead, lead-zinc and copper smelters can include lead, arsenic, cadmium and other toxic heavy metals in substantial quantities, especially if old-fashioned reverberatory furnaces are still in use. The damage to human health caused by such emissions is generally large, especially if they affect a substantial population, with the worst sufferers being children whose development is affected by exposure to lead. Since children are the major victims of lead pollution, the costs are incurred over a long period of time and it is important to deal with the problem as soon as possible in order to prevent damage to those born in the next few years. It is not only direct exposure to airborne dust which is the source of damage but the deposition of heavy metals on soils which may move up the food chain or which may leach into surface waters or groundwater used for drinking. Thus, even after the installation of adequate dust control equipment it will be important to maintain a *cordon sanitaire* around smelters to prevent soils which are already contaminated with high levels of heavy metals from being used to grow crops or for grazing.

5.24 Remarkable improvements in the damage caused by non-ferrous smelters can be achieved by focusing on plant management and hygiene. Even a cursory inspection may reveal very simple measures that can be taken to reduce wind-blown dust, energy losses and other fugitive emissions. A common problem is the poor handling and storage of metal ores which results in large quantities of dust being distributed around the surrounding area. Investment in water sprays, partial (or complete) enclosure of stockpiles and conveyors, and careful attention to cleaning roadways are the clearest possible example of "win-win" measures related to good housekeeping. The costs involved are small in relation to the value of the ores that are lost.

5.25 Even at apparently well-run plants it is possible to make large improvements by better management and meticulous attention to the details of plant housekeeping. The largest lead smelter in the US (at Herculaneum, Missouri) was able to cut the ambient level of lead just outside its plant in half

Airborne Dust or Gases – Which Is More Important?

The work described in this report has come at a time in which new knowledge is rapidly emerging about the impact of air pollution on human health. The role of certain gases and vapors (especially sulfur dioxide, oxides of nitrogen, ozone, and hydrocarbons) in precipitating acute respiratory episodes and exacerbating chronic bronchitis and asthma is being elucidated. At the same time, the impact of respirable dust on mortality (in addition to its role in respiratory morbidity) is being recognized from studies of a variety of major urban centers in the West with ambient dust concentrations which are much lower than many places in Central and Eastern Europe. Thus, from a health perspective, it is difficult to come up with a strong theoretical rationale to concentrate on either dust or gases to the exclusion of the other.

In practice, the list of places in the region with human health problems due to airborne pollution include some where the primary exposure is to dust; some where the primary exposure is to one or more gas or vapor; and many where the problem is a combination of the two. This same pattern holds true for regional hot spots, areas with a confluence of point sources, and areas where the "bad town planning" model best applies.

Knowledge of the relative importance of the health impacts of dusts and gases does not provide us with a basis to set environmental action priorities which would target one and neglect the other. However, even if the health impacts of dusts and gases is similar, the cost of controlling the former is typically much lower. Strategies which target dust control while incidentally reducing gaseous emissions are therefore potentially much more cost-effective and provide a basis for setting priorities.

without any new investment by taking steps to : (a) coordinate operations, (b) anticipate problems and act before they caused significant emissions, and (c) ensure that emissions are constantly monitored and that all staff are involved in measures to bring them down. By making the plant's environmental performance a constant concern of both management and workers most CEE smelters should be able to reduce the environmental damage that they cause and improve their economic prospects even without substantial investments.

5.26 Most smelters already have dust collection systems, but they are either poorly maintained or inadequate to cope with the volumes of air coming from sintering plants and furnaces. The costs of installing new baghouse dust filters or electrostatic precipitators designed to eliminate more than 99 percent of dust emissions are quite modest, so that the complete replacement of existing systems may be cheaper in the long run than any attempt to upgrade existing controls. For a typical lead or lead-zinc smelter the cost of an appropriate baghouse filter system would be of the order of $6 million, while an electrostatic precipitator costing about $10 million might be required for a typical copper smelter.

5.27 The question of who should pay for installing these controls must depend upon circumstances. The long run answer is simple: no smelter should be allowed to continue operating without controls that achieve a level of dust removal which meets reasonable emission standards. Thus, governments could require that any smelter bear the cost of better environmental controls as a condition for being allowed to continue to operate. The difficulty is that publicly-owned enterprises may have neither the cash flow nor the access to loans that would be required to finance these improvements, so that governments may feel obliged to allow a significant period before enforcing much stricter emission standards. There may also be a reluctance to close down smelters which are major local employers in areas where alternative employment prospects are poor, which may prompt governments to extend the transitional period that is allowed.

Environmental improvements in the non-ferrous metals industry

Lead and lead/zinc smelters. Lead and zinc are produced in Bulgaria, the Czech Republic, Poland, Romania, Russia, and Ukraine. Production is characterised by both technical inadequacy - low grade ore and outdated process technology - and financial weakness - high indebtedness and lack of funds for investment. Some of the ores treated in the CEE countries would not be considered economic in Western Europe, both because of the low metal content and the potential pollution problems. Indeed, the future of many plants is highly uncertain because of their environmental problems. In 1991 the Bulgarian Government announced that all primary production of lead would be closed down, although this has not yet happened. It appears that the lead and zinc subsectors are the weakest of the non-ferrous metal activities in the CEE countries.

The main environmental problem concerns emissions of dust containing lead which can contaminate soils and affect children in a wide radius around a plant. In the plants studied -- Plovdiv in Bulgaria, Copsa Mica in Romania -- the main sources of dust emissions were: (a) dust creation in handling the metal concentrates including unloading trucks or railway wagons, mixing and crushing operations, and transferring it to the sinter plant; (b) wind-blown losses of concentrates from stockpiles; and (c) fume and dust emissions from the sinter plant, blast furnace and other refining operations. The worst problems at both plants seem to be associated with handling the concentrates and losses from stockpiles. Drastic reductions in output since 1989 have reduced emissions from both plants more than proportionately because concentrates are handled more carefully and dust control systems are not expected to operate far beyond their design capacity. However, it is probable that neither plant is economically viable in the long run at current levels of output, unless the size of their workforces is drastically cut, since they are operating at less than half the scale of equivalent plants in market economies.

The immediate priorities are measures to deal with dust from concentrate reception, stockpiles and handling. At Copsa Mica a simple system of water sprays to damp down the stockpiles -- at a cost of less than $100,000 -- would have a big effect, provided that the water drained from the stockpiles is properly treated. Completion or installation of perimeter walls (or even complete enclosure) plus other measures to prevent spillage -- costing less than $2 million for at each plant -- would greatly reduce the dispersion of dust that has contaminated the areas around the plants. These should be "win-win" investments since lower concentrate losses should cover most or all of the costs involved. Similar "good housekeeping" measures could also reduce other emissions to both air and water at a very small cost.

At Plovdiv the dust collection system within the plant has been substantially upgraded in the last two years with the installation of new hoods, baghouse filters and upgrading of the old equipment. The plant's management expect to be able to meet the new emission standards which came into effect in January 1993. Similar measures are the second priority at Copsa Mica. A sum of $2 million should be sufficient to repair and modernize existing controls and to install additional hoods and filters.

The sulphuric acid plants at both Plovdiv and Copsa Mica are both in a bad state of repair. Most of the sulphur dioxide produced in the sintering and roasting operations and in the blast furnace is emitted to the air rather than being recovered. New acid plants could not be justified economically, but repairs and upgrading to process more of the sinter plants gases could reduce SO_2 emissions substantially. The cost would be of the order of $3-4 million for Copsa Mica and $6-8 for Plovdiv, part of which could be defrayed by the higher sulphuric acid yield from the plants.

Similar measures will be required at several other lead or lead-zinc smelters in the region. In particular, three lead-zinc smelters in Upper Silesia at Bukowno, Szopienice and Olkusz in Poland, at Ordzhonikidze in Russia, and at Konstantinova in Ukraine plus the zinc smelter at Chelyabinsk in Russia are prime candidates for such investments.

(contd)

Environmental improvements in the non-ferrous metals industry (contd)

Copper smelters. The major environmental problem with copper smelters in the region concerns emissions of lead and arsenic which occur as contaminants in copper ores. There are three important sources of these emissions : (a) particulates in gases from the smelting and conversion operations and dusts created in preparing and handling copper concentrates; (b) liquid effluents derived from hydrometallurgical operations which are discharged to settling ponds; and (c) large volumes of smelter slags which may lead to the leaching of heavy metals into ground or surface waters if not handled properly.

Installation of new dust controls – electrostatic precipitators, scrubbers or baghouses – would cost $5-10 million for a smelter producing 100-200,00 tonnes of copper per year. Upgrading existing facilities should be much cheaper : the costs are very site-dependent but an expenditure of $2-3 million per plant would have a large impact on dust emissions from most CEE plants. Water treatment and measures to prevent leaching from solid wastes can be more expensive -- for example, $10-15 million for a water treatment plant utilizing precipitation techniques and closed circuit systems to reduce water use -- but, again, it is possible to make significant improvements to existing facilities for relatively modest expenditures.

The priority sites for such expenditures include : Alaverdi in Armenia; Pirdop in Bulgaria; Glogow and Legnica in Poland; Baia-Mare in Romania; Krasnouralsk, Kushtym, Mednogorsk, Pyshma and Sredneuralsk in Russia, and Krompachy in Slovakia.

Aluminium smelters. Aluminium smelting is a highly electricity-intensive operation whose economic viability in most CEE countries is very uncertain once electricity prices have been raised to reflect true long run marginal costs. This is true even in Hungary with its domestic reserves of bauxite and the low operating costs of nuclear power, because the country relies heavily upon electricity imports from Ukraine whose marginal cost should determine the price at which power is supplied to the aluminium smelter. With such doubts about their long run prospects, it is difficult to justify the large expenditures -- $50-100 million -- that would be required for potroom refits to eliminate fluorine emissions at most of the alumimium smelters. For some of the Russian smelters -- for example, those at Kamensk, Krasnoturinsk, and Volgograd -- such investments might be appropriate because low cost coal plus the prospect of surplus generating capacity may yield marginal costs of power that are low enough to sustain continued operation. The Zaporozhe smelter in Ukraine, which relies upon the nearby nuclear power stations, is another case where "win-win" investments in environmental improvements and better energy efficiency would probably be justified.

For other alumimium smelters in the region the priority must be given to better management and "good housekeeping". The case study of the plant at Ziad nad Hronom indicated that : (a) the equipment for handling bauxite was old and there were considerable raw material losses in the form of dust emissions; (b) the solid/liquid separation stage of producing alumina from bauxite has poorly controlled and archaic technology with the result that there are substantial caustic emissions; and (c) in-plant hygiene in the alumina reduction pot-lines is very poor and leads to severe emissions of pot-gases laden with tar, fluorine and particulates. The plant's environmental strategy relies upon the replacement of existing facilities by a new smelter by late-1994, but funds to complete the necessary investment are not guaranteed. Unless completion of the new smelter and closure of the old facilities within the next 2-3 years is assured, low cost measures would be justified to reduce dust losses of bauxite and to improve plant controls and hygiene. No detailed costings are available, but an expenditure of $2-3 million at most should result in substantial reductions in emissions.

5.28 The central issue is, therefore, whether the short run benefits of immediate public investment which eliminates the transitional period that might be required if enterprises were to finance their own controls are sufficient to justify the costs involved. For lead and other heavy metal emissions from non-ferrous smelters, the short run benefits are substantial. The costs can be minimized by the following strategy:

(i) Some smelters rely upon obsolescent, polluting and energy-intensive technologies. These are unlikely to be economically viable in a market economy and should be closed as rapidly as possible with appropriate assistance to help workers find alternative employment. This will reduce the capacity of the industry which would, in any case, be necessary because of the impact of industrial restructuring on future demand.

(ii) This leaves a set of enterprises which are potentially capable of operating profitably in a market economy and which, as a condition for continued operation, will be required to meet much stricter environmental standards in future. One option would be to privatize them immediately with an obligation on the new owners to install better dust controls within a period of 2-4 years. This would probably mean that potential purchasers would be limited to foreign investors able to provide the necessary additional finance.

(iii) Where the option of sale to a foreign investor is either not possible or not considered desirable, the government could finance the necessary improvements itself by extending a special environmental investment loan to the enterprise. A realistic real rate of interest should be charged on such loans. The amount of the loan and any accrued interest would eventually be recovered when the enterprise is privatized, so that the cost of immediate rather than delayed installation of the controls would only amount to the difference between the opportunity cost of the capital invested and the interest rate charged to the enterprise. While the opportunity cost of government funds for investment may be high because of the squeeze on public expenditure, foreign donors could reduce this cost by extending loans on reasonable terms.

5.29 This approach to financing environmental improvements in medium or large industrial enterprises is not special to the non-ferrous metals industry, so that it can be applied equally well to many of the investment priorities discussed below. On the other hand, somewhat different considerations must be taken into account when dealing with small industrial enterprises because the difficulty of monitoring their emissions makes the application of economic incentives or regulations much more difficult. Improvements in environmental performance may also be less closely linked to general efficiency gains, so that the enterprises concerned will be more reluctant to invest in eliminating or treating their emissions. Thus, the government may need to bear a larger share of the cost of environmental improvements for small industrial operations than for larger plants.

5.30 Some of the aluminum smelters in Central and Eastern European have a very poor environmental record because of their emissions of hydrogen fluoride and other fluorides which can be a serious health hazard for those living close to the plants. Aluminum smelting is highly energy-intensive, so that many (probably most) smelters will be seen to be uneconomic as energy prices are raised to world levels, even taking account of the special electricity tariffs that are usually established for the industry. On the other hand, many of the enterprises -- especially those in Russia -- have taken advantage of current price distortions to operate their plants at full capacity despite the decline in domestic demand by exporting the surplus to the world market. Installing adequate environmental controls is more expensive than for other non-ferrous smelters -- the cost might be as high as $35 million for a smelter producing 100,000 tonnes of raw aluminum per year -- so that any decision to invest must first take account of the viability of the plant at realistic energy prices. Closing plants (especially those in or close to urban areas) or reducing their capacity is the first step. Only after this has been carried out should new investment in environmental controls be contemplated.

5.31 **Iron and steel plants (b).** Every country in Central and Eastern Europe, other than Hungary, has two or more large urban areas whose air quality is grossly polluted by iron and steel plants which belch out particulates, sulfur dioxide, carbon monoxide and miscellaneous hydrocarbons. At the same time, the economic prospect of the ferrous metallurgy industry in the region is dire. Domestic demand for its output is not likely to rise above 60 percent of pre-reform levels before the end of the century while export possibilities are severely constrained. The quality of output tends to be poor so that the existing plants are competing in the most price-sensitive part of the market and, if capital costs are properly taken into account, they have little chance of competing successfully with mini-mills that rely upon electric-arc furnaces. Thus, most of the industry can survive only by utilizing capital stock that is fully depreciated and that is economic because of the region's low labor costs.

5.32 Much of the iron and steel industry in Central and Eastern Europe relies upon out-dated and inefficient technology which results in poor environmental performance. Open hearth furnaces account for almost half of crude steel production. By ensuring that steel capacity with the worst environmental record is shut down, governments can achieve substantial reductions in emissions as well as enhancing average levels of productivity and energy-efficiency for their steel industries. In many cases this will mean that open hearth units will be closed at plants which combine both open hearth and basic oxygen steel-making -- for example, two-thirds of total capacity at both Chelyabinsk and Magnitogorsk in Russia consists of open hearth units.

5.33 In the face of such pressures, Poland has already decided to restructure its steel industry, cutting capacity by at least one-third and modernizing the remaining plants to reduce energy costs and improve the quality of output. The installation of better environmental controls should be an absolute requirement for any plant that receives modernization investment. It is unlikely that any plants with open hearth furnaces will be modernized, so that the typical cost of new controls to meet reasonable (but not strict) emission standards for air pollutants would amount to $20 million per 1 million tonnes per year of output capacity for a basic oxygen plant. This would cover all of the stages of steelmaking including the sintering plant, coke ovens, furnaces and finishing.

5.34 As noted elsewhere in this document, towns and cities with old steel plants have always been among the dirtiest areas in any country, whether in market or formerly centrally planned economies. Ambient levels of particulates are especially high, which leads to high levels of both acute and chronic respiratory disease as well as a variety of heart and other conditions. The damage done by particulates is usually exacerbated by relatively high ambient levels of sulfur dioxide and carbon monoxide. All of

Environmental investments in the iron and steel sector

The main sources of particulate emissions from iron and steel plants are materials handling and storage, coke ovens, the sinter plant, blast furnaces and steel converters. Most plants have reasonable facilities for primary gas collection and cleaning for coke ovens, sinter plants, blast furnaces and oxygen converters, especially where the exhaust gases used to fuel other stages of the operation. Thus, attention must focus on secondary collection of fugitive emissions including those from charging and discharging steel converters. These emissions may be high because of poor maintenance or careless operating practices in the past and dealing with them will involve the installation of ventilation hoods, fans and filters or precipitators whose costs will be highly plant-specific.

At Krivoi Rog in Ukraine dust generated by the nearby iron ore beneficiation/pelletization plant is the most serious environmental problem, while better arrangements for dust suppression are also required at Kosice in Slovakia. Water sprays, partial enclosure of conveyor belts and other simple measures can reduce dust emissions, especially that generated by handling fine ores in dry and windy weather. The investment cost would amount to $1-2 per tonne of steel-making capacity or up to $25 million at Krivoi Rog and up to $10 million at Kosice.

At Kosice, all four units of the sinter plant have cyclones, while two have also had electrostatic precipitators fitted to the sinter breaker and screening areas but not to the sinter furnace. As a result, the emissions from the stacks at Kosice are dirty, and will almost certainly contain relatively large amounts of fine iron oxide dust. The solution to the problem, which is expensive, will involve changes in operating practice to improve the sinter quality, and the replacement of the ignition and filtration systems. The total cost of these measures applied to two of the units (two are expected to be closed) is estimated at $12-18 million. The sinter plant at Krivoi Rog has a very bad dust problem, partly because it uses low quality waste and sludge from the iron beneficiation plant. A combination of better housekeeping, installation of fans with sufficient capacity to capture and clean waste gas prior to stack discharge and the use either of iron ore pellets or of higher grade fines could achieve large reductions in emissions. The plant management would like to invest in a new sinter preparation plant, but more limited investment of up to $50 million to improve the existing unit would probably be justified.

Controlling particulate releases from coking ovens is largely a matter of good operation and maintenance. For example, adherence to a regular charging and discharging schedule and effective control of oven heating can assist in minimising brickwork damage and hence gas leakage. Where plants have been poorly operated and maintained, significant repairs may be needed to affect a reduction in emissions. The coke ovens at Kosice and at Krivoi Rog display signs of age, misuse and the need for urgent repair. Most of the doors were leaking and there was a constant haze emanating from the top of the ovens. Detailed studies of the coke ovens would be needed to determine the precise measures needed to reduce the emission levels but replacement or major rehabilitation of many of the coke batteries may be necessary in the medium term. This would be expensive with a cost of $100 million or more for Kosice.

Improvement of primary particulate controls plus installation of secondary fume collection and cleaning for basic oxygen converters in existing basic oxygen converters may cost up to $10 per tonne of steel-making capacity. For example, the electrostatic precipitator on one of the BOS units at Kosice was ineffective -- the stack was emitting a thick plume which deposited red dust around the surrounding area -- and may need repair or replacement at a cost of up to $8 million. It is unlikely to be worth investing significant sums in open hearth plants whose economic life should be very limited.

Prime candidates for environmental upgrading include the BOS units at : Kremikovtsi in Bulgaria; Trinec in the Czech Republic; Katowice and Krakow in Poland; Galati in Romania; Chelyabinsk, Cherepovets, Lipetsk, Magnitogorsk, Nizhniy-Tagil, Novokuznetsk and St Petersburg in Russia; Kosice in Slovakia; and Krivoi Rog, Mariupol (both the Azovstal & the Ilyich plants) and Yenakiyevo in Ukraine.

these health conditions can be alleviated by better air quality (even for longstanding sufferers), so that eliminating the pollution from steel plants will lead to a gradual improvement in the health status of the local population. Thus, the benefits of investing in better environmental controls for steel plants are typically large because of the size of the population affected and the health gains that can be achieved in a reasonable period of time.

5.35 There is substantial scope for "win-win" investments in a combination of good housekeeping, better operating practices and greater energy efficiency which would also improve the environmental performance of those plants which continue to operate. For example, an evaluation of Ukraine's steel industry estimated that increased use of scrap could reduce coal requirements per tonne of finished steel by 20% or more. One operational measure that is standard in the West but is not used by most Ukrainian mills is the injection of tar, oil, gas or coal in the tuyeres of the blast furnace to provide heat and reducing gas. This permits a saving of 100-200 kg of coke per tonne of pig iron. Other such measures include : heat recovery from the sinter cooler, installation of top pressure recovery turbines on blast furnaces (already used on one of Krivoi Rog's furnaces), gas recovery from basic oxygen converterrs without combustion, and installation of regenerative burners and thermal insulation for heating furnaces. In many plants process controls are primitive by comparison with Western facilities, so that the installation of better controls could have a substantial impact on energy and raw material use and on emissions.

5.36 It should not be assumed that emissions from the iron and steel making processes are always the main source of environmental damage. In the case of Krivoi Rog in Ukraine, indeed, the main environmental problems are associated with the linked mining operation and the iron ore beneficiation and pelletization plant rather than with the steel plant. Large volumes of saline water effluent from the mines contaminated with heavy metals and radionuclides (from nearby uranium deposits) are discharged along a canal to settling ponds which barely have the capacity to cope with the volume of water released. Leakages from these ponds are infiltrating into local groundwater reservoirs, maing them unfit as sources of drinking water. Larger releases of water would flow into a tributary of the Dnieper and threaten the downstream quality of water which is used for domestic, agricultural and industrial purposes. Thus, steps to reduce the volume and potential toxicity of these discharges must be a high priority. The handling and storage of ores at the beneficiation plant leads to huge clouds of dust which have the largest impact on surrounding areas. Again, low cost measures should be implemented to deal with this dust problem and to reduce ore losses.

5.37 **Coal in households and small scale boilers (c).** Though the volume of coal burnt in power stations and large industrial plants is generally several times that used in households and small scale boilers, it is the latter which are responsible for a large portion of the local concentrations of particulates and sulfur dioxide in the majority of the most polluted urban areas in Central and Eastern Europe. For large boilers, it is possible, at modest cost, to install electrostatic precipitators or other dust filters to eliminate 98 percent or more of the particulate emissions. In any case, most such emissions are dispersed over a relatively wide area because of the height of the chimneys concerned as well as the relatively high emission velocities. By contrast, the emissions from burning coal on a small scale are neither dispersed nor can they easily be controlled. Thus, the Action Program focuses on the need to tackle excessive exposure to particulates linked to the use of coal in households, small commercial and industrial premises, and small district heating units.

5.38 This does not mean that emissions from power stations and similar large sources can be neglected, but rather that the solution is clear -- install and maintain appropriate electrostatic precipitators.

The capital costs of these controls should be borne by the enterprises responsible for emissions and appropriate incentives provided either via pollution charges or regulatory constraints. In due course the costs of environmental controls on power stations must be built into electricity tariffs, so that consumers bear the full cost of electricity including all environmental costs. The necessary adjustments in electricity tariffs to reflect long run marginal costs were much greater than the average increase in energy prices that was required to reach economic levels in all CEE countries -- especially for domestic consumers -- and governments have made less progress in this respect than for other energy prices. As a consequence, the financial situation of electricity utilities is often poor and they can ill-afford environmental investments. Clearly, the best solution is to eliminate price controls since they are an inefficient instrument of social policy. If this is not possible, governments might consider providing special, repayable loans to finance the early installation or upgrading of filters on those power stations responsible for the worst pollution. Since the demand for electricity has fallen substantially in most countries and is unlikely to recover quickly, such finance should only be provided for power stations whose continued operation is supported by a least cost power planning study that takes proper account of environmental costs.

5.39 Studies of the damage caused by air pollution consistently identify the economic costs of average ambient levels of total suspended particulates in excess of 75 $\mu g/m^3$ as one of the two largest components of the total damage. The other component is usually the losses due to lead emissions, though such estimates are controversial because they depend critically upon the value attached to the lowering of children's IQ associated with excessive levels of lead exposure. In addition, high levels of particulates associated with the burning of coal have substantial material costs because of the soiling of clothing, buildings and other physical assets. Estimates of the total environmental damage due to particulates in some countries of Central and Eastern are currently being reviewed and updated, but preliminary work suggests that the cost might amount to $750-1,000 million dollars per year in Poland. This damage is concentrated in the most polluted areas of Upper Silesia and a small number of other urban areas that have traditionally relied upon coal for domestic heating.

5.40 There are basically two ways of eliminating or, at least, drastically reducing the emission of particulates from small scale sources. The first is to require that all users burn smokeless solid fuel rather than ordinary coal or coal briquettes, while the second is to substitute some alternative fuel -- normally gas -- for coal. Reliance upon smokeless fuel involves little investment in the distribution of alternative fuels or in the installation of new boilers, so that it is relatively simple to achieve provided that the investment in carbonizing plants required to supply smokeless fuel is ensured. The difficulty is, however, that most households and other small users have a strong preference for gas over solid fuels, so that a market cannot be guaranteed for smokeless fuel plants while investments in gas distribution and conversion will, in any case, proceed in response to consumer demand.

5.41 An appropriate strategy would be to provide the resources required to accelerate the substitution of gas for coal in large, heavily polluted urban areas. In parallel, governments could adopt a policy of requiring the use of smokeless fuels in smaller towns whose average levels of particulate exposure during the heating season exceed some critical value -- probably 150 $\mu g/m^3$. The Gas Development Plan for Poland estimated that the total cost (at 1990 prices) of extending gas distribution for heating purposes to all urban areas would be about $5 billion over two decades to 2010. The population living in those urban centers worst affected by particulates amounts to about 6 million people out of an urban population of 24 million, so that the cost of a priority program of gas conversion might amount to $1.25 billion over the remainder of the current decade; that is less than $200 million per year.

5.42 The full costs of such a program should eventually be paid by gas consumers who would benefit substantially from the wider availability of gas. Experience in many countries shows that households and other small scale users of coal are prepared to pay a premium for the convenience, cleanliness and labor-saving advantages of gas relative to coal. Thus, the role of external donors should be (i) to provide technical assistance to minimize the costs of the program, and (ii) to make available loans on conventional banking terms which would be repaid from the revenues of gas utilities in the usual manner.

5.43 **Treatment/pre-treatment of wastewater from small industrial plants (d).** In most parts of Central and Eastern Europe, it is usual for small and, sometimes, medium scale industrial plants to discharge their wastewater to municipal sewers. At a minimum this can place a large burden on municipal wastewater treatment plants (where they are operating) and the nature of industrial effluent may severely reduce the efficacy of biological or other treatment processes. Since these industrial effluents may contain significant amounts of heavy metals, organic chemicals or heavy concentrations of COD and BOD, municipal treatment plants may also not be adequately equipped to prevent serious contamination of the receiving waters.

5.44 A long run strategy of encouraging "win-win" investments in cleaner technologies which minimize both water use and waste generation must be a crucial part of policies to deal with industrial wastewater from all industrial sources. New, clean technologies reduce total emissions by 50 percent or more with no economic penalty. A combination of realistic charges for water consumption plus pollution charges based on the volume and characters of discharges to sewers will provide a strong incentive for the adoption of these technologies. Resources devoted to disseminating information and providing technical expertise relating to these technologies should produce substantial environmental and economic benefits.

5.45 Where there are concentrations of small industrial enterprises engaged in tanning, textile dyeing, electroplating or other metal processing activities in a town or city, the most cost-effective approach to environmental protection will be to invest in one or two industrial treatment or pre-treatment facilities designed specifically to remove the persistent, toxic and bioaccumulating substances. The total cost of such a facility will, of course, depend upon the precise nature of the effluent that it is designed to handle but it will usually not be large. As an example, a central facility to remove chromium, COD, BOD and other pollutants from the effluent produced by nearly 200 tanneries in Italy required a total investment about $20 million to treat 10,000 m^3 of wastewater per day. At the same time, it is equally important to reduce the total volume of effluent to be treated by encouraging enterprises to switch to tanning technologies which do not rely upon chromium. On a smaller scale, a facility to treat 6,000 m^3 of wastewater from textile activities might involve an investment of $2-2.5 million.

5.46 Based on available data, discharges of industrial wastewater have not been a significant threat to human health in the region, because water authorities have been able to obtain water from unpolluted sources. To meet the demand for water they have had to incur increasing costs to pipe uncontaminated water to treatment plants, sometimes over considerable distances. At the same time, it is certainly the case that careless and unmonitored discharges of industrial effluent from small industrial plants either have caused or may cause irreversible damage to groundwater in a number of industrial towns and cities. The costs of treating such emissions centrally is relatively small, public investment to provide such facilities should generate a good return in terms of reducing environmental damage.

5.47 As for some of the other priorities, the case for public intervention and provision of treatment facilities rests on the difficulty of monitoring emissions from small industrial plants and of enforcing regulations or pollution charges designed to reduce emissions of the most damaging pollutants. The long run cost of operating central facilities should be recovered from the firms that use them, who should also be barred from discharging their effluent to public sewers. By providing the initial funds required to develop central treatment plants the government or external donors will provide the basis for local environmental authorities to take strong action against enterprises that neither treat their own discharges nor ensure that it is dealt with by a central plant.

5.48 **Rural wastewater treatment (e).** Excessive levels of nitrates in shallow wells and similar sources used for drinking water is a widespread problem in the rural areas of many countries in Central and Eastern Europe. However, as with many diffuse environmental problems, tackling it involves a large number of small measures designed to reduce discharges of nitrates and to ensure that groundwater sources used for drinking are protected from the infiltration of nitrates resulting from the careless disposal of human and animal wastes. These measures involve a large component of agricultural extension and public education as well as programs to finance the relatively small individual expenditures required to install septic tanks or simple systems to collect and treat wastewater in larger villages and small towns. The major issue is proper legislation followed up by effective enforcement to ensure that the design, construction and operation of septic tanks are according to the permission given. If this is not achieved, septic tanks are nothing more than point sources for groundwater pollution.

5.49 A short term program to reduce the incidence of methemoglobinemia among infants should concentrate on monitoring nitrate levels in the affected areas combined with public education and the provision of bottled water for families at risk. This is strictly a palliative approach, but it is necessary as an interim step because other measures to reduce levels of nitrates will take a considerable period to have an impact on exposure levels.

5.50 Once the population is being provided with better protection from existing problems, the focus of public policy should turn to reducing the flow of nitrates into groundwater,

Rural Water Supplies

The question of how best to provide rural households with access to safe drinking water gives rise to some difficult environmental choices in many parts of Central and Eastern Europe. As in many other countries, it is expensive to provide piped water to remote rural communities. Further, if piped water is installed the level of water consumption per person tends to rise dramatically, which can lead to substantial problems in dealing with the resulting wastewater. In many communities the provision of piped water has far outstripped the capacity of existing septic tanks with the result that the quality of groundwater supplies, especially from shallow wells, is deteriorating rapidly.

The solution is not to deny piped water to rural communities, provided that they are willing to bear an appropriate share of the investment and other costs involved. However, these costs must include provision for expenditures that will be required to collect and treat the resulting wastewater, so that water and sewerage are seen as joint rather than separate activities. Discounts could be given to those households who maintain adequate septic tanks whose outflows do not jeopardize neighboring wells.

For those households which cannot or choose not to be connected to piped water supplies, the crucial concern must be education about the importance of protecting their water supply -- usually from a shallow well -- from pollution caused by septic tank discharges. Intermittent monitoring of the quality of water from non-piped sources should also be carried out, so that measures to protect babies and other vulnerable individuals can be taken if required.

especially from intensive animal husbandry and rural housing. This need not involve substantial government expenditure on capital projects since much of the necessary finance should be found by the households and agricultural enterprises responsible for the offending discharges, but the nature of the problem means that a substantial commitment to demonstration projects, dissemination of good practice and the provision of advice will be required. Further, offering grants or loans on special terms may be required to speed up the necessary investments and changes in practice. Similarly, increases in fertilizer prices combined with agricultural extension focusing on how to get the greatest benefit from reduced fertilizer applications can have a substantial impact on nitrate run-off from intensive arable agriculture.

5.51 There is a broad range of rural communities which will need different facilities according to their population, area and location. At one extreme there are scattered individual households for which proper septic tanks is clearly the solution, while at the other end there are villages with 2,000-5,000 inhabitants that will require some kind of sewage collection network and a small scale treatment facility. In between, the appropriate solution will depend greatly on the concentration of the population and the physical characteristics of the land as the cost of installing a collection network for a community of 500-1,000 people can easily dominate the cost of treatment facilities. The size of each community is not the only issue, since small but closely spaced communities could be served by a single treatment plant with interconnected collection networks. Natural treatment systems, such as artificial wetlands, can be used as low cost alternatives to conventional treatment if an appropriate site is available.

5.52 The immediate priority for public investment should be to ensure that the manure from feedlots, dairy and pig farms, and poultry units is properly managed, so that highly concentrated effluent is not allowed to seep into the ground and is not discharged into neighboring streams or rivers. Quite apart from the contribution such activities make to levels of nitrates in groundwater, they can have a devastating impact on river quality and aquatic life if the untreated liquors from manure heaps are simply piped into nearby surface waters. The responsibility for financing improvements in the treatment and disposal of manure is similar to that for other environmental problems caused by small or medium sized industrial enterprises. Over the long run, enterprises should bear the full costs themselves, but governments may find it difficult to privatize agricultural enterprises with an uncosted commitment to invest in environmental improvements. This implies that assessments of likely costs plus initial improvements might be financed by loans made available now, subject to the conditions: (i) that such loans must be repaid when the enterprises are privatized, and (ii) that privatization is on the basis of making appropriate further investments to remedy any remaining problems. In some areas, where there are several enterprises in a particular locality, it may be sensible to invest in collective treatment and disposal arrangements with effluent being transported to the central facility. Projects which provide finance and technical assistance for such facilities may be excellent candidates for support from the donor community.

5.53 **Toxic, nuclear and other hazardous wastes (f).** The crucial point that must be made here is that financing the clean-up of sites where hazardous wastes have been dumped in the past is *not* a high priority in current circumstances -- except where there is clear evidence that groundwater is being, or is likely to be, contaminated. The overriding concern of governments and others must be to ensure that the disposal of wastes now and in the future is organized in a way such as to avoid large future costs of damage caused by leakages from waste disposal sites into ground or surface waters. This means that disposal sites must be properly constructed and inspected at regular intervals, that appropriate monitoring arrangements should be made to test for leakages, and that full documentation on the types of waste that are being handled must be maintained. As a second concern, governments will need to compile an inventory of sites where hazardous wastes have been dumped in the past and to initiate a program of monitoring what impact these sites have had or might in future have on the surrounding environment. These two elements need not be expensive in financial terms, but they involve a sustained commitment to providing the staff and other resources required to maintain the necessary capacity to monitor sites and to analyze the resulting data. Technical assistance and even finance to support the initial work involved in setting up such a program will probably be required from outside donors.

5.54 Wherever possible governments should also promote the development and adoption of low waste processes and practices which encourage the reuse of hazardous wastes and reduce the total volume of discharges as well as improved methods of waste management. Changing technology also raises the problem of the emergence of new forms of toxic waste. This may be a particular problem as industries modernize by producing new products or adopting novel Western technologies. Environmental authorities must ensure that they are equipped both to provide advice to enterprises on how to deal with these new wastes and to monitor their disposal.

5.55 With respect to nuclear waste there is a major problem in ensuring that the spent fuel from nuclear power stations is either properly stored or reprocessed. This responsibility fell on the Soviet Union in the past as the supplier of both nuclear power plants and of nuclear fuel. However, changes in the trade and other links between the CEE countries have lead to considerable uncertainty about the extent to which Russian enterprises will be willing and able to receive and deal with spent fuel. This is an issue that must be resolved if countries are to continue to rely heavily upon their nuclear power stations. Within Russia itself there are difficulties concerning the management of nuclear waste that will need to be addressed by the environmental authorities in cooperation with the Ministry of Atom Power and other bodies concerned with the nuclear industry.

Country-specific investments

5.56 **Municipal wastewater treatment plants (g and h).** In many countries of the region there are numerous partially completed municipal wastewater treatment plants. It is, therefore, tempting to conclude that the completion of such plants should have a high priority in the Action Program. While this may, indeed, be true for some such plants, there will be many that should not be completed, either because they were ill-conceived in the first place or because the resources could be better devoted to other objectives. The design of such plants was often predicated on assumptions about operating costs -- for example about the price of energy -- which are no longer valid, so that modifications in the proposed treatment method might be appropriate even where completion can be justified. Neither should it be assumed that the sums involved are small. The total cost of completing plants in Poland has been estimated at over $1 billion, though the situation is much better in the Czech Republic. The expenditures necessary to complete partially completed plants should be assessed on exactly the same basis as other elements of the Action Programme. Bygones are bygones, so the issue is what are the net benefits from spending additional resources in this manner rather than on, say, control of particulate emissions in highly polluted towns and cities.

5.57 The two categories of wastewater treatment plants identified in items (g) and (h) of the list of investment priorities are placed there because they are likely to generate the largest benefits from any investment in this sector. However, as the box illustrates the process of setting priorities is a complex one and the recommendations are intended as general guidance rather than specific precepts to be followed in all circumstances. The economic losses due to the pollution of beaches and of surface waters

Setting priorities for water investments

Water specialists have long been aware that the process of setting priorities for water investments is a very complicated one. Indeed, the techniques of cost-benefit and system planning were originally developed to address the problem in a systematic manner. The conclusions of the work carried out in preparing the Action Programme have been simplified in order to highlight the key lessons for those concerned with the allocation of funds over the next few years. Further, they apply to the CEE region as a whole rather than to each individual river, city or country.

In drawing up detailed expenditure plans, governments, region water basin authorities and others will have to take into account a variety of specific considerations. These should include :

- Public health, recreation, ecosystem stability, other water uses.
- Cost-effectiveness of different treatment technologies, and of upgrading or completing plants.
- Trade-offs over time between the benefits of treatment and the costs of treatment.
- Interactions between multiple pollutants, upstream and downstream sources, and different types of water use.

As an illustration of such interactions, the removal of BOD from a reasonably clean river may improve light conditions and trigger the growth of algae (if nutrient levels are high) which would eventually reduce the amenity values.

Nonetheless, it is essential that action should not be paralyzed by such complexities. Reasonable guidelines about priorities can be developed and they should be applied while more detailed planning work continues to refine the priorities and to improve the overall management of water systems.

in other tourist areas can be large[6]. Equally, the long term costs of careless disposal of wastewater in areas of high ecological value are substantial, especially relative to the comparatively small expenditures that are required to protect these areas.

5.58 Deterioration in the quality of water in sources from which drinking water is abstracted can, in many cases, be compensated by more stringent water treatment, but there may be a considerable economic cost involved. Where deterioration is associated with the presence of heavy metals or toxic organic compounds, the costs will be even higher since it will usually be necessary to seek out alternative water sources which may imply substantial additional investment or operating costs. Usually, such deterioration is a result of industrial activities, hence the emphasis on the protection of drinking water supplies in priority categories **(d)**, **(f)** and **(l)**. However, if lack of municipal wastewater treatment is the reason for a serious threat to the maintenance of drinking water supplies, then investment in an appropriate treatment plant should be regarded as having equal priority with investments in category **(d)**.

5.59 For other waters it is clear on amenity grounds that priority should be given to reducing emissions into river segments which are relatively clean rather than those into river segments which already bear a heavy load of pollution from industrial or municipal sources upstream. A major

6/ The local importance of the tourist and inshore fishing industries, together with the threat to groundwater sources used for drinking water from industrial discharges, are likely to justify high priority being given to municipal wastewater treatment in Istria, Croatia combined with measures to assure the pre-treatment of industrial discharges from the chemical, metalworking and food processing industries.

qualification to this general precept is that the bacteriological quality of urban waters may warrant action if children are frequently exposed to dirty river water.

5.60 While large investments in municipal wastewater treatment will undoubtedly be required over the next two decades, it should always be borne in mind that measures to reduce the volume of sewer discharges can have a substantial impact on the scale of the resources required. A variety of measures -- varying from dealing with leaks and dripping taps to the installation of low volume toilets -- can reduce household discharges by 30-50 percent. Publicity, technical advice and even the provision of free plumbing services reinforced by the incentives provided by the charging appropriately for water use and sewer discharges clearly fall into the category of "win-win" expenditures in this context.

5.61 A broad range of wastewater treatment technologies is available that can be designed reliably to meet specified rates of removal and emission standards. They include mechanical, chemical and biological processes as well as their combinations. Major pollutants considered are BOD, suspended solids (SS), total phosphorus (TP) and total nitrogen (TN). Comparing the unit costs of dealing with various pollutants it turns out that the marginal costs of removing nutrients (TP, TN) are very high relative to the average costs of removing BOD and SS for traditional treatment methods. This explains the large capital costs involved in constructing advanced treatment plants to meet EC guidelines for the removal of BOD, TP and TN -- see the Box on different types of wastewater treatment. The additional costs are even higher when existing facilities are upgraded.

5.62 The differences in capital and operating costs between wastewater treatment plants designed to achieve different levels of treatment are substantial. For a population of 100,000 the investment cost for mechanical treatment would typically amount to $10 million while chemical enhancement of existing mechanical treatment plants would add only an extra $2 million, yielding a significant improvement in BOD, SS and TP removal. Various levels of biological treatment would increase investment costs to between $15 million and $25 million. The amounts of different pollutants removed from the wastewater stream also differ. For instance, chemical enhancement significantly reduces the phosphorus content of the final discharge. Traditional biological treatment is more effective in reducing the BOD content while none of the above methods is really efficient in terms of nitrogen removal. It follows that there can be no single best technological option, since the choice depends upon the quality of the receiving waters both at the point of discharge and further downstream.

5.63 In the industrial countries plenty of experience is available on how to design, construct and operate treatment plants of various kinds. The starting point is always the existing legislation defining requirements in terms of standards -- effluent and, sometimes, ambient water quality standards, or their combination -- often attached to a given technology ("best available technology"). The development of standards well suited to conditions in a given country is a lengthy process -- perhaps taking decades -- based on actual pollution problems, the financial resources available, public choice and awareness, and other considerations. The CEE countries face this process now. They should recognize the time span required to develop their own standards and the economic implications. In particular, they should not mimic the West. Under present economic constraints, they must solve existing problems in a cost-effective manner and move towards West European standards over a period of 15-25 years as resources become available. This approach should be reflected in setting water quality goals as well as standards

Different types of wastewater treatment

Municipal wastewater treatment plants are designed to remove organic material (characterized by BOD), suspended solids (SS), phosphorus (P) and nitrogen (N) at required levels (depending on the type of receiving water, its desired quality and planned water uses). For this purpose, various physical, biological and chemical processes -- or a combination of these -- can be used. Examples are sedimentation, metabolizing organic compounds by bacteria, and precipitation.

- *Mechanical treatment* removes particulate matter primarily by sedimentation in a settling tank.
- The addition of chemicals (to the flow from the settling tank) for precipitation enhances sedimentation, leading to *Chemically-enhanced mechanical treatment* requiring practically no additional capital costs but still leading to significant upgrading (and good performance even in comparison to biological treatment -- see next).
- *"Traditional" biological treatment* incorporates an aeration basin after the settling tank in order to allow bacteria to oxidize a substantial fraction of the remaining organic wastes.
- *Biological-chemical treatment* enhances biological treatment by adding chemicals to the flow from the settling tank to improve primarily the efficiency of P removal by precipitation.
- Finally, *Advanced (biological-chemical) treatment* incorporates an anoxic basin (oxygen is absent, but nitrate is available) for denitrification, and also sometimes an anaerobic tank for biological P removal. Chemicals may be added for increasing efficiency and improving economy. This method is the most expensive of the treatment options in terms of capital costs and requires careful management by specially trained staff.
- *"Natural" (extensive) treatment systems* (including artificial wetlands and the root-zone method) can be low-cost alternatives depending on site-specific conditions. The area requirement is larger than for the technologies mentioned above, but operation is simple. BOD and SS removal is acceptable, while P and N removal is not yet properly understood. (The Kis-Balaton reservoir at the inflow of the Zala River to Lake Balaton in Hungary operates partially as an artificial wetland with positive experiences.)

The processes differ also in the composition, treatment and disposal of the sludge that they generate. The table below shows how the technologies differ in terms of their typical removal rates for BOD, Phosphorus, Nitrogen, and Suspended Solids, and the associated capital and operating costs.

Treatment Process	Typical Removal Rates (%) for: BOD	Total Phosphorus	Total Nitrogen	Suspended Solids
Mechanical (primary)	30	15	15	60
Chemically-enhanced mechanical	60	80-90	30	80
Traditional biological (secondary)	70-90	30	30	80-90
Biological-chemical (secondary)	90-95	90-95	35	90-95
Advanced	95-97	90-95	70-85	97

	Typical Costs (Mechanical Treatment = 1): Capital Costs	Annual OMR Costs a/	Total Annual Costs b/
Mechanical (primary)	1.0	1.0	1.0
Chemically-enhanced mechanical	1.1	1.6	1.3
Traditional biological (secondary)	1.5	1.7	1.6
Biological-chemical (secondary)	1.7	2.7	2.0
Advanced	2.4	3.0	2.6

a/ OMR = Operation, Maintenance, and Replacement (includes dewatering and anaerobic stabilization for sludge treatment).
b/ OMR plus amortization of capital costs @ 12% interest rate over 20 years of economic life.

Priorities and Alternative Technologies: Case Studies of Municipal Wastewater Treatment Options

Szeged (180,000 inhabitants) is located on the Tisza River close to the southern border of Hungary. 60% of the population is connected to public sewerage, but sewage is discharged into the river without treatment. Due to high dilution and self-purification, water quality is still acceptable. The current aim of the city is to construct a 100,000 m^3/d capacity advanced biological treatment plant with P and N removal (about US$60 million investment cost) requiring also the extension of the collection network (≈US$20 million). On the benefit side, small reductions in river load and improvements in both local and regional water quality (10-15% for BOD_5, 3-5% for inorganic N) would be achieved. Thus, no action would be the other extreme alternative. However, this appears equally unacceptable (discharge of raw sewerage, management of shared water resources, public attitude, etc.). *This suggests the need for a sequence of actions and their scheduling depending on the available budget.* Mechanical pre-treatment (screening and grit removal) would require little investment. Mechanical treatment of the presently collected wastewater (≈50,000 m^3/d) would require US$10-15 million (including sludge treatment). The extension of the collection network and doubling the mechanical capacity could be the next stage (US$30-35 million). Chemical enhancement would lead to significant additional load reductions while increasing primarily operation and maintenance costs. Transboundary considerations may, in the future, call for the addition of a biological unit of reduced size (due to the existing chemical step) with a denitrification unit but only after action to reduce coastal and downstream emissions which have a more direct impact on the Black Sea (see Chapter VI).

Nove Zamky. The usage of chemicals (in proper composition and dosage) can be extremely effective in upgrading existing mechanical and biological plants alike. Nove Zamky in Slovakia is just one of the highly overloaded plants in the CEE region (in spite of the decreasing water consumption). The use level is about 100% and thus action is needed regardless of the quality of the receiving downstream stretch of the Nitra River. The traditional enlargement of the existing biological plant would require about US$10 million, while retrofitting costs to the mechanical-chemical-biological process would be an order of magnitude smaller. Such an upgrading can cope with the high industrial sewage contribution and it is flexible so as to be adjusted to the likely further reduction in water consumption. Sludge management is not solved adequately at present; this would require an additional US$1-2 million for any alternatives. Most of the local river problems can be handled by BOD removal; N affects drinking water resources and seas. If the budget is strongly limited, N is the most problematic component since its removal requires 30-50% additional investments. Thus, there might need to be a trade-off between addressing local or regional problems in the short-to-medium term.

Warsaw. The corresponding incremental costs could exceed US$150 million for Warsaw. BOD removal would reduce the corresponding "concentration" from above 15 mg/l to below 10 mg/l. DO level is quite acceptable (≈6 mg/l) and the actual problem is the high algae biomass (several hundred mg/m^3 in chlorophyll-a). BOD removal alone would actually improve light conditions and enhance further algal growth. For this reason, P removal is unavoidable. A decision on N removal strongly depends on the portion of N load retained in the river prior to reaching the sea. 50% retention (as estimated by various studies) halves cost-efficiency (US$/kg N removed) and estimates are rather uncertain. Thus, on one hand, more detailed studies are needed. On the other hand, the lack of financial resources suggests a policy based on multi-stage technology development. First, only a feasible/realistic set of technologies would be constructed at various sites. This would be followed by monitoring. Further extension would depend on the outcome of the latter and budget availability.

The above examples show some of the savings. For Szeged, the *savings would be at least US$40 million.* Taking account of the interest rate on money saved during the time span considered, the above figure would be doubled at least. The examples also show that no general recipe can be offered. The approach must be adapted to site-specific cases within a river basin management framework. Type and level of development of existing facilities as well as tradition obviously play an important role when working out a strategy for a particular country. For instance, wastewater treatment is far better developed in the Czech Republic than anywhere else in CEE. All the plants are based on biological processes. The addition of a chemical precipitation stage in such plants can be a cost-effective of reducing water pollution, especially where phosphorus is a problem. However, whether the additional operating costs can be justified will depend heavily on river quality and other considerations. In the short run, the focus will be on sludge handling and the renovation of aged infrastructure which are serious problems throughout the entire region.

and the phasing of their implementation.[7]

5.64 The strategy suggested here is based on the multi-stage construction of wastewater treatment plants (in consonance with the gradual updating of standards). The first stage is aimed at the removal of organic matter and, in some cases, phosphorus where local conditions warrant it -- e.g. the need to protect lakes. Later, extensions (for removing P and N in varying degrees depending on local and regional needs, standards, etc.) can be added as resources become available, since the original design should already have allowed for these process modifications. This is an unusual procedure in Western Europe where plants are generally constructed in one stage as a result of more relaxed financial constraints. In contrast, the strategy implies that "many" wastewater treatment plants with medium removal efficiency should be built rather than a few advanced ones with high removal efficiency.

5.65 The same strategy applies also to the completion of unfinished treatment plants and the upgrading of existing ones. Chemical enhancement can be effective for upgrading both mechanical and overloaded biological treatment plants. Since it removes about one-half of BOD, the size and cost of any biological process can be significantly reduced (or the capacity increased). Innovative application of various chemicals in combination in low doses -- such as metal salts and synthetic polymers -- lead to a much smaller increase in the amount of sludge produced by comparison with traditional biological methods.

5.66 The results of work carried out in preparing the Action Program suggest that immediate priority should be given to ensuring that chemically-enhanced mechanical treatment is installed wherever expenditure on municipal wastewater treatment is warranted. This implies that for most of the incomplete plants the appropriate action will be to spend limited sums in order to enable them to provide mechanical or chemically-enhanced mechanical treatment as soon as possible, while deferring any plans for more elaborate treatment until these can be assessed in the context of an overall plan for water quality management in the relevant river basin (or coastal zone). Small amounts of money spent in this way can achieve significant improvements in water quality and amenity, while attempts to follow the original plans are likely to be frustrated by lack of resources and may generate little in the way of additional benefits in the form of better water quality and amenity.

5.67 The approach of updating standards gradually and relying upon multi-stage technology must be complemented by careful planning at a water basin or sub-basin level in order to maximize the impact of expenditures on water quality. The management of water quality in a river basin should be regarded as an exercise in system planning similar in character to the planning of a power system. Both are complex, highly-interrelated systems which need to be analyzed as a whole rather than treating each investment decision as it could be decided on the basis of limited local information. It is, therefore, inappropriate to impose uniform emission or technological standards on all municipal wastewater treatment plants within a river basin. A more flexible approach will be required in order to achieve long run improvements in the water quality of rivers in Central and Eastern Europe at a cost that can be afforded by the countries concerned.

7/ It is worth noting that in OECD countries as a whole, 40% of the population (330 million people) are not served by wastewater treatment plants.

Wastewater investments which meet both domestic and transboundary objectives

The Baltic Sea program sets out an extensive list of wastewater treatment projects to be implemented gradually over the next two decades. Applying the criteria developed for the Action Programme to these projects suggests that a number of them should have high priority because they will generate substantial local or national benefits in terms of the environmental objectives outlined here. At the same time they will make a significant contribution to mitigating the problems of transboundary pollution in the Baltic Sea. These projects include :

- Poland — Treatment plants at Gdansk, Gdynia and Szczecin with the inclusion of denitrification capacity in order to reduce discharges of nutrients which encourage algal blooms that are jeopardizing valuable coastal ecosystems and tourist revenues.
- Lithuania — The completion of the partially constructed treatment plant at Klaipeda plus support for pre-treatment of industrial wastewater discharged to municipal sewers. This investment together with actions to improve nature conservation and coastal management affecting the nearby Kursiu lagoon will protect an important recreational area as well as ecosystems.
- Latvia — Rehabilitation and extension of the Liepaja wastewater system, again with provision for pretreatment of industrial wastewater in order to protect recreational facilities.
- Estonia — Improvements at the Haapsalu wastewater treatment plant to protect the ecological valuable resources of Haapsalu Bay which has unique curative mud and of Matsalu Bay, a protected area important for migratory birds.
- Russia — Investments in the wastewater treatment plants at Kaliningrad and St Petersburg. The former currently has a treatment efficiency that is close to zero that the investment will contribute substantially to improving the quality of nearby coastal waters and to the protection of the Kursiu lagoon. The overloaded treatment plants in St Petersburg are responsible for 40 percent of BOD and 50 percent of phosphorus from all point source discharges to the Gulf of Finland. The project would concentrate initially on collection and primary treatment of untreated discharges and on pre-treatment of industrial wastewater that accounts for nearly 90 percent of heavy metal discharges to the Gulf of Finland, especially copper and chromium.

In all of these cases it will be important to phase the expenditures over a considerable period in order to obtain the maximum benefit both domestically and in the Baltic from the resources available. Primary treatment with chemical enhancement will often be the best approach in the short term. Then, as more resources become available plants can be extended to incorporate various degrees of biological treatment or denitrification.

5.68 This has important implications for the types of institutions required to implement projects in this sector. Many Central and Eastern European countries have expressed an intent to establish river basin management authorities; in some countries, these have existed for some time but need to be strengthened. It is desirable that large scale investments should await the establishment of well-functioning river basin authorities which can make sound decisions regarding the most effective investments to water distribution and in improving water quality. Such authorities should ensure -- in collaboration with municipalities -- that the necessary recurrent costs can be met, *inter alia*, out of user fees and pollution charges. Where the development of these institutions is delayed, then any proposal for substantial investments in the water sector should, at the very least, be evaluated by consultants with a brief to examine the regional or river basin implications of the proposal. Further, cooperation between municipalities in addressing their problems should be encouraged wherever possible.

5.69 **Biodiversity conservation priorities (i).** Since the major polluted areas are relatively well-defined and do not evenly cover all of Central and Eastern Europe, it is possible to prevent deterioration in those areas that are relatively untouched -- *at a cost that is but a very small fraction of the costs of the investments required to address the main pollution problems.* This is true especially for some of the remaining large, contiguous unspoiled areas (such as the Mazurian Lakes in northeast Poland and parts of the Taiga in Russia), and for the remaining wetlands which, according to recent studies, are the most vulnerable ecosystems in the CEE region. As part of conservation measures for such sites, investments should ensure above all that tourism and other facilities in pristine areas meet rigorous standards for waste water treatment. Revenues from tourism and other recreation activities could provide funds for investment and maintenance expenses in protected areas.

5.70 Where protected areas are located in polluted zones (e.g., in Poland, 6 out of 18 national parks are located in regions of "ecological disaster" or "ecological hazard"), conservation of living natural resources requires, in the first instance, the same kinds of measures as are called for to address the impact of environmental degradation on human health. In some cases, and only if no other possibilities are available, *ex situ* conservation of species through special measures (e.g., creation of gene banks) may be called for[8]. With regard to protected areas, the basic premise is that investments should focus on establishing and funding integrated management plans for *existing* designated areas. Standard procedures for environmental impact assessment should be used to ensure that new activities do not affect the conservation values of these areas adversely.

5.71 In Western Europe, biodiversity conservation is concentrated on 10% of the land area which cannot easily be isolated from the encroachment of nutrients and pollutants from intensive agriculture on the remainder of the land area. Hence, even if all existing protected areas (in Western or Eastern Europe) were managed in exemplary fashion, conservation could not be assured. There is thus a need to go well beyond improving management of protected areas alone; to prevent irreversible loss of species and habitats or the costs associated with rehabilitation and loss of natural processes requires awareness and actions outside protected areas, in sectors such as agriculture, tourism, or industry. In other words, conservation should be embedded in all economic activity.

5.72 CEE countries, in collaboration with the Council of Europe and IUCN, have proposed five site-based projects in areas of outstanding biodiversity as examples of an integrated approach serving both conservation and development objectives (see box). Another 22 projects from the region have been proposed. A complete picture of the areas that are or should be protected will not emerge until completion of the CORINE extension to CEE countries (end 1993), the work in CEE for the State of the Environment Report, and completion of the IUCN ecosystem surveys.

5.73 *Green Lungs of Europe Proposal.* In March 1992, Environment Ministers of Belarus, Lithuania, Latvia, Poland, Russia, and Ukraine established a working group to prepare a proposal for a

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8/ A project financed by the Global Environment Facility (GEF) is underway in Poland to provide institutional support for biodiversity conservation management activities and a forest gene bank to conserve tree species found in the old-growth Bialowieza National Park.

Biodiversity conservation -- short-term investment examples

The following sites have been selected on the basis of their regional importance for biological diversity and vulnerability to immediate threats which would result in irreversible damage and decreases in natural resource productivity. Further, the approach proposed demonstrates the twin advantages of: (i) conservation of the biological and landscape (including cultural) diversity and, (ii) income-earning activities for the local populations. A mix of integrated activities are required including direct short-term and medium-term investment, technical assistance for policy and institutional support, and training. Negotiations between foreign donors and a range of national and local government departments should be able to fashion appropriate financing packages. The projects offer an unparalleled opportunity to put into practice and test the calls from UNCED for sustainable development and to apply the principle of cost effective prevention of degradation in Eastern and Central Europe rather than expensive "cure" as is the case in western Europe.

Albania: Karavastas Lagoon/Dijvake Pine Zone. This area is located on the coast 100 km south of Tirana. It has world importance biologically by virtue of a nesting colony of Dalmatian Pelican and is said to have several endemic plant species, including orchids, but a detailed survey is required to confirm this. The occasional occurrence of the Mediterranean Monk Seal and White-Tailed Eagle, both threatened on a regional scale, have been reported. The site is threatened by inappropriate tourism, agriculture and hunting and is extremely vulnerable in that there is no effective legal protection or management plan, and the economic plight of the local population encourages short-term exploitation above the carrying capacity of the natural systems.

Bulgaria: Strandja Mountain and Adjacent Coastline. The overriding natural value of the area lies in its natural forests covering more than 81,000 ha. Eastern Europe contains areas of what are now unique forests in Europe because of total disappearance in western Europe. There are 15 endemic species and Strandja is the only place in Europe where the wild Medlar tree is found. All five of the reptile species at the site are in the International Red Data Book. Regeneration of natural forest in the place of plantations depends in part on grazing yet there is serious decline in the size of the human population (1.09% a year between 1975 and 1985). The area also has forty historically interesting houses and churches which have been identified for restoration. The region is suffering from encroachment of ecologically damaging tourism along the coast (sand dunes have already been destroyed and marshes polluted), inappropriate forestry methods, new land-ownership arrangements in the absence of land use guidelines and management plans, and water pollution from pig farms. The depressed economic situation renders the area extremely vulnerable to unsustainable exploitation of the natural resources.

Croatia: Lonjsko Polje Nature Park, Middle Sava Valley. The park covers one of the largest semi-inundated areas left in Europe (50,560 ha). Its regional importance is particularly clear in threatened breeding or migratory bird populations (e.g. spoonbill, white stork) but also in its otter population and waterplant communities. There are four important, interdependent habitat types: alluvial forests; open regularly flooded grassland; traditional farmed landscapes and fishponds. The threats include drainage and transformation of wetlands into arable land; over-intensive use of forests; air and water pollution from nearby industrial plant and intensification of agriculture; alterations in the hydrology through construction of dikes; proposed dam construction and transport routes. Maintenance of the landscape and biological diversity depends on solving the economic reasons for migration from the region as well as adjustments in agricultural, industrial and transport policy.

Romania: Retezat National Park and Buffer Zone. Of the species identified on the site, 5.2% are endemics and one plant (*Draba dorner*) covers just 400 sq.m. of the earth! The scientific reserve within the site is considered to be the European genetic centre for certain grasses and spurges. Twelve fish, 32 bird and 22 mammal species are found in the park. Threats include the impacts of energy production (a 2 million cu. cm lake and associated HEP plant which will eventually generate 348 MW are already nearing completion), unspecified types of tourism development in the absence of an overall management plan, and overgrazing. The presence of former state farms in the vicinity of the park (now partially abandoned) offers the possibility of providing a model of ecological reconstruction that could be replicated elsewhere.

The Russian Federation: Losiny Ostror (Elk Island) National Park, Moscow. The park is unique in Europe and possibly the world, as the only natural complex of such size (13,000 ha) partially within the boundaries of a major capital city with, above all, a population of beavers. Forty-five species of mammal are present including elk; rare birds visit on migration. The park is the only virgin natural area surviving around Moscow and contains one of only several virgin forests outside Zapovedniki in central Russia. Threats include increases in traffic using the roads across and around the park; air, soil and water pollution; pressure from unregulated visitor numbers and illegal encroachment with built structures. A successful project to manage this natural "island" will not only save severely threatened habitats and species but will also serve as a valuable demonstration for other similar projects on the borders of urban areas.

Green Lungs of Europe program aiming to protect regions in those countries richest in biodiversity[9]. The program has its roots in the concept of the Green Lungs of Poland -- the north-eastern part of the country that remains largely unharmed from industrial pollution. The Green Lungs of Europe proposal foresees the development of sustainable practices in all productive sectors.

5.74 *Natural Resource and Forest Management.* Some temperate forests are as rich in species as tropical forests although the diversity is not in the tree species themselves but in the organisms which inhabit or depend upon them. Russia contains 42 percent of the world's temperate forests. A recent WWF study has found that the most serious threat to temperate forests is logging. Economic pressures and lack of capacity to enforce legislation is enabling timber exploitation to proceed in protected areas, especially in Russia.

5.75 There is a risk of partitioning large natural forest units through privatization and/or logging concessions which may in time pose management and conservation problems. Natural forests are a store of considerable biological diversity in the region. Technical and financial support for sustainable use and protection should be directed through national Biodiversity Conservation Strategies.

5.76 The shift to market structures will require a fundamental change in the ways in which natural resources, especially forests, are utilized. This is a matter of great concern in Russia because of the threat to the Taiga from uncontrolled logging, but similar considerations apply in other countries and to the exploitation of mineral and fishery resources. External resources and technical assistance is required to enable governments to redirect the activities of Departments of Forestry and Natural Resources and to retrain their staff as well as to introduce new legislative and regulatory regimes governing the use of these resources. In the case of forestry this will involve the introduction of stumpage fees plus a combination of incentives and regulations to ensure that privatized forestry and logging operations manage their resources in a sustainable manner and that an appropriate share of the resource rents accrues to the government. The experience of other sub-Arctic countries would be especially useful as a basis for providing the necessary technical assistance.

5.77 In some areas it may be possible to generate the resources required to enhance the management of national parks and protected areas from the user fees and tourism taxes that can be earned by encouraging ecologically-sensitive tourist development. Care must be taken to ensure that such revenues do not just disappear into the general budget of either national or local government and that a reasonable share of the revenues is reinvested to protect the natural, ecological and other characteristics that provide the basis for tourist development.

Enterprise Investments

5.78 As explained in para. 5.3, **investments to reduce water salinity (j), to provide industrial wastewater treatment facilities (k), and install equipment to reduce leakages of toxic pollutants (l)** are all cases in which enterprises should normally either be required to invest their own resources in order to reduce emissions or they would eventually be closed down. The first step is to ensure that appropriate economic incentives or regulatory mechanisms are established, since until that is done the enterprises will have no reason to control their emissions. This should also make it possible to determine whether the

9/ Estonia joined the working group in February 1993.

enterprises concerned are likely to be economically viable after they have met the costs of making necessary environmental improvements. Thereafter, the question is primarily one of how best to finance the necessary investments in the short run, while retaining the principle that the long run cost of whatever environmental controls are required must be borne by the enterprises themselves.

Environmental investments in the paper and pulp sector

The composition of pulping processes installed in CEE countries is broadly comparable with that for West European plants, though few plants are designed to use recycled paper. Thermo-mechanical pulp making has been adopted more rapidly in Western Europe while the much lower demand for packaging materials in the CEE region has favoured the use of simple chemical or mechanical processes rather than combined semi-chemical processes.

The environmental problems of CEE pulp mills seem to be particularly associated with the control of wastewater treatment plants and the treatment of condensate liquors from chemical pulping. Primitive controls -- for managing the pulping process as well as treating wastewater -- combined with very limited adoption of water recycling means that CEE plants tend to be much more wasteful of energy and water than their Western equivalents. There are other techniques which could be adopted by CEE plants such as steam stripping of condensates and black liquors in Kraft and sulfite plants which can pay for themselves by reducing energy costs while also lessening the burden on wastewater treatment facilities. The costs of such measures varies greatly from plant to plant but an investment of $2-3 million for a plant producing 50,000 tonnes per year should permit major improvements in both efficiency and environmental performance.

Chlorine-based bleaching is believed to be a significant source of pollution from many CEE kraft mills since they have not been subject to the increasingly stringent emission standards applied to most Western plants with respect to emissions of chlorinated and halogenated organic compounds (known as AOX and including such compounds as pentachlorophenol and dioxin). AOX emissions cannot be eliminated but they can be largely removed from wastewater and disposed of safely in solid form. Further, a variety of options are available to minimize the amount of AOX produced -- this can run to 1-1.5 kg per tonne of pulp with chlorine bleaching of kraft pulp. Pre-bleaching technologies such as improved pulp washing, exclusion of condensate liquors from wash waters, extended cooking in the digestion stage, oxygen addition to reduce the lignin content of pulp, and better process control rely more on process modifications rather than end-of-pipe controls with potentially large investment requirements.

The case study of the Sloka pulp plant in Latvia, which primarily produces chemical pulp using a sulfite process, showed that the plant's major environmental problem concerned emissions of various organic compounds such as lignosulfonates and phenols. The plant would benefit from better process controls, though their main benefit would be economic since they would reduce energy and material inputs and improve output quality. Separate treatment of condensate liquors would involve an investment of $2-2.5 million, but the cost could partly be recovered by burning the methane and distillate produced. The lignosulfonate problem arises because the wastewater treatment plant cannot degrade this material efficiently, so that it would be better to remove and reprocess it in solid form. Both the cost and the economics of any investment in such reprocessing are highly uncertain.

Chemical pulp plants can be highly unpleasant neighbours because of the malodorous nature of their gaseous emissions even though the gases emitted are generally not hazardous to health. An investment of $0.5-1 million can reduce emissions of hydrogen sulfide, other sulfur compounds and aromatic VOCs to air by 80 percent or more.

Environmental investments in the chemicals sector

The chemicals and petrochemicals industry in Central and Eastern Europe has a very dispersed age profile of plants including many of an age and type that would probably have been shut down some time ago in the market economies. For example, PVC plants based on an acetylene route are unlikely to be able to compete directly against ethylene-based processes now standard in the West. Older plants were often designed with limited pollution controls or before the dangers associated with certain chemicals were fully appreciated – e.g. the carcinogenic monomer VCM produced in PVC plants. Finally, the state of maintenance of older plants is often poor, so that simple "good housekeeping" measures can do much to reduce spills and leaks that are the source of substantial emissions – e.g. refinery emissions of VOCs from leaks in heat exchangers into cooling waters, or large styrene losses from driers. The investment cost of achieving these improvements in maintenance and operating practices is typically small – less than $5 million even for large plants.

Inorganic chemicals. Chlor alkali plants relying upon mercury cells account for 10-15 percent of total emissions of mercury in the CEE countries. Emissions can be almost eliminated by switching to membrane cells, but this is a relatively expensive option – though a case study of PO Kaustik in Russia revealed a plant in Volgograd which had the necessary equipment but lacked the funds to install it. A combination of minor equipment modifications to recover lost mercury, better operating practices and possible conversion from graphite to titanium anodes would permit substantial reductions in emissions (of the order of 80-90 percent) at a cost of about $6 million per plant or about $200 million for all plants in the region. Among the large emitters which should receive priority in the allocation of such funds are : Devnia in Bulgaria; Oswiecim in Poland; Dzerzhinsk, Volgograd, Berezniki and Sterlitamak in Russia; and Lysichansk in Ukraine.

Borsod Chem in Hungary was another plant studied. This used to emit substantial quantities of mercury to both air and water but air filters and better water treatment combined with water recycling have largely eliminated these emissions, though there is still a need to ensure safe disposal of sludges and other solid wastes containing mercury. Past practices have left a legacy of contaminated land, especially below the electrolysis unit. Mercury has largely been washed out of the river sediment in the section of the Sajo river downstream of the plant and there seems to be no serious problem of groundwater contamination. Some investment may be warranted to prevent further intrusion of mercury from the electrolysis unit into the ground underneath, but measures to deal with existing soil contamination should be deferred until more is known about the extent and nature of seepage from the site into ground or surface waters.

Synthetic soda ash plants using the Solvay process generate a large volume of saline water effluent which is difficult to deal with. Most inland CEE plants discharge their effluent – typically 1,000-2,000 tonnes per day containing up to 15 percent of chlorides -- into nearby rivers. This can cause serious damage to physical and other assets due to water salinity. Solutions rely upon use of settling lagoons, extraction of lime solids plus the return of concentrated brine to spent brine cavities assuming that solution mining is the source of the brine feedstock. Lagoons must be carefully constructed and managed to avoid contamination of nearby soils and groundwater. The total cost of such measures would amount to $8-12 million for a plant producing 500,000 tonnes of soda ash per year. A modest part of this cost can be recovered from the sale of lime from lime beds. Plants where some or all of these investments have high priority include Govora in Romania, Bashkiria in Russia, Lysichansk in Ukraine.

Air emissions of hydrogen fluoride from the processing of phosphate rock are the major problem associated with the production of phosphoric acid for fertilizers. Most CEE plants have relatively low efficiency absorbers which could be replaced by high efficiency Venturi scrubbers at a typical cost of $0.5-1 million. Plants where such an investment may be justified include : Gomel in Belarus; Kedainiai in Lithuania; Gdansk in Poland; and Balakovo, Cherepovets, Krasnodar and Voskresensk (Moscow) in Russia.

(contd)

Environmental investments in the chemical sector (contd)

Organic chemicals. The main environmental problems are to be found in plants producing ethylene intermediates including PVC. There are a number of acetylene-based PVC plants in the CEE region which are both uneconomic and produce substantial dust emissions; they should be closed down as quickly as possible. For ethylene-based plants concern focuses on emissions of vinyl chloride monomer (VCM) and of other chlorinated organic compounds. VCM is a carcinogen which is primarily a threat to plant workers but may pose a threat to those living near to PVC plants. Emissions depend partly on plant design, on the collection and treatment of vent gases, the extent of fugitive emissions, and on the method of dealing with slurry from the recovery vessel. The most cost-effective way of reducing VCM emissions include: (a) the minimization of losses in the VCM recovery system; (b) carbon adsorption of VCM from vent gases; and (c) steam stripping of VCM from slurry. The total investment cost of these measures would amount to $10-12 million for a plant producing 75,000 tonnes per year of PVC. A further $3-6 million would be required to install a proper high-temperature incinerator to deal with chlorinated organic residues. Plants where such an investment may be justified include : Devnia in Bulgaria; Usti nad Labem in the Czech Republic; Wloclawek in Poland; Tula in Russia; Novaky in Slovakia; and Lysichansk and Severo-Donetsk in Ukraine.

The case studies indicated that investment in an incinerator to dispose of chlorinated effluents would be a very high priority at PO Kaustik in Volgograd. An appropriate unit could serve the whole Volga basin whose ecosystem is increasingly severely threatened by water discharges containing a variety of chlorinated hydrocarbons. Other changes in operating practices including the separate treatment of water effluents from different sources within the plant and a steam stripper for the PVC unit would also reduce emissions of chlorinated organics.

The Chimcomplex and Carom plants near Onesti, Romania share a wastewater treatment plant that is overloaded and is suffering from substantial corrosion. There are plans to upgrade this plant -- at a cost of $10-15 million – but an expenditure of $1-2 million on centrifuges and presses could reduce the volume of suspended solids and BOD in water sent for treatment. A further expenditure of up to $5 million on process controls, better maintenance and simple upgrading should result in substantial reductions in both air and water pollution together with lower operating costs.

Refining and petrochemicals. One important type of emissions from refineries and petrochemical plants is of miscellaneous VOCs to air and hydrocarbons in water effluent. Some aromatic organic compounds, notably benzene, may be a severe threat to the health of plant workers in certain CEE plants and there are concerns about general levels of benzene exposure in a number of Russian cities. A combination of improved seals on equipment plus floating roof covers on storage tanks offers something close to a "win-win" solution to the most serious leakages of VOCs. Costs depend greatly on the design and capacity of the plant concerned but $0.5-1 million should be sufficient for a typical plant producing benzene, toluene or xylene while up to $10 million might be required for a refinery processing 10 million tonnes of oil per year. Reductions in product losses should certainly be sufficient to repay the cost of the latter investment within a short period. For Plock in Poland the total cost of such investments might amount to $15 million covering both the refinery and the petrochemical plant.

Water discharges from refineries may be contaminated with oily wastes while wastewater treatment plants tend to accumulate sludge with containing a mixture of heavy oil and other chemicals. Quite large investments -- of the order of $20-40 million -- are required to deal with these emissions but the oil recovered can either be burnt or converted to other products that can be sold to recover much of the cost. Good housekeeping practices, especially the separation of effluent streams, can reduce the volume of such wastes and the associated losses of products. The case study of the Burgas refinery in Bulgaria showed that an expenditure of $5-6 million on improving the plant's separators, its sewer system and its wastewater treatment plant could substantially reduce water emissions to the Bay of Burgas and thus to the Black Sea.

5.79 None of the cases under (j) and (k) involves serious and ongoing damage to human health, though the economic losses caused by saline water are large. If the resources required to address the immediate priorities discussed in the previous section exhaust the government's own resources for specifically environmental investments, then enterprises will have to find alternative sources of finance. Of course, since the government still owns most of the industrial sector, it could decide to redirect some part of general investment spending towards the relevant enterprises or it could provide some kind of loan guarantee to help the enterprises to raise the necessary funds. Finally, the government could decide to put such enterprises at the top of the list of firms to be privatized or sold to foreign investors, with, of course, a clear obligation to achieve the necessary reduction in emissions.

5.80 For chemical plants -- category (l) -- there are real but unquantified hazards to health. Plant employees are at greatest risk, but emissions of mercury, VCM (vinyl chloride monomer), and BTX (benzene, toluene and xylene) can pose a significant threat to the health of people living close to chemical plants. The exposure of workers should be covered under the normal provisions of health and safety at work legislation, while action under environmental legislation is required to deal with off-site exposure. In all cases the implementation of 'good housekeeping' procedures will greatly reduce emissions, which tend to originate from leaks and spills that are allowed to persist. Such procedures will, usually, pay for themselves many times over by reducing losses of raw materials or products and by lowering the costs of standard operations. However, where significant investments are required then they should be financed in the manner described in the previous paragraph.

Measures to address longer term environmental problems

5.81 **Traffic (m), (n) and natural resource management related concerns (o)** are either cases where the maxim that prevention is much cheaper than cure applies or where it is necessary first to develop a proper understanding of the environmental processes involved before making any substantial commitment of resources. The amounts of public expenditure involved will be small, but is critical that the policies or research should be carefully focused in order to achieve the best return on the effort and expenditure involved. Technical assistance, training and research support are the obvious areas where external donors can support these measures.

5.82 There are numerous policy options available for the control of emissions from transport sources which can be grouped in three broad categories:

(a) *Transport demand management* aimed at reducing or limiting the growth of vehicle traffic. These include measures such as parking fees and prohibitions, fuel taxes, vehicle emission taxes, urban tolls, area/corridor licensing, and land-use planning to reduce the volume of traffic from residential to commercial areas. Measures aimed at commercial vehicles include night-time deliveries, and user charges.

(b) *Traffic management* aimed at improving traffic circulation. This includes measures such as parking enforcement, car-free zones, computerized traffic signals, and traffic routing.

(c) *Emissions standards* aimed at limiting emissions per vehicle-km. These include end-of-pipe technology, fuel-efficiency standards, and fuel quality standards. For vehicle emissions standards to be effective, countries must have in place inspection and maintenance programs.

5.83 Each city in CEE has different problems involving vehicle pollution. Pollution abatement strategies should be based on detailed city-specific emissions inventories and air quality monitoring programs. Much more research on the cost-effectiveness of various policy options is also needed. However, even in the absence of detailed information, it is possible to suggest some priorities:

- Since high blood-lead levels have been recorded in several cities in CEE, and since the benefits of reducing lead emissions almost certainly outweigh the costs, reducing lead emissions from transport sources should be a priority. Cost-effective measures may include: (i) taxing fuels differentially according to lead content, and (ii) reformulating the leaded grade of motor fuel. Vehicles using a leaded grade of gasoline would not be using catalytic converters, and will thus have much higher emissions than the (mostly catalyst-equipped) vehicles using unleaded gasoline.

- Since the vehicle stock in CEE is, on average, old (in Hungary, 42% of passenger cars are over 10 years old, and 62% are over 7 years old), poorly maintained, and includes a high proportion of cars with highly polluting two-stroke engines (in Hungary, two-stroke engines comprise nearly one-third of the vehicle fleet), cost-effective strategies may involve targeting these vehicles. Possible measures may include an ownership tax which rises as the vehicle ages and an ownership tax on vehicles with two-stroke engines. Alternatively, governments may offer subsidies for vehicle scrappage or incentives (such as tax breaks) for the acquisition and use of "clean" cars; the latter approach has been practiced in a number of Western European countries as a transition measure before making control technology (such as catalytic converters) mandatory. Now that new EC and UN/ECE regulations will require strict emission controls from 1994, CEE countries may wish to adopt these standards for new motor vehicles and concentrate on selecting the most efficient methods on reducing emissions from large and medium-sized stationary sources.

- Because of their intensive use, the amount of pollution emitted by buses, trucks, and taxis is very high in relation to their proportion in the vehicle fleet. Therefore focusing on high-use vehicles may be a cost-effective approach for many urban areas. A recent study of comparing mobile source emission control options for Budapest concluded that the least expensive way to reduce mobile source pollution is to replace standard diesel bus engines with "clean" engines (which are also more fuel efficient than standard engines). Another study showed that retrofitting high-use vehicles such as trucks to operate on "clean" fuels such as liquid petroleum gas or compressed natural gas may be cost-effective for some cities. Finally, it may be cost-effective to target taxis for emission controls.

- There is concern to discourage a large shift of freight transport from rail to road. In part this can be achieved by ensuring that trucks bear the full cost of the environmental and congestion externalities that they cause in the form of heavy licence fees and fuel taxes. One additional measure is to encourage and fund the development of rail container-handling facilities, since it is the cost of transferring freight from road to rail or vice-versa which has discouraged the combination of long distance rail freight with local road distribution in Western Europe. Of course, in large countries with long average hauls such as Russia rail will continue play a major role in freight transport so long as its efficiency is improved and emphasis is given to the timely delivery of valuable and time-sensitive cargoes.

5.84 Measures to strengthen public transport, including subsidies, are often proposed in West European cities as a way of reducing environmental damage caused by urban traffic. However, the situation of public transport in Central and Eastern Europe is quite different from that in Western Europe. Most cities have very extensive public transport networks, though some require substantial rehabilitation. Their main problem is one of finance which is a consequence of continued reliance upon government subsidies when public expenditure is under extreme pressure. It is important that automobiles and trucks should bear the full cost of the environmental damage that they cause as well as the infrastructure they require. Fuel taxes, vehicle license fees, parking charges and even road user charges for vehicles operating in congested city centers are all possible elements of a package designed to internalize the costs associated with vehicle use. At the same time another step (which has already been tried in some CEE countries) is to raise fares substantially in order to finance the modernization of bus fleets -- diesel buses are a major source of traffic pollution -- and to enhance the quality of service offered -- since this is the decisive factor in persuading people to continue using public transport. If such a package is implemented, the case for additional public spending on public transport is weak, since the experience of the rich countries suggests that such expenditures have only a marginal effect in shifting passengers and freight from private vehicles to public transport.

VI. TRANSBOUNDARY ISSUES: REGIONAL AND GLOBAL CONCERNS

The central element of a strategy to address region or global problems of air and water pollution must be to build, as far as possible, on the overlap between the local and the transboundary impacts of measures to reduce emissions. Market reforms and target policies or investments to meet domestic environmental goals will lead to large reductions in emissions of regional and global air pollutants. If further reductions are required in the CEE countries to meet regional or global concerns, then donors may wish to consider bilateral or multilateral funding to cover the net incremental cost of meeting stricter emission targets. Such arrangements would be particularly appropriate where the marginal costs of reducing emission vary widely across countries.

Maximizing the joint domestic and transboundary benefit of improving water quality implies that resources should primarily be directed to the reduction of emissions from coastal or estuarial sources. This will contribute to the preservation of coastal ecosystems as well as reducing the nutrient flows which are the main source of transboundary damage.

6.1 All environmental problems have a local origin, but their impacts may occur over a much broader area. The solutions to these problems likewise will have implications locally, across boundaries and globally. An example is fossil fuel emissions: emissions originate at one point and must be controlled there. Impacts can be local (e.g. can contaminate the of soils and air immediately surrounding the source of the emissions); transboundary (e.g. the emissions can be transported over long distances and descend as acid precipitation) and global (e.g. emissions contribute to the cumulative build up of greenhouse gases over the globe).

6.2 Action to control the broader effects of local problems have been taken principally through regional and global agreements. In this Action Programme, the focus will be on measures which address, as far as possible, both the domestic and transboundary damage caused by emissions in order to minimize the net costs of complying with international agreements.

Regional Concerns: Air Pollution

6.3 Transboundary air pollution in Central and Eastern Europe is dominated by the problem of acid rain, which is linked to emissions of sulfur dioxide and nitrogen oxides from power stations, large industrial plants, small scale and household burning of coal and other fuels, and motor vehicles. The box on the next page describes some of the scientific aspects of the environmental damage caused by acid emissions both within and between countries. The CEE countries are important contributors to total transboundary flows of acid pollutants -- **Maps 5 and 6** illustrate the distribution of acid emissions in the area of the Central European Initiative (CEI). They are also large recipients of acid depositions from other countries, so that, for example, almost 50 percent of Poland's acid depositions originate from outside Poland. Thus, environmental policies to address the problems caused by acid rain must take account of the interdependence between countries and of the joint efforts by European countries to reduce emissions.

6.4 Public attention has tended to focus on the transboundary dimension of sulfur and nitrogen oxide emissions, the local -- i.e. within-country -- damage caused by these emissions (either on their own or in combination with particulates) is at least as important as the transboundary damage. Any program to reduce sulfur and NO_x emissions must, therefore, build upon the joint benefits of improving local environmental conditions as well as mitigating the damage caused by long distance transport of acid pollutants.

6.5 Studies of the transport of acid pollutants show that an average of only 10-25 percent of sulfur and NO_x emissions stay within the 150 km grid square from which they originate. Of course, dispersion means that the average concentration of these gases and the associated aerosols is much higher in the locality of the source. Under particular circumstances of topography and weather, emissions of sulfur dioxide or NO_x can be temporarily trapped in smog close to the ground and cause dramatic increases in respiratory morbidity or mortality, especially among children, the elderly and those already suffering from respiratory or heart disease. Such smog emergencies can cover wide areas over several countries and are greatly exacerbated by the presence of high concentrations of particulates, can be alleviated by rapid measures to cut emissions by requiring power plants and other large sources either to close down temporarily or to switch fuels. This illustrates the importance of implementing a range of policy measures which address both peak levels of exposure to acid pollutants or their by-products as well as average or total emissions.

6.6 The crucial issues concern (a) the extent to which policies should be designed to achieve emission reductions which go beyond those that can be justified on the basis of their local or national benefits alone and (b) how these additional measures should be financed. Answers to both questions depend upon the nature of the cost curve for reducing total emissions and the marginal benefits of improving local ambient conditions. The larger are the marginal local benefits relative to the costs, the less will be the investment and other costs of meeting specific targets for reducing transboundary flows. In effect, the question of dealing with transboundary pollution becomes one of identifying those reductions that are desirable for domestic reasons such as improving the health of their own populations and ecosystems, and how these compare with the reductions required to realize the collective benefits of reducing transboundary flows.

6.7 **Minimizing the cost of reducing emissions.** Most West European countries have relied upon command-and-control (CAC) mechanisms for controlling emissions of sulfur dioxide and NO_x from large sources[1]. These have a predictable impact but can be expensive because they allow less scope for exploiting low cost methods of control. It is also more difficult to apply CAC policies to small sources

1/ The European Community's Large Combustion Plant (LCP) directive sets stringent targets for reducing emissions of SO_2 and NO_x from large sources. The policies for implementing the directive vary across countries but effectively all new and many existing large plants (> 300 MW) will be required to install flue gas desulfurization or in-furnace sulfur controls plus low NO_x burners and selective catalytic reduction if they are to continue operating into the next century.

The environmental damage caused by acid emissions

Sulfur dioxide is an irritant which, in high concentrations, can cause acute respiratory conditions. In conjunction with high levels of exposure to particulates it is implicated in the excess mortality observed during severe smogs and it worsens the morbidity associated with chronic respiratory problems. Exposure to high levels of nitrogen dioxide can also worsen the health of those with pre-existing respiratory problems, but it is the role of NOx as an agent in the generation of photochemical smog and ozone (another respiratory irritant that aggravates the condition of people with asthma and heart disease) which is the main cause for local health damage associated with NOx emissions.

High levels of sulfur dioxide and NOx emissions can cause substantial material damage to buildings and other structures because of relatively high concentrations of acid and of sulfur particles in rainfall. Much concern has been expressed about damage to cultural artifacts and especially historic buildings in cities such as Krakow and Prague. It is, however, difficult to disentangle this damage from that caused by poor maintenance and mistaken attempts at restoration in the past. While there is uncertainty about the magnitude of local material damage caused by acid emissions, there is no doubt that they give rise to amenity costs because of reductions in visibility. The presence of sulphate and nitrate particles plus acid aerosols, as a result of either direct emissions or their secondary formation in the atmosphere, leads to light scattering. Further, gaseous nitrogen dioxide absorbs light at the high end of the spectrum, which gives the atmosphere a reddish-brown tinge. The result is a haze which may extend over a large region such as Upper Silesia and Northern Bohemia or Eastern Ukraine. Alternatively, topographical features may concentrate the haze over a city as is the case in Sofia and Zagreb.

Depositions of sulfur and nitrogen or 'acid rain' is primarily associated with the long distance transport of acid aerosols which are formed in the atmosphere and contain a mixture of dilute hydrochloric, nitric and sulfuric acids plus ammonium sulfate and nitrate. Rainfall gives rise to wet deposition which rapidly infiltrates soils, groundwater, rivers and lakes. Both dry and wet depositions may cause direct damage to trees and other vegetation by affecting their plant chemistry and pathology. Acidification of soils leads to a leaching of plant nutrients combined with the mobilization of aluminum that would otherwise be bound up in rocks and mineral particles. An excessive level of aluminum damages roots, reduces the capacity of plants to take up necessary trace elements such as calcium and magnesium, and interferes with water transport within trees which increases sensitivity to drought. Acidification of rivers and lakes can result in drastic changes in their ecosystems including the complete loss of fish stocks.

The dose-response relationships between acidic emissions and damage to forests, crops and lakes are complex and still poorly understood. Rainwater has not become significantly more acid (lower pH) in Central Europe over the last 50 years but the area covered by highly acid rainfall has increased greatly. Evidence from Germany and other West European countries suggests that forest loss may be linked to the long term effects of acid depositions but that a variety of other (often site-specific) stress factors are also involved. This is consistent with the findings of the US NAPAP studies that marginal changes in emissions or depositions may have little impact on most kinds of forest and other ecosystem damage in the US.

The nature of the damage to ecosystems caused by acid rain means that it is necessary to distinguish between 'stock' and 'flow' aspects of the problem. Long term acidification of soils is a 'stock' problem which cannot be quickly reversed by reducing the level of current depositions, though applications of lime and nutrients and changes in silvicultural practices may mitigate its consequences. At the same time it is possible to define 'critical loads' which represent the maximum 'flow' of acid depositions that can be absorbed by specific soil types without provoking a tendency to acidification. These critical loads define a measure of long run sustainability which can be used in setting the ultimate goals of environmental policy. However, in setting priorities for short term actions, countries must also consider how far immediate measures to reduce acid emissions will affect the amount of damage that will occur over the next few years.

The implication is that short term priorities should focus on the local, health-related, damage caused by acid emissions while longer term concerns about damage to ecosystems should define the framework for a trend reduction in emissions from those sources and regions which contribute most to exceedances of critical loads in areas which have suffered significant damage in the past. It follows that any measures to alleviate the local damage caused by sulfur dioxide and other emissions should be consistent with achieving a declining trend in emissions, which would not, for example, be the case with a policy of dispersing emission sources.

which contribute an increasing share of acid emissions as controls are applied to large sources. An alternative approach would be to reinforce existing systems of pollution charges so that emitters have a substantial incentive to reduce emissions without being required to adopt specific control technologies. This will only work if the framework for monitoring and enforcing charges is implemented. Emissions of sulfur dioxide from large or medium sources can be estimated and monitored with reasonable accuracy without imposing excessive costs on the emitters. Small scale sources and motor vehicles present more of a problem, but with data on the sulfur content of fuels it is possible to impose pollution charges in the form of specific fuel taxes. Thus, emissions of NO_x from large sources and of sulfur may be considered as potential candidates for the application of market-based instruments either in the form of direct pollution charges or indirect charges in the form of fuel taxes.[2]

6.8 The cost advantages of relying upon market-based instruments such as charges or tradeable permits arise from differences in the control options and their costs between different sources. The impact of sulfur emissions on neighboring populations and other considerations may prompt environmental authorities to require that all large sources reduce their emissions by some minimum amount. However, it is important that such minimum targets should not limit the scope for differential reductions too much. Minimum targets which are close to aggregate targets would eliminate many of the gains that can be achieved by encouraging those with low control costs to reduce their emissions by more than those with high control costs. This is particularly important when the major concern is with the transboundary consequences of emissions, since it is the total levels of emissions from a locality or a country that are of concern rather than their distribution across sources. Attempts to operate a combination of CAC and market-based policies within a country may thus jeopardize the cost advantages of market-based policies and lead to a lower overall level of control than could have been achieved for the same cost.

6.9 Even if a country does not intend to rely upon market-based instruments to reduce emissions of sulfur, the idea of pollution charges provides the basis for ranking alternative measures to meet a given target. As described, the cost curve for a particular country is constructed by considering what measures would be implemented if a tax of, say, US$100 or US$200 per ton of sulfur emitted were imposed either directly or indirectly. The information provided by this analysis tells us where capital-intensive controls such as desulfurization of oil or of flue gases appear in the cost curve. Such estimates are essential to any attempt to assess the extent to which CEE countries may require assistance in order to conform with the new targets now being negotiated under the Geneva Convention on Long-range Transboundary Air Pollution. (**Annex 8** lists the status of ratifications by different countries for this protocol and others under the Convention.)

6.10 **The options for controlling total sulfur emissions.** The alternatives for reducing sulfur emissions from a *single source* may be quite limited. The use of low sulfur coal or oil, switching from coal to oil or gas, the installation of in-furnace controls or of FGD, or the partial or complete closure of the source are likely to be the principal alternatives. However, if the reduction applies to the total emissions from *two or more sources*, attention must turn to the relative costs of reducing emissions from

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2/ The U.S. has introduced a system of tradeable permits for large and medium sources in the Clean Air Act Amendments of 1990. In principle, this system could be extended to small scale sources by requiring that fuel suppliers must acquire permits to cover the estimated emissions of small scale consumers of gasoline, heating oil or coal. Emissions trading in the U.S. is gradually beginning to be a well-accepted process in the power sector and is expected to result in substantial resource savings and additional industrial growth.

each source in order to determine how a given total reduction is to be distributed across the separate sources. The minimum cost solution will be found by equalizing the incremental cost of additional reductions in emissions from each source. The calculations may be implemented most easily by mimicking the ways in which sources would respond to the imposition of different levels of pollution charges on sulfur emissions. This would have to take account of possible adjustments in the number of operating hours for plants within the power sector. It would clearly not be efficient to commit large sums to installing expensive controls at a high-emission plant if an equivalent reduction in emissions could be achieved by operating the plant for less hours per year and replacing its output by production from a low-emission plant, albeit one with higher operating costs.

6.11 Constructing an optimization model to compute the most cost-effective methods of achieving some target reduction sulfur emissions from a variety of emission sources is a fairly complex exercise with close links to least-cost power planning models. However, it is not necessary to attempt to address the problem in great detail. The great merit of relying upon market-based instruments is that they allow decisions to be decentralized in a manner that encourages enterprises to find low cost solutions which may not be apparent to regulators. It follows that models are likely to overestimate the marginal cost of reducing emissions and the level of the emission charge necessary to meet a particular target.

Low cost measures to reduce sulfur dioxide pollution

- Use low sulfur coal or fuel oil
- Switch from burning coal to fuel oil, or from both to gas
- Temporarily close down large industrial plants -- e.g. iron & steel mills, large petrochemical plants, pulp mills -- when there are temperature inversions or sulfur dioxide levels are very high
- Reduce the number of operating hours per year of power plants burning sulfurous fuels by placing them lower in the ranking that governs how plants are brought on-stream as the total demand for electricity increases.

6.12 A study of the costs of controlling sulfur emissions for the United Kingdom[3] illustrates the implications of this approach. The savings permitted by adopting a single target for total UK emissions or targets for separate regions within the country instead of imposing uniform technological standards or emission targets on all individual emitters are potentially large. For example, if a single target for Great Britain were established and plants were allowed to trade sulfur emission permits, the cost of achieving the level of emissions implied by applying the Large Combustion Plant (LCP) directive to each individual plant would be 15-20% lower than the cost of strict compliance with the LCP directive on a plant by plant basis.

6.13 It is only cost-effective to install flue gas desulfurization (FGD) on coal-fired power stations which will be used to meet base load demand. For both cost and operational reasons it is more economic to invest in combined cycle gas turbine plants to expand capacity or to replace old plant, so that the least cost solution involves the installation of FGD only for the largest existing coal-fired units (rather than all such plants) while small and medium-sized units would either be decommissioned or moved much lower

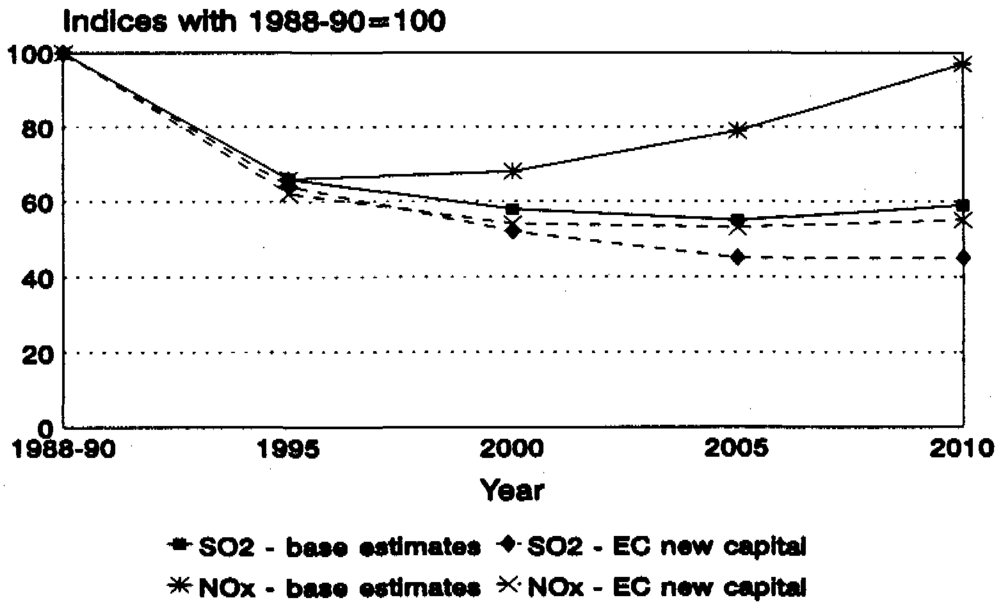
3/ London Economics, *The Potential Role of Market Mechanisms in the Control of Acid Rain*. Environmental Economic Research Series (Department of the Environment, London, HMSO: 1992).

in ranking which governs how plants are used at different levels of demand. The analysis shows, also, that spatial differentials in the actual or implicit pollution charges for sulfur emissions may be appropriate and significant when the geographical pattern of damage caused by emissions from different sources is taken into account. Such spatial variation must be built into the design of any policy for meeting aggregate emission targets.

6.14 Once estimates of the costs of reducing emissions have been constructed, attention must turn to the question of how far up the country's cost curve each government wishes to go. Thus, a blanket decision either to require FGD for all new and upgraded power plants or to avoid FGD as far as possible will not be appropriate. In particular, countries like the Czech Republic and Poland are likely to find that the decision about investing in FGD in order to meet their emission targets under the UNECE convention will depend critically on the speed with which emissions of sulfur from small scale sources - - households, the service sector and small industry -- can be reduced by substituting either low sulfur smokeless fuel or gas for coal.

Figure 14

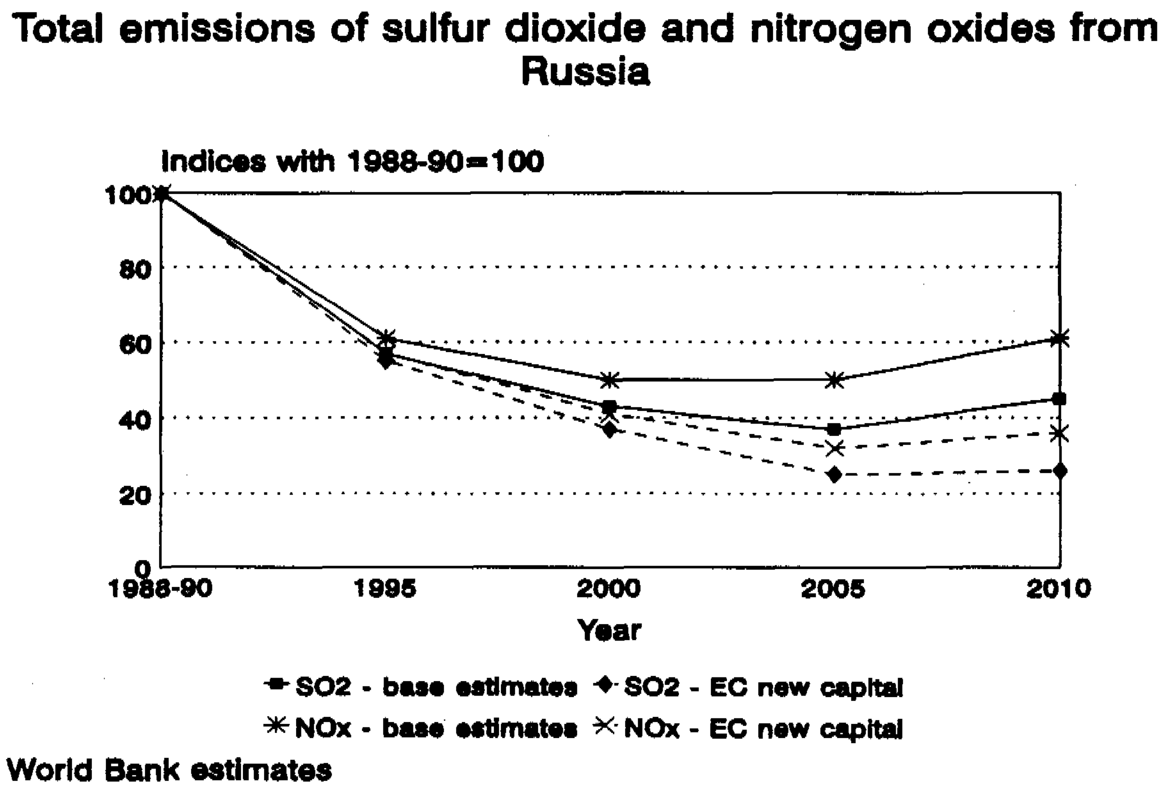
Total emissions of sulfur dioxide and nitrogen oxides from Central and South-Eastern Europe



World Bank estimates

6.15 **Combining local and transboundary concerns.** It is crucial to start from the observation that, for the most part, there is no conflict between measures that reduce local, national and transboundary damage. As the scenario analysis demonstrates, the pursuit of appropriate economic and industrial policies will lead to a substantial fall in emissions of sulfur dioxide and of NO_x for most countries in the region up to the end of the century. This point is reinforced by **Figures 14-16** which

Figure 15

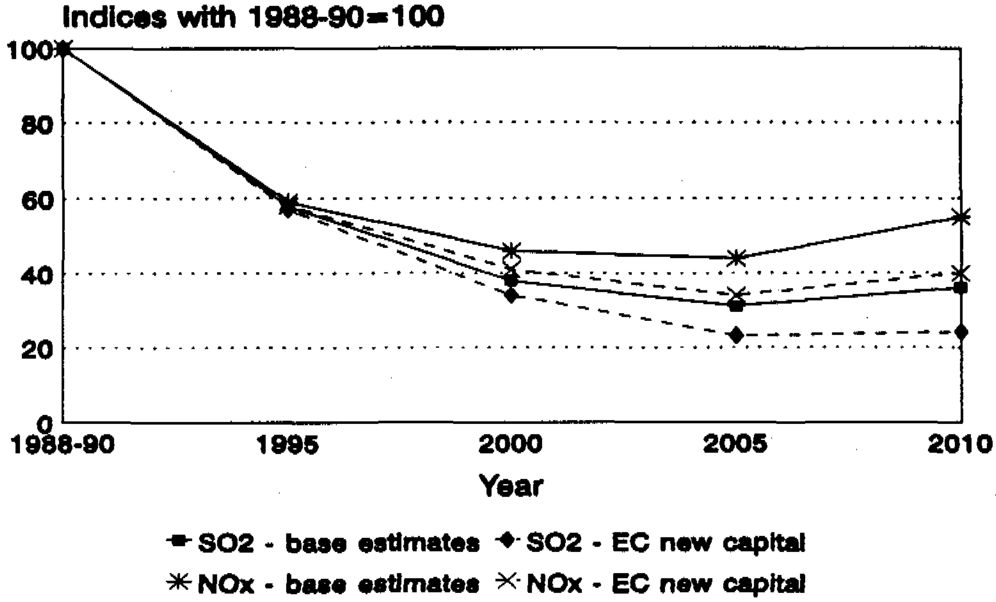


show total emissions of these pollutants for Central and South-Eastern Europe, Russia and other European countries of the former Soviet Union. Under a combination of economic reform and minimal environmental regulations, emissions of sulfur dioxide could fall by 40-60 percent over the next decade. Stricter but affordable environmental policies (equivalent to requiring that all new capital meets current EC emission standards) could ensure that emissions of sulfur dioxide are at least halved by 2005. For NO_x the decline in emissions in the base scenario is rather less, especially for Central and South-Eastern Europe, because of the growth of emissions from vehicles. Even so, the imposition of EC standards on new capital and vehicles alone should result in a reduction of almost 50 percent.

6.16 These results show that it is possible to ensure that total emissions of acid pollutants from the countries of Central and Eastern Europe follow a declining trend towards meeting long term goals based on criteria of sustainability such as critical loads without imposing excessive costs. **Map 7** shows that under the scenario in which EC standards are achieved by 2010 for all new plant the exceedances of critical loads for acidity would be concentrated in the most sensitive areas of Central Europe. To reduce exceedances further will be much more expensive and will still leave substantial exceedances in Central Europe -- see **Map 8** for the distribution when EC standards are assumed for all plant by 2010. It may, therefore, be appropriate to focus the additional measures and expenditures on hot spots rather than attempting to agree on relatively uniform targets for reducing acid emissions. These targets are currently being discussed in the UN-ECE negotiations leading up to the proposed Second Sulphur Protocol. The nature and phasing of these targets must, of course, also reflect the short and medium term priorities of each country, for which a clear understanding of the national as well as the transboundary

Figure 16

Total emissions of sulfur dioxide and nitrogen oxides from other countries of the former Soviet Union



World Bank estimates

benefits of emission reductions is essential[4].

6.17 It is in the interest of any country to reduce emissions of sulfur or NO_x wherever the benefits to its population exceed the costs involved. These local/national benefits include (a) better health, (b) reduced damage to threatened ecosystems such as forests and lakes, (c) less damage to buildings and other structures, and (d) improved visibility. Thus, a range of low cost measures to reduce acid emissions can be justified on purely local and/or domestic grounds without taking any account of transboundary considerations. Provided that ambient standards have been set to reflect a reasonable balance between the costs and benefits of improving air quality, such measures should ensure that these ambient standards are met in most parts of each country.

6.18 A future international agreement aimed at reducing transboundary environmental damage may, for a particular country, entail abatement measures whose cost cannot be justified on purely local and/or national grounds, including the benefits of the reductions made by other parties to the agreement as well as the wider economic and political benefits of international cooperation. The Stockholm Declaration, in the spirit of the Polluter Pays Principle, states that countries in this situation should bear

4/ Information on the local and transboundary dispersion of pollutants is only now becoming available, especially at a subgrid scale. The next step is to investigate how various control measures affect the geographical pattern of depositions. In this way it would be possible to link data on human and other exposure to pollutants with information on long range transport to assist the development of international abatement strategies.

the costs of reducing emissions to avoid causing significant damage to the environment in other countries. Nonetheless, for hard-pressed countries in Central and Eastern Europe the costs of undertaking an accelerated program of emission reductions to meet such international obligations may involve an unacceptable diversion of resources from domestic environmental or other objectives. Some countries might, therefore, decide not to participate in the agreement or might find themselves unable to afford to make the emission reductions which they had committed themselves to.

6.19 Provided that the total benefits across all countries of the emission reductions proposed exceed the costs involved, there should be ample scope for establishing transitional arrangements under which those who benefit most from reductions in transboundary flows agree to assist individual CEE countries to meet larger or accelerated targets for emission reductions. Such private agreements between two or more countries would leave all parties better off if the transfers cover the net incremental costs of reducing emissions after allowing for the domestic benefits to health, productivity and ecosystems. Countries which provide such assistance will not agree to open-ended commitments, so that any such arrangements could only operate over a strictly limited period. Thereafter, recipients would be expected to meet the final targets without help, so that the agreements would not affect the long term commitment to the Polluter Pays Principle.

6.20 Specific agreements between two or more countries can also provide a mechanism for cutting the costs of meeting overall emission reduction targets for a group of countries and would thus allow them to set stricter targets. Typically, the marginal costs of abatement will vary greatly between countries. It follows that a country which faces a high marginal cost of abatement could benefit everyone by offering to finance abatement in another country which faces a much lower marginal cost of abatement, provided that the substitution has a similar effect in mitigating environmental damage. Such "trades" need not be on a one-for-one basis, though difficulties in monitoring compliance with international agreements may arise if the target reductions are specified in terms of a weighted sum of emissions rather than a simple aggregate level[5]. Despite these potential complications countries in both Western and Eastern Europe could gain by allowing greater flexibility in the implementation of international agreements to reduce emissions. The box provides illustrative examples of mechanisms that would permit this flexibility.

6.21 **Conclusions.** The key messages are as follows:

(a) Countries in Central and Eastern Europe are important contributors to transboundary flows of air pollutants as well as recipients of acid depositions from such flows. They share a common interest with other European countries in reducing emissions which cause both local (i.e. within-country) and transboundary damage.

(b) Sensible economic policies, reinforced by fuel-switching to control emissions of particulates from small sources, will make a major contribution to reducing emissions of sulfur and NO_x.

5/ In the case of greenhouse gases discussed below it might be sensible to set an overall target for reducing GHG emissions in which methane was given a much larger weight than carbon dioxide. A similar mechanism could be applied to acid pollutants to reflect the much greater damage caused by emissions that are deposited in areas with very low critical loads for acid depositions.

Mechanisms to share the burden of reducing transboundary pollution

The transboundary benefits of reducing air pollution can be "internalized" in various ways :

A. *Direct deals.* Countries which expect to benefit from a reduction in emissions may offer to finance part of the cost of installing controls or adopting other measures to reduce emissions. So long as there are only a small number of origin and destination countries involved, negotiations of this kind can lead to an efficient outcome. The main difficulty is that transboundary flows from a single source country (or, even, from a single large emitter) will typically cause damage in several countries. Some beneficiaries may, then, be tempted to "free-ride" by offering less than the full value of their benefits from a reduction in emissions in the hope that other beneficiaries will contribute a larger share of the cost of reducing emissions. Strategic behaviour of this kind will result in less than the efficient level of emission reductions being achieved.

B. *Compensatory premia.* The idea of pollution charges can be extended to introduce a system of premia for countries which reduce their emissions below agreed base levels. Beneficiaries could contribute to a fund which would be used to pay each source country a premium (per tonne of sulfur or NO_x) reflecting the transboundary benefits of incremental reductions in its emissions which should be built into the comparisons of the costs and benefits of alternative domestic measures and would shift the balance towards more stringent reductions. This approach avoids many of the difficulties of multilateral negotiation when there are several beneficiary and source countries, but strategic behaviour by beneficiaries may still result in a lower level of compensation and reductions than would be efficient.

C. *Tradeable permits.* These are discussed -- in the domestic context -- in Chapter 3. Each country would be allocated permits corresponding the basic level of emission targets. Countries wishing to see larger reductions in permits could buy but not use permits from the source countries whose emissions most affect them. This mechanism is more transparent than direct negotiations and should lead to a more efficient result, but, as for all permit trading schemes, the non-uniform impact of emission reductions in different locations causes problems. Where one country's emissions affect several countries, it will be necessary to put together a coalition of beneficiaries to buy permits, which will lead to the difficulties outlined in A above. The great advantage of tradeable permits is that they can provide the basis for reducing total emissions from a group of countries at minimum cost without requiring the monetary payments associated with compensatory premia. Thus, a permit scheme would be more appropriate for global pollutants like carbon dioxide whose origin is unimportant than for regional pollutants like sulfur dioxide whose origin is critical to the marginal damage caused by emissions.

Certain problems are common to all of these schemes and, indeed, to any international agreement to reduce emissions of acid pollutants. Monitoring total emissions is difficult and estimates of total emissions are quite uncertain. It is difficult to devise enforceable penalties for countries which fail to honor undertakings to reduce emissions, though most will wish to do so for reasons of their credibility in future negotiations about environmental or other matters. Payments under any mechanism may be staged or linked to the implementation of specific investments in emission controls, but these cannot avoid the problem that the extent of emission reductions may depend upon the maintenance and operation of the control equipment.

International negotiations over emission targets are what economists call a "repeated game" since they occur at more or less regular intervals. Some people have, therefore, suggested that any mechanism involving compensation for reducing emissions will provide an incentive encouraging some source countries to increase their emissions. This argument is mistaken so long as it is possible to monitor levels of emissions, which is an essential pre-condition for any such agreement. Assuming that there are domestic benefits from reducing emissions, any compensation offered will be less than the marginal cost of controls, so that strategic behavior of this kind would leave the country worse off. In any case, countries are rightly concerned about their reputation which is a critical aspect of any repeated game, since the penalties for being thought of as an unreliable partner can be high. The short term gains from such strategic behavior will, therefore, be greatly outweighed by the prospective costs.

(c) There will often be substantial local benefits from reducing emissions of sulfur, particularly in regions where ambient exposure to sulfur dioxide is high -- for example, Northern Bohemia, Upper Silesia and the areas near to large lignite-fired power stations in Poland, Bulgaria, Hungary and other countries. Appropriate measures to control sulfur emissions in such locations are in the national interest without any regard to transboundary concerns. The transboundary benefits of such measures reinforce the case for taking these actions.

(d) Minimizing the net cost of meeting international agreements, after allowing for the contribution of such reductions to national environmental objectives, is in the interest of both individual countries and of Europe as a whole. By lowering the net cost of reducing transboundary flows, countries could afford to act earlier or to adopt more stringent reduction targets.

(e) The cost curves that have been obtained for controlling emissions of acid pollutants have the characteristic that substantial reductions can be achieved at relatively low cost by a combination of fuel switching (both to low sulfur fuels and to gas) and changing the utilization of installed equipment. Beyond a certain point, which will vary from country to country, further reductions in emissions will typically involve a large increase in the marginal costs of control.

(f) Emissions of sulfur and NO_x from large stationary sources are prime candidates for the application of economic instruments -- either pollution charges or tradeable permits. An appropriate system of pollution charges can easily be developed within the framework of current legislation in most Central and East European countries.

(g) Mobile and small scale emissions of sulfur can be covered by imposing differential charges on fuels. In due course, it will be necessary to require that new vehicles should be fitted with catalytic converters in order to avoid a rapid increase in NO_x emissions as well as traffic-related urban pollution. Over the next decade, however, it is likely to be more cost effective to concentrate on reducing sulfur and NO_x emissions from large sources as indicated by the Polish study reported in Chapter III.

(h) New international agreements are under discussion which are likely to commit countries in Central and Eastern Europe to make substantial reductions in acid emissions. These agreements may be facilitated by arrangements between two or more countries which provide a financial incentive to promote the acceleration of reductions having a transboundary impact. Such arrangements would mean that specific targets could be met earlier than might otherwise be possible.

Regional Concerns: Water Pollution

6.22 The protection and management of freshwater resources is an issue that must primarily be addressed at a domestic level. However, it has an important regional dimension where river or lake basins are shared. There are a number of international agreements that regulate access to and use of these shared resources. The most relevant is the 1992 ECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes. Coastal areas and inland seas are also important foci for regional concerns. In these cases attention must be directed to the establishment of regional mechanisms for the management of the discharges into the seas. Several general international conventions are particularly important in this context:

- the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention), as amended;
- the 1973/1978 International Convention for the Prevention of Pollution from Ships (MARPOL), with its annexes;
- the 1974 Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area, as revised in 1992;
- the 1976 Barcelona Convention for the Protection of the Mediterranean Sea against Pollution, with its related protocols;
- the 1990 International Convention on Oil Pollution Preparedness, Response and Cooperation;
- the 1992 Bucharest Convention on the Protection of the Black Sea against Pollution, with its related protocols.

6.23 Developing programs to address transboundary water pollution raises many of the issues concerning the appropriate balance between local and transboundary concerns that have been discussed for the case of transboundary air pollution. There are some specific problems arising from the relationship between neighboring riparian countries for international rivers. In particular, it is important that upstream countries should ensure that the water quality of rivers that leave their territory should be no different from the quality of similar rivers in other parts of the country where no borders are involved. One simple rule of thumb would be to set a target that the quality of water that leaves the country is no worse than the quality of water in rivers that enter the country. The strict application of this goal may not be feasible or, indeed, sensible where major cities or industrial centers are located just upstream of a border. Nonetheless, it embodies the fundamental principle of international law that upstream riparians should not cause appreciable harm to downstream riparians.

6.24 Most of the international concern about transboundary water pollution has focused on the long term threat to enclosed seas such as the Baltic, the Black Sea and the Mediterranean. These problems are primarily associated with flows of nutrients and the danger of eutrophication. There are

The Baltic Sea Programme

In April 1992 a Convention on the Protection of the Marine Environment of the Baltic Sea was signed in Helsinki. At the same time Ministers from 12 countries in the Baltic Sea basin adopted a strategy for addressing the environmental problems of the Baltic Sea outlined in the Baltic Sea Joint Comprehensive Environmental Action Programme. In preparing the Programme detailed studies of wetlands, agricultural run-off and atmospheric deposition of pollutants were carried out as well as pre-feasibility studies in 8 former centrally-planned economies (including the Eastern states of Germany).

Implementation of the Programme is estimated to cost at least 18 billion ecu over 20 years (at 1992 prices). Measures to reduce emissions from 98 hot spots in Central and Eastern Europe -- covering both point and non-point sources -- will cost at least 8.5 billion ecu. Among these hot spots, 47 have been identified as priorities with an estimated budget of 6.5 billion ecu being required to cover the cost of investments and other measures required to deal with their emissions.

A task force to finalize the Programme, co-ordinate and monitor Programme implementation, and to update the Programme periodically has been established. Efforts are being made to ensure that feasibility studies are carried out as rapidly as possible for the measures required at the priority hot spots. On March 24-25th 1993 a conference was held in Gdansk to mobilize resources to fund the initial stage of the Programme with the participation of bilateral donors and multilateral financial institutions.

also significant issues of coastal zone management because of the impact of untreated sewage discharges from coastal towns and cities in the Baltic and the Black Sea. The latter is more easily tackled because there are substantial local benefits from reducing such emissions and the costs involved need not be large.

6.25 Chapter V identified investments to prevent irreversible damage to sensitive coastal ecosystems and to protect economically valuable coastal industries -- especially tourism and fishing -- as falling in the list of short term priorities for action. Such measures, which are important for purely local reasons, will also make a significant contribution to reducing BOD and nutrient loads in the Baltic and Black Seas. Thus, transboundary considerations reinforce an already strong case for giving priority to such investments over other forms of wastewater treatment.

6.26 Taking account of transboundary as well as local concerns may justify the installation of treatment technologies in coastal centers which remove more nitrogen and, perhaps, phosphorus than those which would be appropriate on the basis of local considerations alone. International assistance for the additional investment resources required to remove these nutrients would then be an appropriate form of support for those countries in Central and Eastern Europe which border on international seas threatened by transboundary pollution (see the Box on the Baltic Sea program).

6.27 There is considerable uncertainty about the extent of the *transmission to the sea* of BOD and nutrients from upstream cities, industries and agricultural run-off. While major rivers such as the Danube, the Dnieper, the Don, the Dvina, the Oder and the Vistula carry large loads of these pollutants into the Black Sea and the Baltic, it is difficult to establish what proportion of the total load originates from sources more than 100-200 km upstream. During the initial stages of programs to address these problems it will generally be advisable to concentrate the limited resources for dealing with transboundary pollution on downstream sources. As better information on both the principal sources and the transmission of pollutants becomes available, it will be possible to develop a more comprehensive framework for emission reductions in international river basins which will maximize the domestic and transboundary benefits of control expenditures. This implies that over the next 3-5 years countries should follow a two-pronged strategy of focusing domestic resources on improving upstream water quality -- see Chapter V -- while external resources are directed towards downstream sources which have the most direct impact on the sea concerned (see the Box on investments which meet both domestic and transboundary concerns in Chapter V).

6.28 In conjunction with these measures it is important to develop the mechanisms which would establish the information and a framework of cooperation needed to take stronger action in future if justified. This would cover:

- an assessment of water pollution affecting shared water resources as a basis for determining the most cost-effective control measures which could be implemented;
- the development of systems to collect and exchange information about trends in water quality and emissions[6];
- the coordination across countries of water policies and regulations affecting shared water basins -- including, if appropriate, a joint water basin management agency responsible for implementing cooperative programs.

6.29 **Wetland management.** Policies concerning the management of water resources and quality have a major impact on inland and coastal wetlands, which are internationally important because of their role as habitats for migratory birds. These issues are addressed by the 1971 Ramsar Convention on Wetlands of International Importance, to which most Central and East European countries are now Parties. The Danube and Volga deltas, Lake Balaton and Lonsjko Pole are among the most important sites in the region. The immediate threat are from general encroachment and disturbance due to an expansion of agriculture or of settlement which lead to the drainage of wetlands. The longer term and more insidious threat arises from emissions of heavy metals and toxic chemicals which are concentrated up the food chain and can represent a potent threat to bird and fish species at the top of the food chain. Serious population declines due to this process have been reported for various species in the Danube and Volga deltas, though it is difficult to disentangle the relative contributions of over-exploitation and of environmental factors in these cases. Even so, these concerns reinforce the importance of dealing with emissions of toxic materials from chemical plants and other sources along these rivers and their tributaries as outlined in Chapter V.

6.30 Among the actions which can be undertaken immediately to support longer term programs for the integrated management of wetlands are:

- support for current measures to protect the Danube and Volga deltas;

6/ For example, Bulgaria and Greece are considering the possibility of establishing a system which would monitor discharges into rivers that flow from the Balkan and Rhodope Mountains into the Mediterranean, including the Maritsa and Struma Rivers which are among the most polluted in Bulgaria.

- complete inventories of wetlands and assess the status of resources which they offer and the potential threats to their future health;

- ensure that wetland management is integrated into the broad framework of policies for water management and nature conservation with due account being taken of the scope for multiple use management.

Global Issues

6.31 **Phaseout of Ozone Depleting Substances.** The stratospheric ozone layer shields people, plants and animals from sun's harmful ultraviolet (UV) rays, and is a factor in determining the earth's climate. There is a consensus in the scientific community that the protective ozone layer is being depleted by man's use of certain chemical agents, particularly chlorofluorocarbons (CFC) and halons. These chemical compounds are used in aerosol propellants, hard and soft foams, refrigeration and air conditioning, industrial solvents, coatings and adhesives, and in materials for fire extinguishing. A reduction in total stratospheric ozone is expected to increase ultraviolet-B radiation at ground levels with adverse consequences for human health and the earth's ecosystems.

What are the effects of ozone depletion ?

The main known effects of increased ultraviolet radiation resulting from ozone depletion are:

Human Health

- An increase in non-melanoma skin cancer. A 10% decrease in ozone is expected to result in a 26% rise in skin-cancer cases or an increase of more than 300,000 cases per year.

- An increase in cases of cataracts. A 10% decrease in ozone may lead to a 7% rise in cases of cataracts, or 1.7 million cases per year.

- An increase in the incidence or severity of infectious diseases due to suppression of human immunological systems.

Aquatic Ecosystems

- A reduction in the numbers of phytoplankton. Given that marine phytoplankton produces as much biomass as terrestrial ecosystems, any loss in phytoplankton may reverberate throughout the food chain. In addition, since marine phytoplankton is a major sink for atmospheric carbon dioxide, any reduction in their numbers which reduces its capacity to fix carbon will have implications for global warming.

Terrestrial Plants

- Inhibited growth and photosynthesis of certain plants.

6.32 Within the framework of the 1985 Vienna Convention for the Protection of the Ozone Layer, the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol, as amended in London 1990 and in Copenhagen 1992) now requires phase-outs for the production and consumption of halons by 1994, of CFCs by 1996, and of other ozone-depleting substances (ODS) by

2000. All countries in the CEE region which are major producers or consumers of ODS are Parties to these agreements (see Annex 8).

6.33 Each country within CEE faces somewhat different challenges, partly because each country has different ODS production and consumption patterns, is converting to a market economy at different speeds, and has a unique industrial structure and privatization strategy. Yet all countries have much in common, providing a rationale for a regional strategy, for example:

- modest progress to date in developing substitutes for ODS;

- similarity in the ODS technologies, ODS-using industry structure, and trade patterns for ODS manufactured products;

- similar challenges in moving from a centrally planned to a market economy.

6.34 The table outlines the critical issues now facing four CEE countries in their efforts to phase out the use of ODS. The constraints in each of the ODS-using sectors are somewhat different. For example, in the aerosol sector, there are few, if any, technical constraints to CFC replacement. The obstacle to progress in this sector is a scarcity of investment capital, even for commercially attractive projects. In the foam sector, the key question is whether to move to intermediate raw material formulations (that is those which still contain some regulated substances but at much lower concentrations) or to wait and make only one switch to non-ODS substitutes. Both strategies are followed elsewhere. For domestic refrigeration, the key constraint is technological: critical problems remain with redesigning refrigeration appliances to use non-ODS compressors in many of the countries. In the refrigeration servicing area, where the concern is reducing the release of fugitive emissions, the critical issues are the training of service technicians and ensuring the technical and economic viability of the recycling schemes.

6.35 The box lists the key ODS phaseout activities and strategies for all important ODS uses in different production sectors. High priority should be given to identifying solutions for the refrigeration and solvent sectors as these face the most serious barriers (economic as well as technical) in meeting the 1996 phaseout date.

6.36 Substantial environmental benefits can be realized in the short-term with limited resources in the aerosol and flexible foam sectors where ODS use can be eliminated at very low cost. Substitute technologies already exist. Scarcity of capital is the key constraint. These projects are not expensive and may be candidates for international funding (on a grant or loan basis) given the potential global environmental benefits.

6.37 In the technology-intensive sectors (mainly refrigeration), developing non-ODS technologies will be a much more difficult challenge given the often limited resources available for research and development. Several companies in CEE have established technology alliances with multinational companies to facilitate access to new technologies.

6.38 Governments in Central and Eastern Europe should prepare national recovery/reclamation/recycling strategies to ensure a sufficient supply of refrigerant to maintain the existing stock of capital goods relying on ODS (mainly cooling, air conditioning and refrigeration equipments). Refrigeration appliances have operational lifetimes of an average of 20 years, and during

ODS Phaseout Activities

Refrigeration Sector

- Support research and development to manufacture refrigerators and freezers using the new HFC-134a compressors, now established as the international standard for domestic refrigeration appliances;

- Develop and implement a CFC recovery and recycling program to help meet the demand for CFC refrigerants for refrigeration applications and air conditioners, including improved servicing and maintenance procedures.

Foam Sector

- *Flexible foam.* Encourage the development of water-blown foam manufacturing for soft foam products. The use of HCFC or other chemical based blowing agent is not recommended given the cost and production-related health considerations especially now that most qualities of foam can be produced without using these substances.

- *Rigid foam.* Introduce the internationally available reduced-CFC foam formulations (which use 50% fewer ODS). Keep abreast of international developments and experiences with HFC and HCFC-blends and with complete water-blown rigid foams.

Aerosol Sector

- Make capital available for production of ODS substitutes.

Solvent Sector

- Disseminate technical information to this sector's numerous small users through seminars and demonstration projects. Establish a technical clearing house within industry associations serving the solvent users.

Fire Protection Sector

- Introduce measures to recover and recycle or destroy the large stock of halons which has accumulated over the last few years. Consider participating in the planned international Halon Bank.

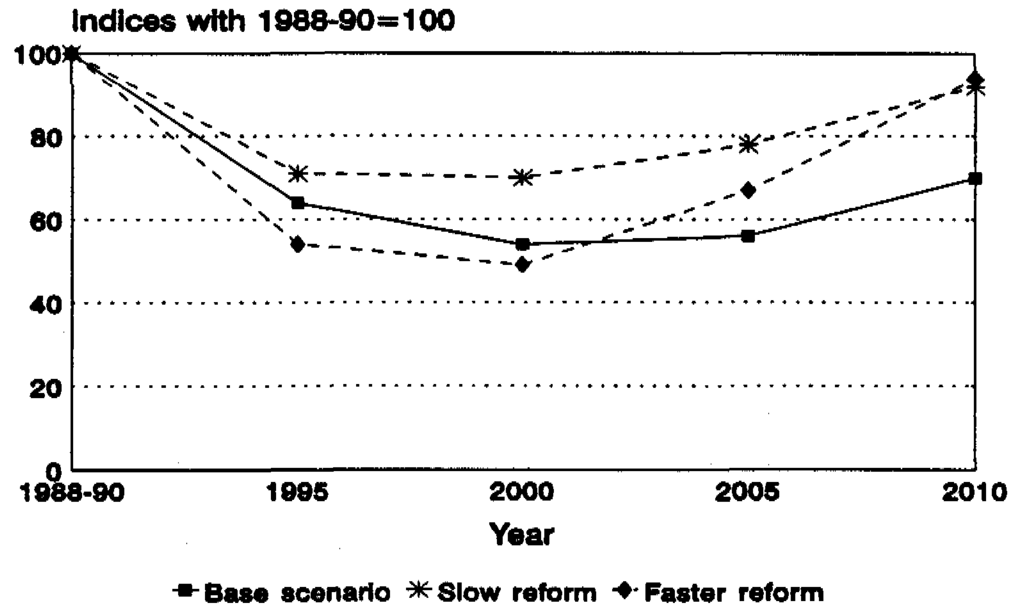
this period, many require refilling of refrigerant. Investments in recovering and recycling ODS-refrigerant to serve this purpose are likely to provide high returns by averting the need to retire equipment prematurely.

6.39 **Reduction of Greenhouse Gases.** Major changes are likely to take place in the level and composition of energy use in Central and Eastern Europe during the next decade. The energy intensity of production will decline as will the share of coal in total energy demand. These, as well as other changes associated with the transition to markets, are expected to reduce CEE's emissions of carbon dioxide.

6.40 **Figure 17** shows the projected emissions of carbon dioxide until the year 2010. The Central and East European countries covered by these projections account for a little over 20% of total

Figure 17

Emissions of carbon dioxide in Central and Eastern Europe (Total emissions from all countries)



World Bank estimates

world emissions of carbon dioxide from industrial sources. Under the main reform scenario (see Annex 5), their *emissions would fall by 46% in the period up to 2000*, so that *economic reform in the region should lead to a reduction of 10% of global carbon dioxide emissions from industrial sources.* This is *equivalent to 80% of the total emissions from the European Community countries combined* or to the total emissions from all of the countries in Asia other than China and India. Economic recovery and growth will lead to an increase in emissions after 2000, unless measures are adopted to reduce the energy-intensity of production and to reduce dependence upon coal. The reduction in emissions will, of course, be less if economic reform proceeds more slowly, while faster economic reform enhances the initial decline but leads to higher emissions after 2000 because of the higher rates of economic growth that it permits.

6.41 Further reductions in emissions of carbon dioxide and other greenhouse gases, especially methane, could be achieved by collecting the gas associated with oil production rather than flaring it, by minimizing natural gas losses from transmission and distribution systems, and by installing more efficient compressors on gas pipelines. These investments will typically generate high rates of return without taking any account of their environmental benefits. Some projects of this kind are underway or are at the planning stage -- primarily in Russia -- and the provision of technical assistance to develop more would clearly be justified. There have also been proposals to utilize coal-bed methane resources, especially in Poland and Ukraine. The economic returns to such investments are highly uncertain at present but their potential environmental benefits could warrant the provision of technical and financial assistance to develop pilot schemes.

United Nations Framework Convention on Climate Change

The main provisions of the Convention call for the following actions to be taken by States :

- development national inventories of emissions of greenhouse gases by sources and removals by sources;
- institution of measures to mitigate climate change and to facilitate adaption;
- application of processes to control emissions in all relevant sectors;
- sustainable management and conservation of sinks and reservoirs of greenhouse gases;
- inclusion of climate change considerations in social, economic and environmental policies;
- cooperation in the adaption to climate change;
- cooperation in research, exchange of information, education, training and raising public awareness.

It is expected that the Convention will enter into force in 1994. For a list of signatories in Central and Eastern Europe see **Annex 8**.

6.42 These changes follow directly from policies and investments that are economically or environmentally desirable for the countries themselves. Further measures to implement the 1992 United Nations Framework Convention on Climate Change would have to be assessed in the context of the limited resources available and the relative priorities attached to other environmental problems -- local and transboundary -- for which these resources might be used. In the future, reliance upon national taxes on the carbon content of fuels would minimize the economic cost of meeting national targets for reducing carbon dioxide emissions. They would provide direct economic incentives to reduce the use of all fossil fuels by encouraging the development of renewable sources of energy as well as to switch from high to low carbon fuels (i.e. from coal to gas). In addition, an arrangement which allowed countries to trade national emission reduction targets would provide the flexibility required to minimize the overall cost of meeting a fixed target for reducing carbon dioxide emissions over the whole region.

6.43 Overall, the marginal cost of reducing emissions of carbon dioxide and other greenhouse gases (GHGs) from countries in Central and Eastern Europe will remain well below the equivalent marginal costs for Western Europe for many years. Since greenhouse warming is the archetypal example of damage caused to a "global commons," common concerns should focus on the least expensive methods of reducing GHG emissions in order to achieve the greatest possible reductions with the resources available. *In the European context, West European countries could make the best possible use of their resources devoted to greenhouse warming by allocating a substantial fraction to accelerating the process of reducing energy use and carbon emissions from the CEE countries.*

6.44 **Conservation of bio-diversity.** There are a number of existing international and regional legal agreements that regulate various aspects of the protection and management of biological diversity, either through protection of species or of ecosystems and habitats. The broadest legal instrument is the convention on Biological Diversity (see Box), signed by over 150 States at the time of UNCED. The status of biological resources and diversity of species has traditionally been good in the region because population densities are so much lower than in Western Europe. However, the transition to market economies together with high levels of pollution in some vulnerable areas are beginning to have a negative impact.

Convention on Biological Diversity

The main provisions of the Convention call for the following actions to be taken by States :

- development of measures for conservation and sustainable use, including national strategies, plans and programmes and integration into relevant sectoral and cross-sectoral plans, programmes, policies;
- identification and monitoring of important components and of processes and activities with adverse impacts;
- in-situ conservation through a variety of means, among which establishment of protected areas; protection of ecosystems and habitats; appropriate management practices, legislation and financial support; ex-situ conservation through a variety of means to complement in-situ conservation;
- sustainable use of components of biological diversity, including through integration of these concerns into national decision making, management and customary use;
- adoption of economically and socially sound incentive measures;
- establishment and maintenance of programmes for research and training in identification, conservation and sustainable use; promotion of public education and awareness;
- introduction of appropriate procedures for environmental impact assessment and measures for minimizing adverse impacts;
- stipulation of conditions regulating a variety of aspects, including access to genetic resources; access to and transfer of technology; exchange of information; technical and scientific cooperation; the handling of biotechnology and distribution of its benefits; financial resources and mechanisms; relationship to other Conventions;

For a list of signatories in Central and Eastern Europe see **Annex 8.**

6.45 There are various suggestions for immediate actions that can be undertaken to allow countries to fulfil their commitments under the Conventions as well as setting in place the necessary support structures to protect species and habitats. These should be taken in conjunction with the measures discussed in Chapter V as well as the actions in the report on Nature Protection before the Ministers. They include:

- complete inventories of biological resources;
- build up the institutional and human resources required to assess and manage biological resources;
- revise national legislation to conform with the provisions of the Convention on Biological Diversity;
- prepare national strategies for the conservation of biological resources and implementation of the Convention;

Management of Toxic Chemicals and Hazardous Wastes

6.46 The concern here is not only toxic chemicals originating in commerce, services, agriculture as well as small to large scale industry, but also radioactive substances linked to energy generation, research and medicine and for military purposes. While these activities are primarily of national concern, they become issues for regional or even global attention in the case of accidents and transport, when they can have serious transboundary effects. Various international agreements regulate the management and transport of hazardous substances, including the 1957 European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR, as amended), the 1986 Convention on Early Notification of a Nuclear Accident; 1986 Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency; the 1989 Convention on the Control of Transboundary Movements of Hazardous Wastes (Basel Convention) (see Box); the 1992 ECE Convention on the Transboundary Effects of Industrial Accidents.

The Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted on 22 March 1989 and entered into effect on 5 May 1992. The main provisions of the Convention call for the following actions to be taken by States :

- information exchange with other Parties on waste exports and imports, through designated national authorities;
- prohibition of waste exports to countries that are not Parties or to Parties that have not expressly authorized import;
- licensing and supervision of persons transporting, or disposing of, wastes;
- packaging, labelling and transport of wastes in accordance with international rules and standards;
- cooperation in environmentally sound management of wastes;
- mutual information in case of accidents occurring during transboundary movement of wastes;

For a list of Parties and Signatories in Central and Eastern Europe see **Annex 8**.

6.47 Changes in governance in the region have important implications for the management of hazardous substances. Of particular concern is the rapid loosening of state controls that could result in unregulated transport of hazardous substances across borders.

6.48 Immediate actions could be directed to:

- assessment of the state of industrial plants and activities that generate hazardous wastes as well as the related disposal and transport facilities;
- improvement of safety measures, including through institutional, technological, managerial systems and equipment;
- strengthen the institutional and technical capacity to comply with the provisions of the Basel Convention.

VII. IMPLEMENTATION, COST AND FINANCING IMPLICATIONS -- NATIONAL AND INTERNATIONAL PERSPECTIVES

The Action Programme establishes a partnership between Eastern and Western countries. CEE countries would undertake essential policy and institutional reforms, while Western governments and international institutions would provide technical assistance to support these reforms, and contribute toward the implementation of priority projects. The various partners must re-examine their policies and programs in light of the Action Programme. Governments -- not just environment ministries -- should actively support this process. Inter-ministerial task forces may be useful instruments for this purpose.

Discussions have been initiated to reinforce the partnership under the Action Programme through one or several donor-supported project preparation facilities. These would provide the necessary initial funding to help identify high priority environmental investments in accordance with the Action Programme and to advance such proposals rapidly to the stage where they can be financed either by CEE countries themselves, or in combination with bilateral or multilateral support.

Policy Reform
Strengthening Institutional Capacity
Assistance prior to Investment
Financing Investment
Strengthened Coordination
Informal Sectors
Review of Implementation

7.1 This chapter presents possible mechanisms, and issues which need to be addressed, to implement the Environmental Action Programme (EAP). In accordance with the objectives of the EAP, implementation will require a mix of *policy*, *institutional* and *investment* actions. By establishing a consensus within and between countries of East and West, the EAP provides a basis for an evolving partnership to tackle the most urgent environmental problems in the CEE region. CEE countries would undertake essential policy and institutional reforms, while western governments and international institutions would provide technical assistance to support these reforms, and contribute toward implementation of priority projects. This requires the various partners to re-examine their policies and programs in light of the EAP. Working in this way, limited resources can be used most efficiently, and a greater degree of environmental protection secured than otherwise would be the case.

7.2 The EAP has not been developed in a vacuum. Many CEE countries are actively developing and implementing environmental policies, albeit under very severe constraints. Western governments and international institutions have already provided substantial environmental assistance -- about ECU500 million for CEE (this does not take account of assistance to the NIS or loans). Long-term regional programs are also underway. There is evidence that these various efforts are having a positive impact on environmental conditions and institutional capacity. The EAP is designed to reinforce and help to target these efforts.

7.3 In identifying possible implementation mechanisms, this chapter generally stops short of proposing specific institutional arrangements. These must be the subject of inter-governmental discussions to be carried out up to, and during, the Lucerne Conference. Rather, this chapter is intended to facilitate such discussions and to help ensure that the Conference can agree on practical actions which will result in significant environmental improvements in the most critically affected regions of CEE.

Policy Reform

7.4 CEE countries should be invited to review their existing environmental policies and strategies, or to develop new ones, in light of the EAP. As stressed in the EAP, these strategies and policies should aim to integrate environmental considerations into the process of economic restructuring. The key elements that need to be considered are summarized in **Annex 12.**

7.5 It is essential that national strategies are developed and adopted by governments as a whole, and not just by Environment Ministries. A realistic national strategy should address strategically important market reforms such as privatisation and tax reform and should involve all those sectors that exert the greatest pressures on the environment; in particular energy, industry, transport and agriculture. An adequate policy and institutional framework is essential to attract and target scarce investment resources. The establishment of an inter-ministerial committee provides one mechanism for developing a national environmental strategy.

7.6 Developing cross-sectoral environmental strategies will place a new and difficult burden on Environment Ministries in CEE, which are struggling to develop and implement policy in the traditional environmental sectors. Western governments should share their experience of environmental management with CEE countries and actively support the process of policy reform. As described in earlier chapters, priority should be given to introducing market-based reforms, and removing distortions, so as to promote simultaneously economic efficiency and environmental improvement -- "win - win" strategies.

7.7 The specific type of assistance which is most urgently needed will vary according to the circumstances of individual countries. The secondment of western experts by bilateral donors to work in Central and Eastern European Environment Ministries (and CEE country experts in western institutions) is one particularly effective mechanism. Such secondments would be especially useful for cross-sectoral issues, and for designing effective legislation and implementation procedures. Assistance to upgrade economic analysis and other techniques to support decision-making is also a priority.

7.8 Better use could be made of multilateral channels to share experience and know-how. The Regional Environment Center could provide a particularly useful role in this regard. Moreover, well-organized, results-oriented international meetings can provide a forum for dialogue on experience gained by western governments with a range of policy alternatives. They can also provide a useful networking function. Western governments should ensure that appropriate experts attend meetings designed to share experience East/West. As implementation of the EAP proceeds, it will become increasingly important to provide for effective exchange of experience *among* CEE countries. The Regional Environment Centre for CEE in Budapest could facilitate this process. A more effective mechanism linked to the implementation of the EAP is needed to establish priorities, coordinate and disseminate information about meetings. Related to this is the need for more systematic arrangements for providing financial support for CEE experts participating in such meetings. A number of countries have expressed an interest to provide such support.

7.9 Finally the strengthening of the tools and mechanisms for pan-European co-operation developed within the UN-ECE framework will support some important objectives of the Environmental Action Programme. OECD activities designed to promote the integration of environmental considerations into the process of economic restructuring will also contribute to this goal.

Strengthening Institutional Capacity

7.10 Strengthening institutional capacity is closely linked to policy and regulatory reform. It is also critical for project preparation and implementation, which is addressed in the following sections. While strengthened capacity is needed to establish effective legislative and regulatory frameworks and for enforcement, Environmental Impact Assessment, environmental auditing and other issues, two areas are singled out for attention here: building local environmental management capacity, and education and training.

7.11 **Building local environmental management capacity.** Decentralization is an integral element of the transition process. Building up a local environmental management capacity and establishing appropriate coordination mechanisms are priorities. CEE countries should

(i) clarify roles and responsibilities for environmental management among national, regional and local levels;

(ii) strengthen inter-municipal cooperation to address environmental problems and overcome administrative fragmentation;

(iii) increase efficiency of municipal environmental services with significant environment impact such as water, district heating, solid waste management and urban transport;

(iv) strengthen environmental planning, project preparation and financial management capacity at local level.

7.12 Donors should support these efforts and, in particular, strengthen decentralized cooperation mechanisms (e.g. programming meetings involving decision-makers at all levels), and provide assistance in integrated environmental management and project implementation.

7.13 **Education and Training.** A broadly based effort is needed to develop environmental training programs and to introduce an environmental dimension into other training programs with environmental implications. However, three priority actions have been identified:

(i) design and implement educational training programs for high-level decision-makers at national and local levels, in close collaboration with local institutions. Training programs should be supported by voluntary contributions from donors, with CEE countries providing the on-site organization and support.

(ii) establish a network of national institutions most directly involved in environment training in CEE countries. The purpose of the network would be to promote exchange of information between those institutions and their counterparts in other countries, and with external financial partners.

(iii) all bilateral and multilateral assistance projects having a direct impact on the environment should include environmental training elements. The development of guidelines for this purpose would be useful.

Western governments should also support education and training programs developed by the informal sectors for their counterparts in CEE.

Assistance prior to Investment

7.14 **Project Preparation.** Feasibility studies are essential before major investments can be made. While many feasibility studies have been carried out in CEE countries they have frequently not led to investment. This is generating increased skepticism about the value of such studies in both donor and CEE countries.

The following steps should be taken to address this problem:

- from the outset, donors should consult and agree with the local partner on the objectives of the study. Policy reforms or structural changes that affect the viability of the proposed project should be clearly specified.

- commitments to policy reform and structural change that affect the viability of a project should be clearly specified.

- feasibility studies should be better designed. The terms of reference of such studies should address not only the technical case for investment, but also the often neglected financial and institutional requirements for implementing the project over time. Donors should involve international financial institutions when preparing terms of reference.

- related to this, greater use should be made of local expertise. Not only would this help to develop local skills, it can also provide a better understanding of local circumstances and be more cost-effective then using experts from donor countries. To make progress in this direction, some donors will have to address the problem of tied aid.

7.15 **Project Preparation Facility.** [add text on the functions of a Project Preparation Facility.] The PHARE programme of the CEC has established a Project and Investment Preparation Facility which is designed to provide support mainly for the following activities:

- assessment of project suitability using the EAP's criteria

- pre-investment studies

- feasibility studies

- financial coordination and preparation of co-financing arrangements

7.16 This CEC Facility is arousing considerable interest, and it has been suggested that a proposal should be tabled at Lucerne for establishing some kind of multilateral facility for preparing projects as soon as possible that meet the criteria of the EAP. Furthermore, several other countries and institutions have indicated their interest in establishing such Facilities, and various institutional and management options are under discussion. In these discussions, account should be taken of similar arrangements under consideration in other regional institutions and programs.

The Project Preparation Facilities to be established in preparation for the Lucerne Conference should concentrate on three tasks:

- to select projects from those put forward by CEE countries according to the criteria laid down in the EAP
- to institute feasibility studies (or upgrade existing studies)
- to put together assistance and investment packages for urgent projects with significant environmental benefits which are less financially viable

7.17 **Project Portfolio.** An initial Project Portfolio would be prepared of projects coming out of the soon to be completed investment study, as well as projects proposed by CEE countries themselves. The latter would undergo a screening procedure (still to be developed) to ensure consistency with the EAP. The purpose of the Project Portfolio is to facilitate bilateral cooperative arrangements at Lucerne and in the follow-up to the Conference. The Project Portfolio and the Project Preparation Facility would be closely interrelated.

Financing Investment

7.18 The main bulk of resources required to improve environmental conditions in CEEs must come from the countries themselves. External assistance nevertheless can play an important catalytic role. Bilateral and multilateral donors should cooperate together and with CEE countries to implement priority projects emerging from the EAP. CEE countries, with assistance from western donors, should enhance their capacity to attract and effectively use external assistance.

7.19 There are three main sources of local finance: government funds; self financing (eg by enterprises or municipalities); and bank credit.

7.20 Difficulties in raising revenues, combined with continuing growth of expenditures, have resulted in severe budgetary difficulties in CEE countries. As a result

(i) there is a scarcity of local counterpart funding required by some donors and international financial institutions to finance their projects;

(ii) governments are unable or unwilling to provide the sovereign guarantees which most environmental loans would require; and

(iii) the capital investment budgets are under increasing pressure as budgets are reduced and the share of current expenditure rises.

7.21 The financial sector in most CEE countries is still very weak, with limited opportunities to use local capital markets, innovative local financing instruments or long-term financing. The capacity for financial intermediation needs to be strengthened in CEE countries, through the development of local banks and, in appropriate cases, through specific institutions. However, this will take time.

7.22 In the short-term, this leads to three conclusions. First, projects supported by appropriate cost-recovery mechanisms can be financed most readily. The classic example in this category is environmental infrastructure financed by user charges. However, even here there can be important social and political constraints associated with the imposition of high charges, and there may be opportunities for private sector participation.

7.23 Second, earmarked environmental funds which have been established in a number of CEE's are likely to provide an important source of finance. National and regional funds accounted for more than 40 per cent of environmental investments in Poland in 1991. The PHARE programme has agreed to provide financial support to environmental funds in Poland and Hungary. However, views on the use of earmarked environmental funds differ, particularly on their efficiency in the long run, and it would be useful to review experience and develop guidance on the role of such funds in the transition period. OECD has been requested to examine this matter.

7.24 Third, since there are many environmental projects which cannot be supported by cost recovery mechanisms, there is an urgent need to develop innovative financing mechanisms. The urgency is underlined by the fact that many of the priority projects which are likely to arise in implementing the EAP will fall into this category; for example, projects in the industrial sector. The project preparation facility currently under discussion could provide one mechanism for developing co-financing arrangements. Clearly one or more mechanisms are needed which would facilitate the preparation of financing packages by CEEs and donors involving different combinations of grants, loans, equity investment from the private or public sector and local counterpart funds. "Debt for Environment" swaps provide another possible source of finance.

7.25 Special attention should be given in this context to financing regional programs and projects. Where projects are proposed as part of a comprehensive policy of reducing regional environmental damage, financing could become available as part of regional efforts. The preparation of project proposals where the incremental transboundary cost is clearly identified would facilitate this effort.

7.26 **Program Management.** Investment and technical assistance programs should be managed by CEE countries. However, at present, the ability of many CEE countries to absorb assistance is limited by a variety of factors. This problem is exacerbated by institutional and management differences between donors and recipients. Moreover, different management practices *among* donors place an additional burden on often overstretched recipients. Donors should review their procedural arrangements and consider how they can harmonize their requirements to minimize the burden on recipient countries.

7.27 Donors should provide support to enable local institutions to undertake project and program management effectively. Recipients should make every effort to ensure stability and continuity for institutional arrangements and personnel. Programs should be undertaken in an integrated manner in support of long term country and regional strategies, not as an aggregation of individual projects. Effective program and project management procedures should be established.

7.28 *Sources of Funds.* As pointed out at the outset, the vast majority of financing for environmental investments comes from CEE countries themselves. Even where there is an international financial contribution, donors and financial institutions usually expect that countries will meet the local costs out of their own resources. In contrast to the practices common under central planning (see chapter IV), donors expect that a project not only be well prepared prior to initiating funding discussions, but above all that the project implementing agency can demonstrate up-front that sufficient resources are available to ensure the economic sustainability of the proposed project.

7.29 The principal domestic resources to support environmental activities include:

- allocations from national or local budgets,

- various incentives (income and other tax incentives, conversion of sunk capital, exemptions from duties, etc.),
- earmarked funds, including user charges, pollution fees and fines, permits and environmental taxes,
- local banks, or
- partial or full state guarantees

For any of these mechanisms to function, strenuous efforts are called for from all parties involved to strengthen the local financial system, and to provide the necessary training.

7.30 External resources are available in the form of grants or concessional loans (e.g., from the EC Commission, bilateral donors, export credit agencies), or loans (e.g. from international financial institutions, international commercial banks), or equity investments as part of direct foreign investment. It is proposed that, as part of developing the notion of one or more project preparation facilities, a detailed manual be prepared that would provide useful information for CEE countries and project managers on financing and procurement procedures. Such a manual could build on the work already completed as part of the preparations for the March 1993 Conference on Resource Mobilization of the Baltic Sea Environment Programme.

Financing Environmental Protection in the Russian Federation

In the last three years, the Russian Federation has been establishing a system for financing environmental improvements which does not rely upon transfers from the government budget. Ecological Funds have been set up at federal, provincial (oblast), and local levels to channel resources to programs of environmental protection, nature conservation, scientific studies, technological development and compensation for the health damage caused by pollution.

These Funds rely primarily upon the revenue generated by pollution charges (both fees and fines), waste disposal fees, and other payments made to compensate for the environmental consequences of past actions by enterprises and other organizations.

They are empowered to invest in the development of environmentally-sound technologies or in enterprises with appropriate environmental objectives. They are also permitted to receive grants of foreign exchange or other assistance from foreign donors to fund the foreign exchange costs of their activities.

It is envisaged that the Ecological Funds will receive at least 80-90 billion rubles from pollution charges in 1993 -- equivalent to US$130 million at an exchange rate of US$1 = 650 rubles. This revenue should rise rapidly as pollution charges are increased in real terms, though the steep decline in the output of heavy industries such as metallurgy and chemicals will reduce the sums received by the Funds.

7.31 *Business participation.* One of the most important changes in funding environmental expenditures which must be made is the shift of funding from public to private investments. As stated already, good regulatory guidelines and enforcement provisions are needed. Economically viable (but environmentally unsound) businesses should internalize their environmental costs. The banking system, currently overwhelmed with bad debt management, is not positioned at this stage to identify viable enterprises and facilitate environmental investments by these enterprises. Banking personnel should be trained in assessing potential environmental liabilities in enterprises applying for credit. Explicit guidelines to aid the banking system in this task are needed.

Strengthened Coordination

7.32 Simple, effective coordination can support program management by CEE countries. Currently the G-24 (for central European countries, the Baltic states, and Balkan countries) and the Country Consultative Groups (for the Newly Independent States of the former Soviet Union) play coordination roles. The key functions of coordination should be:

- to monitor whether priority issues are being addressed in investment and technical assistance programs;
- to stimulate corrective actions when priority needs are not being addressed;
- to put CEE countries with a particular need for assistance in touch with potential providers of assistance;
- to help avoid duplication of effort by collecting and effectively disseminating information on assistance activities;
- to review and share experience gained, both by donors and recipients.

7.33 Governments need to consider what coordination arrangements would be most appropriate in connection with the Environmental Action Programme (though coordination issues will involve other intergovernmental forums besides the Conference and must also be considered in the overall framework of follow-up to the Lucerne Conference). This need arises from the scope of the EAP, which covers all central and eastern European countries -- including (some) of the NIS -- while the general coordination mechanisms (the G-24 and the Country Consultative Groups) are separated. Related to this are the roles to be played by the project assistance databases managed by the G-24, OECD, and UN-ECE. Clarification of this issue also might provide donors and recipients with a further incentive to provide information on projects in a more timely and comprehensive manner than hitherto.

Informal Sectors

7.34 The informal sectors and the public more generally must be considered as partners in the effort to improve environmental conditions in CEE's. In this regard it is essential that CEE governments provide clear "rules-of-the-game" for the private sector. Western industry leaders have frequently argued that, clear, transparent, and predictable environmental requirements are needed in order to attract foreign investment and remove uncertainty for business. Lowering environmental standards, in itself, will not help to attract investment from modern, environmentally responsible enterprises. In developing national strategies, priority should be given to clarifying environmental liability issues and establishing appropriate EIA procedures. Western donors should support the development of the local environmental services sector.

7.35 The Budapest Guiding Principles on Environment, Industry and Investment Decisions in Central and Eastern Europe provide guidance to companies concerning the environmental dimension of investment. Efforts by trade associations and companies to follow these Guiding Principles would facilitate the transfer of technology and know-how in an environmentally responsible manner. The country-specific Investors' Environmental Guidelines, prepared by EC/EBRD will provide information on local environmental policies and regulations.

7.36 CEE governments should consider establishing an obligation on enterprises to assign responsibility for environmental affairs to one individual together with an environmental auditing and reporting obligation.

7.37 Consideration of how the EAP might be applied in CEE countries should involve the public. NGOs can help to initiate wider discussion of the EAP, for example, through roundtables involving government, community and business organizations. In addition, the activity to promote public participation proposed as one of the initial elements in the pan-European Environmental Programme would help to facilitate many of the key objectives of the EAP.

Review of Implementation

7.38 Mechanisms for reviewing implementation of the EAP will be closely linked to the arrangements (including timing) agreed as a follow-up to the "Environment for Europe" process. In addition to some of the activities identified under "Coordination", elements that could facilitate review of the EAP's implementation include:

- All countries concerned could be invited to report periodically on implementation of the EAP [guided by the key elements of national strategies set out in **Annex 12**]. Some NGOs have also expressed an interest to contribute to this effort.

- Environmental Performance Reviews, one of the initial elements proposed for inclusion in the Pan-European Environment Programme, could play a significant role in this respect.

- In monitoring the State of the Environment in Europe, the future European Environment Agency should take account of environmental trends in "hot spots" or critical regions identified in the EAP and national strategies.

- The results achieved by a Project Preparation Facility will require joint review.

- Some arrangement is needed whereby the EAP will function as a "living document", elaborating key elements of the strategy and providing feedback on the original strategy.

SUMMARY OF HUMAN HEALTH PROBLEMS IN BULGARIA, CZECHOSLOVAKIA, HUNGARY, POLAND, LATVIA, LITHUANIA, ESTONIA, ROMANIA, BELARUS, UKRAINE, AND EUROPEAN RUSSIA

This summary outlines those environmental health problems in Central and Eastern Europe for which reasonably credible epidemiologic data are available. It is meant to be a comprehensive summary (except in the case of Russia), but there are obstacles to achieving this goal. Health outcomes in the various regions with similar chemical exposure problems have not necessarily been investigated to an equal degree, and different methodologies of varying credibility have been used. This is particularly a problem for chronic and multifactorial diseases which require advanced epidemiologic methods that are not commonly used in Eastern Europe. Thus, the following summary draws attention to those chemical exposure problems which have been adequately studied, but does not mean to imply that other, well recognized episodes of environmental pollution or degradation have not led to human health problems.

The problems described here are primarily the result of exposures to lead in air and soil, airborne dust, sulfur dioxide and other gases,[1] and nitrate in water.

1. **Places where there is a problem with *overexposure to lead among children*** (37 locations in 7 countries):

This problem is important because it may lead to neurobehavioral deficits which will have long term effects on children's educational attainment. Evidence of neurobehavioral deficits among exposed children has been found in several of the following places:

(a) **Poland.** Katowice Wojewodship -- Szopienice, Miasteczko, Zyglin, Lubowice, Zabrza, Toszek, Bytom, Bojszow, Brzeziny, and Brzozowice.

Legnicà-Glogow area -- near copper smelters (note: quality control problems with blood lead data).

(b) **CSFR.** Central Bohemia -- Pribram (note: quality control problems with blood lead data).

(c) **Hungary.** Inner Budapest, Romhany, Szolnok.

1/ There is a need to carefully review the places with environmental health problems due to airborne exposures to evaluate the relative importance of gaseous exposures *in the absence of dust*.

(d) **Bulgaria.** Plovdiv, Asenovgrad, Kuklen, Kurdzhali (results of lead studies of adults in Voden, Kremikovtsi, Jana and Pernik imply that there are probably overexposures to children, too).

(e) **Romania.** Bucharest, Copsa Mica, Baia Mare (probable).

(f) **Russia (European).**[2] St. Petersburg, Berezniki, Podolsk, Yaroslavl, Samara, Nizhnyy Novgorod, Ulyanovsk, Rostov-na-Dony, Kursk, Astrakhan.

(g) **Ukraine.** Konstantinovka (probable).

2. **Places where there are documented associations between *acute respiratory diseases* (sinusitis, pharyngitis, bronchitis and laryngitis) and air pollution** (46 locations in 10 countries):

(a) **Poland.** Kraków.

(b) **CSFR.** Slovakia -- Bratislava.

Central Bohemia -- Neratovice, Kralupy.

North Bohemia -- Usti nad Labem, Teplice, Most, Chomutov, Decin.

(c) **Hungary.** Dorog, Ajka.

(d) **Bulgaria.** Ruse, Vratsa, Devnya, Srednogorie, Krekikovtsi, Asenovgrad, Shvistov, Dimitrovgrad, Sofia, Gabrovo, Varna, Kameno, Burgas.

(e) **Estonia.** Narva/Kohtla-Jarve/Sillamae area, Kunda.

(f) **Lithuania.** Jonava, Kaunas.

(g) **Latvia.** Olaine.

(h) **Romania.** Slatina, Baia Mare, Tasca, Sendreni-Galati, Savinest, Suceava, Hunedoara, Mintia, Otelul Rosu, Navodari, Remicu-Vilcea.

(i) **Russia (European).** Arkhangelsk, Berezniki, Voskresensk, Cheboksary, St. Petersburg.

2/ This and the following information on European Russia is preliminary and subject to verification.

(j) **Ukraine.** Zaporozhye.

3. **Places where there are documented associations between *chronic respiratory diseases* (chronic bronchitis/emphysema and asthma) and air pollution** (29 locations in 9 countries):

(a) **Poland.** Regional association between SO_2 levels and chronic bronchitis and asthma rates throughout the country; also found specifically within Kraków.

(b) **CSFR.** North Bohemia -- Usti nad Labem, Teplice, Most, Chomutov, Decin.

(c) **Hungary.** Dorog, Ajka, Nagyteteny (in District 22 of Budapest), Borsod County (especially Karincbarcika and Miskolc).

(d) **Bulgaria.** Ruse, Razlog, Vratsa, Devnya, Srednogorie, Plovdiv, Asenovgrad, Kremikovtsi, Pernik.

(e) **Estonia.** Narva/Kohtla-Jarve/Sillamae area, Kunda.

(f) **Lithuania.** Jonava, Kaunas.

(g) **Latvia.** Olaine.

(h) **Russia (European).** Sterlitamak, Ufa, Chaykovskiy (Perm oblast).

(i) **Romania.** Turda, Copsa Mica.

4. **Places where there is reasonably strong evidence of a connection between excess infant and lung cancer *mortality* and air pollution** (8 locations in 3 countries):

(a) **Poland.** Katowice -- infant mortality in areas with the highest dust levels.

Kraków -- Lung cancer in relation to community exposures to steel mill emissions.

(b) **CSFR.** Czech Republic -- infant mortality (especially post-neonatal respiratory mortality) in regions with the highest dust and SO_2 levels.

(c) **Russia (European).** Berezniki, Nizhnyy Novgorod, Dzerzhinsk, St. Petersburg, Lipetsk.

NB: Other places where correlations between air pollution and adult mortality and/or cancer incidence are likely valid, but require further investigation, include the mining districts of North Bohemia (lung cancer, all cancer, total mortality), the most polluted districts of Central Bohemia (total mortality), Ziar nad Hronom region of Slovakia (total mortality), Lódz (total mortality) and the mining district of southern Bulgaria (lung cancer).

5. **Places where there are documented associations between *abnormal physiological development* and air pollution** (18 locations in 7 countries):

(a) **Poland.** Kraków -- reduced pulmonary function among adult males exposed to acid rain emissions.

Katowice -- average hemoglobin levels among mothers and children reduced by about 20% below normal.

(b) **CSFR.** Czech Republic -- rates of low birth weight are increased in the regions with the highest levels of dust and SO_2.

Central Bohemia
- -- increased rates of "small for gestational age" babies in the regions with worst environmental quality.
- -- reduced pulmonary, hematological, and immune function in children from most air polluted areas.

Mining Districts of Bohemia
- -- reduced hematological and immune function in children.
- -- delayed bone maturation in children.

Teplice and Usti nad Labem, North Bohemia
- -- increased rates of congenital anomalies.

(c) **Hungary.** Nagyteteny -- anemia among children.

Ajka -- reduced pulmonary function among children.

(d) **Bulgaria.** Dimitrovgrad -- reduced pulmonary function and reduced growth rates among children.

(e) **Estonia.** Narva/Kohtla-Jarve/Sillamae area -- reduced hematological and immune function in children.

Kehra -- reduced pulmonary function among children.

(f) **Romania.** Slatina, Copsa Mica, Turda -- reduced pulmonary function among children.

Copsa Mica, Baia Mare -- growth retardation.

(g) **Ukraine.** Mariupol, Zaporozhye -- increased rates of congenital anomalies.

6. **Places where *nitrates in drinking water* are widespread, requiring water replacement to protect newborns against *methemoglobinemia*** (Widespread in 6 countries):

Methemoglobinemia is a form of chemical asphyxia wherein the oxygen carrying capacity of the blood is chemically inhibited by nitrates:

(a) **CSFR.** Slovakia -- widespread problem.

(b) **Hungary.** Borsod County -- widespread problem.

(c) **Bulgaria.** Districts of Haskovo, Burgas, Varna, Razgrad and Lovech -- widespread problem. Also in Stara Zagora, Pazardgik Targovichte.

(d) **Belarus.** Brest, Gomel, Grodno, Vitebsk, Minsk, Mogibv oblasts.

(e) **Lithuania.** One-third of country covered by water replacement program for pregnant women.

(f) **Romania.** Widespread problem throughout the country.

7. **Places with problems with *arsenic*:**

(a) **CSFR.** Ziar nad Hronom, Slovakia -- increased rates of non-melanoma skin cancer and hearing loss in children downwind.

(b) **Hungary.** Békés County -- high levels of arsenic in the water supply, with evidence of arsenic-related skin conditions and intestinal colic among children, as well as a possibility of increased rates of stillbirths and spontaneous abortions.

(c) **Bulgaria.** Srednogorie – increased levels of arsenic in surface water and in the soil.

(d) **Romania.** Arad-Lipora-Ineu districts -- area is contiguous with Bekes County, Hungary. High rates of skin cancer have been found here.

(e) **Russia (European).** Cherepovets, Kamensk-Shakhtinskiy (Rostov oblast), Tyrnaua (Kabardino-Balkariya), Vladikavkaz.

8. **Other Health Effects of *Contaminated Drinking Water Supplies*:**

(a) **Latvia.** Riga -- large waterborne hepatitis A outbreak

Jelgava -- large milk-borne dysentery outbreak based on contaminated water supply.

(b) **Romania.** -- carcinogenic substances exceeding standards have been measured in water samples from 32 of 41 districts in the country.

-- chlorinated pesticides found in many water supplies around the country.

(c) **Russia (European).** Sankt-Peterburg, Murmansk, Volograd, Kurgan, Novgorod oblast, Mordovian Republic.

9. **Places with *other problems*:**

(a) **Poland.** Kraków -- ongoing problems with fluorosis near an aluminum smelter.

Turow, Silesia -- high prevalence of methemoglobinemia near lignite power plant.

(b) **CSFR.** Michalovce, Slovakia -- PCB exposures, with mini-epidemic of Potter's Syndrome (congenital agenesis of kidneys) in the late 1970s.

(c) **Belarus.** Gomel oblast -- thyroid cancer in children following Chernobyl.

(d) **Estonia.** Widespread beach closures to protect against the spread of infectious disease.

(e) **Latvia.** Water supply in Daugavpils closed twice in the last two years to protect against chemical spills upstream on the Daugava River in Belarus.

Brocenai -- large-scale community asbestos exposure.

Leipaja -- multiple concerns from electromagnetic radiation from radar stations.

Olaine -- disordered immune function in adults.

(f) **Romania.** Several towns/cities with high airborne asbestos levels.

Suceava -- neurological symptoms in children exposed to carbon disulfide.

(g) **Russia (European).** Kalingrad, Novgorod, Lepetsk, Syktyrkar, Kandalaksha, Cherepovets -- high airborne benzo(a)pyrene levels.

Dzerzhinsk, Serpukhov -- High levels of polychlorobiphenyls in air, soil, water, vegetation, and breast milk.

Ufa, Shchelkovo, Chapayevsk, Dzerzhinsk, Moscow, Murmansk -- high concentrations of dioxin in the soil on grounds of industrial plants and in the ashes of waste incinerators.

(h) **Ukraine.** Thyroid cancer in 3 contaminated areas of Ukraine following the Chernobyl accident.

The information collected and evaluated from nine CEE countries provides the following overall picture:

Poland -- The predominant environmental health threat in Poland is the regional hot spot in the Katowice-Kraków area. Threats to human health are mostly due to airborne exposures, and secondarily to deposition of metals (especially lead) in soil. Widespread water pollution has not been shown to be a significant risk to health at this time, presumably because there is a tradition of not using tap water for drinking.

Czech Republic -- Air pollution in the mining districts of Northern Bohemia forms a regional hot spot, which is the primary source of environmental health problems. There are smaller areas of concern in industrial areas of Central Bohemia and Moravia, as well as in Prague. As in Poland, water pollution is not a major current concern with respect to human disease.

Slovak Republic -- The pattern in the Slovak Republic is different from Poland and the Czech Republic, in that nitrates in drinking water in rural areas appear to be a significant problem. In addition, there are human health problems associated with air pollution from specific plants in a handful of specific locations.

Hungary -- In Hungary, areas with human health problems in relation to the environment tend to be old industrial areas with a confluence of airborne pollution sources, such as Borsod County and the industrial areas of Budapest, or areas with a single major point source, such as Ajka. Waterborne exposures to nitrates are important as well in Borsod County, and there are problems with naturally-occurring arsenic in water in Békés County.

Bulgaria -- The pattern in Bulgaria is similar to Hungary with a mixture of single and multiple point sources of air pollution predominating. However, the number of areas with documented associations between air pollution and human health outcomes is much larger in Bulgaria than in Hungary. Nitrate pollution of water is a widespread problem, affecting drinking water supplies in rural areas throughout the Western part of the country.

Romania -- Most of the air pollution related problems in Romania are due to intense exposures from single point sources. These tend to be clustered in certain parts of the country, especially in the area of Transylvania near Cluj. Nitrate pollution is common in 38 of 41 districts of the country.

Baltic Countries -- Aside from prodigious dust emissions from a cement plant in Kunda, Estonia, and a small number of other local concerns, air pollution problems in the Baltic Countries tend to have less health significance than in other parts of Central and Eastern Europe. Instead, problems with water pollution have come to the fore. Rural Lithuania has problems with nitrates which are of human health significance. Riga has had an epidemic of waterborne hepatitis A as a result of a temporary lack of coagulant to treat drinking water from the Daugava River. All three countries have had to close beaches in recent years to prevent the spread of infectious diseases due to inadequate sewage treatment in adjacent settlements.

European Russia -- Russia's size and tremendous diversity impose significant obstacles to generalization. The task is made more difficult by the fact that relevant information has, according to one estimate, been generated by more than 100 different institutes around the country. A preliminary assessment suggests that industrial facilities are the most important sources of air pollution, causing respiratory and developmental problems in urban and industrial locations in European Russia. Chief among these are chemical plants, which emit organic vapors and irritant gases, and petroleum refineries, which emit polycyclic aromatic hydrocarbons (PAH). As in other parts of Central and Eastern Europe, emissions of lead from lead smelters, lead-cadmium battery plants, and storage battery factories have been linked with high blood levels in children living in the vicinity of the plants. Suspended particulate matter is a concern in many urban areas. Finally, there is concern about exposures to ionizing radiation in communities adjacent to military-industrial facilities. As in other countries in the region, it appears that elevated nitrate levels in drinking water may be a widespread problem. Arsenic, pesticides, and petroleum products may also be contaminating drinking water in some places.

OCCUPATIONAL HEALTH

A glance at the map of locations of environmental health concern (Annex x) quickly reveals that there is a high degree of overlap with the areas of industrial concentration in Central and Eastern Europe. This is not surprising since three of the principal environmental health threats are dust, toxic gases, and lead: all of which are emitted in large degree from industrial sources. To the extent that these polluting industries affect both the health of the communities in which they are located and, also, the workers who work there, a remediation strategy which targets environmental health problems will also be effective in capturing workplaces with significant occupational health problems. The best example of this is lead smelters, where significant community exposures to children and in-plant exposures to workers seem to coexist everywhere they have been measured in tandem in Central and Eastern Europe. However, there are some important exceptions to this general pattern which need to be carefully considered in the development of the environmental action plan. These include two types of locations: those where environmental health problems exist in the absence of occupational health problems and, conversely, those where occupational health problems exist in the absence of environmental health problems.

In many locations in Central and Eastern Europe stack emissions from industrial sources are prodigious but in-plant exposures are trivial, or, at least, no worse than would be expected in comparable facilities in the West. This would appear to be true for many coal-fired power and heating stations as well as certain cement plants, such as the one in Kunda, Estonia. But the phenomenon is not confined to these sorts of facilities. In general, the environment inside industrial facilities, except in Romania, seems to be relatively closer to Western norms than conditions in the adjacent communities, despite a widespread lack of basic safety equipment and exceedingly lax enforcement of health and safety regulations. A good example of this is the Nowa Huta steel works near Krakow. The facility has historically been a principal source of air pollution for Krakow and was represented to us as a dangerous place to work, since only 13 percent of the workers were said to retire without a disability. However, our visit to the facility revealed that this statistic distorted the realities of working conditions in the plant, which were no more threatening than an average North American steel plant. It turned out that the high rate of disability could best be explained as a response to the exceedingly generous disability pension benefits that existed for workers in heavy industry in Poland, rather than the workers' experience of disability per se.

Routinely reported data on worker absenteeism and occupational disease across Central and Eastern Europe reveal a pattern which supports these perceptions. Absenteeism rates tend to be high (probably reflecting benefit-driven behavior), while occupational disease rates tend to be no higher than in Western countries. This latter statement, however, must be taken with three important qualifications. First, certain occupational diseases are underdiagnosed and under-recognized in Central and Eastern Europe. Most important among this group are occupational cancers, which have received no recognition at all as occupational diseases and very little investigation has been done of them. Second is the problem of political interference in the reporting of occupational disease. In Czechoslovakia, a political decision was made in the early 1980s to suppress data on silicosis cases at the national level. In Romania, financial incentives were exerted on plant physicians to keep the number of reported cases of occupational disease below a targeted value on an annual basis. Anecdotes about less systematic forms of misreporting came out in other countries. Finally, the prevalence of the "traditional" occupational chest diseases, silicosis and silicotuberculosis, certainly is higher among Central and Eastern European workers in exposed occupations than among their counterparts in the West.

This third qualification of the occupational disease statistics points directly to the nature of many of those places where there are severe occupational health problems in the absence of environmental health problems. These tend to be places with heavy workplace dust exposures in the absence of large scale emissions into the community, in other words, in mines. This generalization would seem to apply to many underground coal and uranium mines in Central and Eastern Europe. A good example is found in Pecs, Hungary, where a uranium mine and a coal mine were both in production until recently. There is currently a mini-epidemic of lung cancer which began among the miners from the (now defunct) uranium mine, while, at the same time, the coal mine (still operating) has been producing 100-120 new silicosis cases per year among a workforce of 4100. Nonetheless, community air quality is not of particular public health concern. Similarly, epidemiologic data for uranium miners in Czechoslovakia suggest an ongoing lung cancer risk there. To be sure, there are examples of especially dangerous workplaces, other than mines, in Central and Eastern Europe which do not coexist with significant community exposures. But, when countries other than Romania are considered, it is fair to say that a large proportion of the dangerous workplaces that do not lead to community exposures are in the energy sector, and should become targets of closure or reinvestment as part of a program of reform in that economic sector.

Romania. As has been hinted at above, Romania is an exception to these general rules. The former regime there pursued a policy of industrialization despite the human cost. It provided stunningly generous danger pay to workers in mines, mills, and smelters which were based on ambient in-plant air quality measurements done periodically by the Centers for Medical Prevention. The scale of perversity of this incentive cannot be overstated. In many locations throughout Romania workers have been militantly demanding that dangerous working conditions be maintained in order to support danger pay which can drive their wage rates to several times the national average. In this context there appear to be many locations throughout the country with severe occupational health problems.

- National data indicate that there are approximately 500-600 new cases of silicosis per year produced in mines and foundries around the country, of which 10 percent have silicotuberculosis. The average time from first exposure to disease is short, 15.5 years in the mines around Suceava during the 1980s and 18.4 years in large foundries around the country over the same time period. The large copper mine near Suceava has a particularly striking history of silicosis. Of 2700 miners retired with permanent disability between 1953 and 1982, 61.5 percent had silicosis. The average age of retirement was less than 40 and 69 percent of these men had less than 10 years of exposure. Tuberculosis complicates 24 percent of cases. So far, 23 percent of the deaths among this sample of pensioners has been from silicosis and the average time from retirement to death has been approximately 7 years.

- In 1990 there were 246 confirmed cases of one-time exposures to ionizing radiation of more than 400 millirem in uranium mines and other workplaces.

- Between 1986 and 1990 approximately 3.6 percent of the workforce, or 51,809 workers, were exposed to carcinogens in the normal course of their work. In six districts, Olt, Giurgiu, Bacau, Vaslui, Prahova, and Salaj, more than 10 percent of the workforce are exposed to carcinogens. The most prevalent exposures, in descending order, are tars/mineral oils/carbon black; polycyclic aromatic hydrocarbons; hexavalent chromium; benzene; asbestos; vinyl chloride; arsenic; naphthylamine and benzidine; nickel; and epichlorhydrin.

- Several workplaces in the vicinity of Bucharest report high levels of chemical disease. These include the Acumulatorul factory in Bucharest, which experiences 30-45 cases of lead intoxication per year; the UREMOAS plant in Bucharest, which produces 15-25 new cases of silicosis per year; the friction materials factory in Rimnicu Sarat, which produced 30 new cases of asbestosis in 1990; and the synthetic fibers factory in Braila, which produces 30-50 cases of carbon disulfide and sulfuric acid toxicity per year.

- Lead related problems have been studied among workers at the IMN plant in Copsa Mica, which is said to be cleaner than the other plant there. Between 1984 and 1989 there have been 61-103 cases of acute lead poisoning per year (from a workforce of approximately 3000), based on clinical symptoms of severe gastric pain. In addition, there have been 113-120 cases of chronic lead poisoning, based on symptoms of neurasthenia, constipation, anemia, anorexia, and moderate gastric pain. Urinary lead samples taken in 1989 showed the following:

Urinary lead level (μg/dl)	Number of workers	Percentage
< 80 (normal)	404	13.6
80-150	998	33.6
150-250	1290	43.4
> 250	280	9.4

Not only are these numbers extremely high, but the categories underestimate the problem because even the category defined here as acceptable would be considered dangerous in the West.

- The town of Baia Mare is heavily polluted with lead and other metals due to two lead smelters in the area. In the Phenix plant there, approximately 25 of 3000 workers per year are removed from work and chelated to reduce dangerously high body burdens of lead. There are currently 17 cases of lung fibrosis at the plant, primarily among maintenance workers. It is interesting to note that the official number was three cases until the December 1989 revolution, when it became possible to report the other fourteen cases. There are fifteen workers still in the plant who have arsenic-related polyneuropathies, and twenty others have recently retired with this condition. The most prevalent complaints are respiratory; with approximately 100 new cases of acute bronchitis, twenty-five new cases of chronic bronchitis, and six new cases of asthma per year.

- In Dej, a four year follow up study was done of workers exposed to carbon disulfide in a plant where the airborne levels ranged from 5-304 milligrams per cubic meter. Of the workers, 85.7 percent were found to have vegetative symptoms consistent with carbon disulfide poisoning; 70 percent had neurological symptoms; 45 percent had digestive symptoms; and 67 percent had cardiovascular symptoms. Studies were also carried out among workers at the artificial fibers plant in Suceava. In 1985, 43 percent were found to have neurological findings consistent with carbon disulfide exposure, 22 percent with alcohol intolerance, 82 percent with nerve conduction abnormalities, 48 percent with personality disorders, 4 percent with chromosomal aberrations, and 6 percent of births to female workers between 1983 to 1987 ended with a congenitally malformed offspring.

- At the "Bicaz" asbestos cement plant, a special chest x-ray survey of the workers showed that 15% had evidence of asbestosis.

- At the vinyl chloride plant in Borzesti, a follow-up study of workers from 1977-87 showed increasing frequencies of Reynauds phenomenon and acro-osteolysis, which are characteristic of vinyl chloride exposure. There have also been increases in hepato-biliary symptoms and changes in liver function tests consistent with vinyl chloride related pathology.

- In a pesticide manufacturing plant in Borzesti there have been problems with exposure to simazine/atrazine and carbamates. In 1991, 149 relatively young workers exposed to the azide pesticides were evaluated. Eighty-eight were found to be suffering medically significant conditions: 60 percent were experiencing allergies, 38 percent had endocrine conditions, 22 percent had digestive conditions, 15 percent had cardiovascular conditions, 10 percent had respiratory conditions, and 5 percent had reno-genital conditions. Approximately 25 percent had hematological changes which were deemed to be "pre-leukemic" by a hematologist. On two different types of chromosomal evaluation, 13 percent and 8 percent of exposed workers and 1 percent and 1 percent of controls, respectively, showed a pattern of damage. Among the workers exposed to carbamates, a positive correlation was found between the prevalence of nerve conduction disorders on electromyography and the concentration of the urinary metabolite DDC-Na. Chromosome damage was found in 15 percent and 8 percent of their samples on the same two tests mentioned above.

- In the galvanizing area of the Electrobanat plant in Timosoara, a study of pulmonary function showed that 24 percent of the workers had forced vital capacity less than 80 percent of predicted (compared with 5 percent of controls) and 20 percent had forced expiratory volumes less than 80 percent of predicted (compared with 8 percent of controls).

Poland. National statistics are available for compensable occupational diseases. The table below details the five major causes of occupational disease among the 9604 individuals (6031 males and 3573 females) who received new compensation claims in 1988. It should be noted that the leading causes of compensable disease in Poland are not dissimilar to what is seen in North America. For instance, if we exclude problems with joints, which seem to be handled as "injuries" in Poland and "diseases" in North America, then skin diseases, pneumoconioses, upper respiratory problems, hearing loss, and infectious diseases are all among the top ten in this part of the world, too. On the other hand, the overall compensation rate of 77 workers per 100,000 per year would appear to be somewhat lower than the North American experience.

ANNUAL INCIDENCE RATE OF OCCUPATIONAL DISEASES, 1988 (PER 100,000)

Disease	Rate
Hearing loss	20.5
Infectious disease	14.7
Throat/voice problems	9.5
Pneumoconiosis	8.2
Skin diseases	6.4

Hungary. In Hungary, attention has been focused on occupational health problems in the city of Pecs, at the Mecseki Uranium Mine and at the Anthracite Mine at Mecseki Mountain. Workers began mining uranium at Mecseki in the late 1950s until the mine was closed in 1990. Under normal operating conditions the mine employed 50,000 people (although at its peak, the mine employed nearly 78,000 workers): by 1990, 10,450 had cumulative lifetime exposures of more than 25 working level months of ionizing radiation. The three main health problems in this mine, aside from accidents, are noise-related hearing loss, silicosis, and lung cancer. When the mine first opened, 3-5 percent of the workers were developing noise related hearing problems per year, whereas in the late 1980s, this had declined to approximately 0.5 percent per year. In the early years of the mine's operation, it took an average of seven years for an underground miner to develop silicosis from exposure to silicate materials. It is reported that by the late 1980s the average time from first employment to the development of silicosis had increased to approximately twenty years. It was also reported that there had been 103 new lung cancer cases since 1981 among the 10,450 people with greater than twenty-five working level months of exposure.

The silicosis and lung cancer statistics, when taken together, are quite ominous. The silicosis rates should be interpreted as a surrogate indicator of the dustiness of working conditions in the mine. If it is true that silicosis developed within seven years of first exposure in the early years of operation, then the dust exposure conditions must have been very severe since this is a very short period in which to accumulate enough silica in the lungs to cause disease. This is significant not only because of silicosis morbidity, but also because of what it might mean for lung cancer patterns in the future. It is well known that occupational cancers usually develop after a latent interval of 20 years or more from the time of first exposure to an occupational carcinogen. In practice, one often has to wait 30 or 40 years from the time that a new carcinogen is introduced into a workplace until its epidemiological effects can be detected.

In the case of uranium mining, radon gas is a known lung carcinogen. Thus it is not surprising that the authorities at the mine identified lung cancer cases starting in 1981, approximately 25 years after the mine opened. What is ominous is that the working conditions in the early years of the mine will largely determine the extent of the subsequent lung cancer epidemic. Since the carcinogenic alpha particles associated with radon gas will absorb to silica aerosols, the number of lung cancer cases which might show up over the next two decades will likely be directly related to the intensity of the exposure to silica in the early years of the operation of the mine. It is impossible to predict how many new lung cancer cases might occur, but it would not be surprising if it exceeded 1,000. If this prediction is correct, it will create a particularly difficult health-social crisis in a community facing the prospect of mass unemployment with the potential shutdown of its two largest industries.

Silicosis was also a major problem among the underground miners in the anthracite mine due to the silicates in the rock in which the coal is found. In recent years, an average workforce of 4100 miners have worked underground. These miners are allowed to do a maximum of 4000 shifts before compulsory retirement from underground mining; which works out to be approximately 20 years of experience. Despite this maximum, the mine is producing 100 to 120 new silicosis cases per year. This implies that the average worker has approximately a 50 percent chance developing silicosis during his working life time.

Czechoslovakia. In Czechoslovakia, as in Hungary and Poland, routinely collected data on occupational diseases do not clearly indicate working conditions which are qualitatively worse than in Western countries. In large measure, this may be the true state of affairs. But as well, it is due to the fact that guidelines on compensability of disease are determined politically rather than scientifically; so direct comparison of compensation statistics from one country to another will be distorted by policy influences. Therefore, compensation data are interesting mostly for identifying specific unusual phenomena rather than for making broad population comparisons.

In reviewing the compensation data for Czechoslovakia for the period 1978-88, two items stand out. One is the persistence of several dozen cases of silicotuberculosis being compensated per year. This is in addition to approximately equal number of cases of non-silicotic type tuberculosis which, presumably, come from the health care sector. These data likely reflect the fact that tuberculosis is still endemic in Czechoslovakia, whereas in most Western countries it is sporadic. The second pertinent finding is that approximately 100 cases of lung cancer related to exposure to ionization radiation are being compensated each year. This is an extremely important outcome because it represents an element of the public health consequences of exploiting nuclear energy as a substitute for coal.

There have been studies of six groups of miners who work in uranium, iron, and shale clay mines and are exposed to radon gas, using world-class cohort methodology and statistical analysis. The study groups include one sub-cohort whose exposure began before 1950, three which began in the 1950s, one in 1968, and the latest one in 1973. The results are particularly useful in estimating an "attributable risk" per unit of exposure; which is given as 20 to 30 lung cancers per million per year per working level month of exposure. From these data, it is possible to make rough estimations of the ongoing risks of continuing to mine uranium and other substances found in rock with high radon levels. If the dose-response relationships reported in the research today still apply to the mining conditions of the early 1990s, then a great deal of improvement in the working conditions will need to made before the risks are in any sense "acceptable," even in a country which must make difficult trade-offs in order to obtain energy.

As good as the work on radon exposed workers is, it is incomplete. It would be very important for studies to evaluate leukemia and other cancers which might be attributable to ionizing radiation exposures. These studies would be necessary in order to more comprehensively determine the health impacts of obtaining energy from radioactive sources.

The following tables provide some information regarding occupational variations in the proportion of reported congenital anomalies among workers in two cities among the mining districts of North Bohemia compared with the town of Jablonec in the non-mining district of North Bohemia. The former table shows three-fold variations in the proportion of children with congenital anomalies among women in six occupational groups where significant chemical exposures might occur. However, because the number of children produced by these women was relatively small during the course of the study, the estimates of the proportion of congenital anomalies may be somewhat unstable. Thus, from a statistical standpoint, it is possible that these results could be explained by chance alone. Similar patterns are seen in the latter table in relation to the proportion of congenital anomalies by paternal occupation. Once again, the highest rates of congenital anomalies are found in the occupations where the smallest number of children have been born (i.e. among printers). However, this methodological problem should not be taken to mean that the data are wrong, only that they are of an exploratory rather than an hypothesis testing character.

Occupational Group	*Mothers*		
	Number of live births	Percent with congenital anomalies	Percent excess compared with Jablonec
Non-exposed	13,069	8.8	
Printing	16	25.0	+184
Hair-dressing	61	11.5	+31
Gas-production	63	11.1	+26
Agriculture	353	11.0	+25
Chemical production	279	10.4	+18
Hospitals	504	9.3	+11
	Fathers		
	Number of live births	Percent with congenital anomalies	Percent excess compared with Jablonec
Non-exposed	12,111	8.4	
Printing	18	33.3	+296
Gas-production	91	14.3	+70
Chemical production	349	11.7	+39
Machine production	504	10.3	+23
Mining	1111	9.5	+13
Medical doctors	190	7.4	-12

Lithuania. The Republican Hygiene Centre estimated that, based on industrial hygiene monitoring; approximately 175,514 workers in 1989 were working in establishments where there is an ongoing concern about exposure to gases and vapors, dust, vibration, or noise. The most hazardous industries are considered to be textiles, machinery and building materials.

In 1990, 373 cases of occupational disease were registered in Lithuania, up from 240 in 1989. Sixty-seven percent of these involved vibration (primarily vibration-related back injury from tractors), 10 percent involved noise (primarily hearing loss in the textile, furniture, and lumber industries), and 7 percent involved the respiratory system. As a result of vibration problems with poorly maintained tractors, half of all reported occupational diseases occur in agriculture. Other recognized problems include skin allergies among health care workers using inadequately sterilized syringes; asthma among painters, workers producing building materials, and workers at the cement plant in Akmene; and silicosis among molders in steel foundries.

Officials at the Republican Hygiene Centre have reason to believe that occupational disease is underreported in the country. For instance, no occupational diseases are reported from pulp and paper mills or fertilizer plants; no record is kept of Hepatitis B cases among medical staff; and no lead surveillance is carried out in electrotechnical industries where soldering is done. There is little specialized diagnostic equipment in the country for occupational health purposes, especially as regards early diagnosis of insidious conditions. Variability due to medical diagnostic factors is best illustrated by the fact that, when a new specialist who was interested in vibration-related disease began work three years ago, the number of compensated cases of vibration-related disease across the country doubled! As another example, only 1-2 acute pesticide poisonings are recorded each year, but these tend to be acute emergencies. No one knows how many less acute cases occur. Finally, there is no organized insurance fund for workers' compensation. The legislated benefits are quite generous, but they must be paid directly by the employer. Therefore workers are pressured to not report occupational health problems. The Republican Hygiene Centre considers establishing a compensation fund to be a priority.

Latvia. There is reason to believe that the most significant environmental chemical exposures in Latvia occur at work, rather than in the community. A study carried out in 1975 showed that the odds of a lung cancer case having had a significant workplace exposure were 11.6 times higher than controls who did not have lung cancer. Unfortunately, this work was done in 1975, and has not been repeated since. Nor have there been any more detailed investigations of cancer or other chronic diseases in the workplace in Latvia.

The Latvian Occupational Diseases Centre has estimated that 166,000 workers, 12.3 percent of the workforce, are working under poor conditions. It is not clear how this estimate was made. More concretely, 56 percent of 2255 monitored enterprises in Latvia do not meet current exposure standards. Despite these estimates, there were only 240 occupational diseases reported in 1990. The following data gives the distribution of these diseases.

MOST COMMONLY REPORTED OCCUPATIONAL DISEASES, 1990

Disease	Percentage of cases
Lung and bronchial illnesses	23.2
Cochlear neuritides	33.1
Musculosketal & peripheral nervous system	18.2
Vibration-induced diseases	9.8
Allergic disorders	9.8

The number of reported lung and bronchial diseases has been increasing in recent years, occurring most frequently among workers in the building material industry, mechanical engineering industry and glass and china industry. In 1990 there were fourteen cases of pneumoconiosis (e.g. silicosis, asbestosis) diagnosed, mostly from the electrotechnical industry. These figures are likely to be gross underestimates. For example in Broceni, polyclinic records show that more than 400 asbestos cement workers are suffering from obstructive lung disease, yet no more than a handful of them have found their way into the national statistics. Like Lithuania, the individual workplace must pay some, though not all, of the compensation to disabled workers. I am not sure to what extent this disincentive has reduced occupational disease reporting and to what extent underdiagnosis and political manipulation have been contributing factors.

Broceni is the site of the 'Slates' asbestos cement plant which has heavy exposures of asbestos in the workroom air. Data show periodic exposures to asbestos and asbestos-laden dust which are as much as 1-2 orders of magnitude above accepted norms in the West.

Data from the local polyclinic, reveals that a very high proportion of the workers in the plant are diagnosed as having obstructive lung disease. In Latvia, this diagnosis is a catch-all, which includes what we would normally call obstructive lung disease, but would also include dust deposit diseases such as asbestosis. This is because many of the screening X-rays done for chest disease in Latvia are not of high enough quality to make the diagnosis of a dust deposit disease. Therefore, all diseases involving chronic cough and breathlessness tend to be lumped together. During the five years 1987-91, the average prevalence of Chronic obstructive lung disease (COPD) was approximately 40 percent and nine respiratory cancers were diagnosed. Since the plant is only 20 years old and the minimum latent period for respiratory cancer due to asbestos is 10-20 years, it is possible that this is the beginning of an epidemic curve.

It is important to realize that, despite the very high dust levels in the plant and associated respiratory morbidity, this plant was not identified to us as a principal concern by environment or health authorities in Latvia. Data were obtained by purely informal means and do not seem to be in the possession of any officials in Riga. Perhaps environmental officials were not concerned because the plant only emits 5000 tons of dust per year into the general environment. In general, concerns about asbestos exposures in the region are not as high as they deserve to be on the basis of the human health impact of asbestos and the exposure conditions which exist in plants like Broceni.

Olaine is the centre of the Latvian pharmaceutical industry. It has two large facilities, known as Biolar and Latbiofarm, which are of environmental health interest because both are within a few hundred meters of town. It is also of occupational health concern because of the complex chemistry of their production processes. Latbiofarm is a large facility with a wide range of products, including anti-cancer agents which are themselves carcinogenic. In one special investigation of workroom air, the MAC was exceeded in 17-21 percent of measurements for ethanol, isopropanol, butanol, benzene, benzaldehyde, chloroform, dichloride, or acetone. At a distance of 1200-1300 meters, 9 percent of short-term air samples exceeded the MAC for isopropanol, ammonia, aliphatic amines, nitrogen oxides, hydrogen chloride, or formaldehyde in 1986-88. In another air monitoring exercise, eight substances (hydrogen chloride, formaldehyde, isopropanol, phenol, acetone, nitrous oxide, sulfuric acid and methanol) were measured at five locations in the area, three months a year for three years. It was reported that 41 percent of the samples exceeded the MAC.

The water effluent includes toluene, formic acid derivatives, various alcohols, and certain carcinogenic substances such as benzene and anti-cancer agents. Thus, the waste water is both toxic and mutagenic. It is treated at the plant's facility which is 500 meters from town. City sewage and waste from Biolar also go into the facility. The facility has technical problems with the complex mixtures of sewage, domestic detergent, and industrial chemicals it must treat. There are problems with creating new toxic agents through chlorination, airborne discharges of volatile hydrocarbons, and contamination of groundwater with toxic sludge. In addition, the plant has been burying solid waste in 1200 meter deep dolomite deposits. It is suspected that these have contaminated the groundwater, but there does not seem to be reliable data on this matter.

The pharmaceutical workers and the town's inhabitants have been the subject of health concern for several years. The most impressive of these involved workers from Biolar, residents of Olaine, and controls from Aizkraukle. Results are shown in the table below. They show that the workers and, to a lesser extent, the residents of Olaine, differ from the controls on four important immunological measures. Also, it was demonstrated that residents and workers had higher rates of bronchitis and allergic rhinitis than controls. The workers, but not the residents, also had higher rates of chronic hepatitis and allergic dermatitis than the controls. These results are reasonably credible because they are specific to the toxic properties of the exposures from the plants.

ALLERGIC AND IMMUNOLOGICAL OBSERVATIONS, OLAINE: PERSONS WORKING AT CHEMICAL FACTORIES, RESIDENTS, AND CONTROLS (PERCENTAGE)

Variable	Workers (n=560)	Residents (n=200)	Controls (n=200)
Sensitization to chemical allergens	41[1]	18[1]	0
Immunosuppression of local immunity	53[1]	33[2]	20
Interference with humoral immunity	32[1]	26[2]	20
Interference with cell-mediated immumity	30[1]	24[2]	18

1/p < 0.05
2/p < 0.01

Bulgaria. The following data shows the distribution of compensated occupational diseases in Bulgaria for the latest available year, 1989.

	Disease	Percentage of cases
1.	Repetition Strain Injuries	49
2.	Hearing Loss	12
3.	Vibration Syndromes	11
4.	Lung Diseases	11
5.	Poisonings	8
6.	Allergies-Skin	4
7.	Biological factors-infection	3

While the proportional distribution of the compensable diseases is credible enough, the total number of new cases (200-400 per year) is approximately ten times lower than I would have expected for a country of 8 million people.

When confronted with this observation, there seemed to be general agreement that, indeed, there was large scale undercounting of occupational diseases in the country. A number of reasons were advanced for this problem. In order for an occupational disease to be compensated, it must be acknowledged by an expert diagnostic commission. These commissions, made up of occupational pathologists, internists, hygienists, and other specialists, exist in 30 locations around the country. Workers must apply to these commissions in order to get a disease compensated. It is thought that many physicians do not refer people to them who have legitimate occupational disease (e.g. noise induced hearing loss) and the network of commissions does not have any method to find individuals who are not being referred by their physicians. If a worker is deemed by the commission to have an occupational disease, he or she still has to take the company to court in order to get compensation. This is a surprising obstacle not found in other Eastern European countries or in North America. When compensation comes, the payment is usually much lower than what the worker would make if he or she were still at work. It would appear that there is no provision made that would allow a worker to continue to work while collecting a disability pension.

In addition to an extended discussion on the problems on workers compensation statistics, I was given general descriptions of several investigations being carried out by the Clinic of Occupational Diseases. Most of this work does not contribute a great deal to our understanding of the environmental health situation in Bulgaria because it deals with special surveillance and screening programs for workers, rather than health outcomes per se. I received one useful set of data from occupational surveillance which provided average blood lead levels on workers from several plants in 1979 and 1990. It shows that the average blood lead levels were at or above the critical range of 40 to 60 micrograms per deciliter for adults. Because these values are averages and not peak values, we must assume that a large fraction of the workers in these facilities are being grossly overexposed to lead. This was the only data set available to me which helped demonstrate the potential scale for occupational disease in Bulgarian industry. It stands in marked contrast to the message implicit in the compensation statistics.

Ukraine. Like several other countries in the Region, there appears to be significant under-reporting of occupational disease in Ukraine. For example, in the industrial city of Mariupol, with a 1990 population of approximately 550,000, there were only 119 reported cases of all occupational diseases over the period 1980-91. The reasons for this are similar to other countries as well. Under the previous regime, physicians and plant managers were discouraged from diagnosing and reporting occupational diseases. The list of compensable occupational diseases is limited, primarily to: chronic dust bronchitis, pneumoconiosis, vibration-associated disorders, noise-induced hearing loss, and certain back and joint conditions. There is a lack of appropriate screening and diagnostic tests.

Despite extensive exposure to lead in the workplace, there are few facilities for testing for blood lead. For instance, at the lead and zinc smelter in Konstantinovka, only 15 cases of lead poisoning were reported between 1985 and 1990 among a workforce of approximately 1600. Although annual physical examinations are done on the workers, no proper blood samples are drawn for analysis. Airborne lead levels in the smelter are exceedingly high. Between 1989 and 1992 the range of mean airborne lead levels in various work stations was 80-750 micrograms per cubic meter (the Ukrainian MAC is 10 micrograms per cubic meter and the American Permissible Exposure Limit is 50 micrograms per cubic meter). Based on the experience of airborne exposures like this in other locations, it must be inferred that there is massive under-diagnosis of acute and chronic lead poisoning in the smelter.

Notwithstanding these problems, some significant occupational health problems can be identified through routinely collected data. There are an estimated 35,000 prevalent cases of coal workers' pneumoconiosis and chronic dust bronchitis in Donetsk Oblast, which is home to approximately 300,000 underground coal miners. There are other, more direct indications that the coal mines may be specially hostile working environments. Underground coal miners who work strenuously in a hot environment have increased rates of acute myocardial infarction (heart attack), which has been attributed by researchers to hot microclimates in the mines (often with temperatures at 35 degrees Celsius) and arduous physical work. The rate of sudden death among coal miners in Donetsk Oblast is 170 per 100,000 per year (a total of 510 sudden deaths a year among coal miners in the oblast), as compared with a rate of 120 per 100,000 per year among the rest of the population.

In Ukraine, many coal mines have vertical shafts. Rates of occupational disease and injury are higher in mines with vertical shafts than those with horizontal shafts. Coal dust levels are said to average 90-150 milligrams per cubic meter in the horizontal shafts and about 400-500 milligrams per cubic meter in the vertical shafts. The rate of vibration-associated disorders is more than fifteen times higher in mines with vertical shafts than those with horizontal shafts. In addition, there have been documented instances of chemicals such as chlorobenzene, formaldehyde, and cyanides directly leaking into mines with vertical shafts from factories that sit atop or near the top of the mine shafts. In one incident, three deaths occurred when chlorobenzene had been allowed to leak into a vertical mine shaft over at least several weeks, despite warnings, from a factory that was located at the top of the mine.

Belarus. Further evidence of under-reporting of occupational disease comes from Belarus, where, in the most recent year for which data are available, only 247 cases were identified in a republic of 10.8 million people. A close examination of this low number of cases revealed that this number represented only what may be better defined as "occupational disability" cases and that in fact the number of workers with occupational diseases must be much larger, but is currently inestimable. Like in Romania, wages among workers rise with the dangerousness of the job. Thus, workers are reluctant to move to a less hazardous position or complain of ill health because of the fear of losing precious income, particularly during difficult times. Like in Bulgaria, industry opposes identifying occupational disability because management has to compensate the worker. In other words, there is no "no fault" system. Also like in Bulgaria the worker is required to undergo a series of medical examinations before (s)he is classified as occupationally disabled. The first one is done at the plant by a physician paid for by management, the second is done by an oblast committee, and the final one is done by a committee at the Republican Centre at Minsk. There is a lack of appropriate diagnostic equipment at all levels and so it is difficult to verify many conditions.

AMBIENT AIR QUALITY IN SELECTED LOCALITIES IN EASTERN EUROPE

Country/City	Annual ambient concentrations ($\mu g/m^3$) TSP	SO₂	
Bulgaria (1989-90)			
Dimitrovgrad	530	119	
Srednogorie	400	440	
Devnya	350	28	
Panagiurishte	320	350	
Kurdzhali	310	103	
Sofia	303	67	
Ruse	300	32	
Plovdiv	280	306	
Stara Zagora	275	120	
Asenovgrad	270	485	
Pernik	245	469	
Vratsa	160	59	
Czechoslovakia (range of annual averages, 1981-88)			
N. Bohemia:	63-223	43-184	
Usti nad Labem	94-223	70-98	
Litvinov	70-161	59-184	
Decin	91-150	60-126	
Most	75-127	55-176	
Teplice	63-111	87-141	
Chomutov	66-106	58-120	
C. Bohemia:			
Beroun	85-134	9-34	
Prague	77-107	26-117	
Kladno	64-98	30-72	
Melnik	52-85	46-72	
S. Bohemia:			
Sokolov	74-129	24-50	
Plzen	47-118	16-113	
Other:			
Ostrava	102-139	47-77	
Ziar nad Hronom	>100		
Brno	63-86	23-55	
Bratislava	70-90	24-40	
Hungary (1987-88)		winter (10/1-3/31)	annual
Borsod-Abauj-Zemplen industrial zone:			
Izsofalva		133	72
N. Transdanubian:			
Tata		146	84
Dorog		114	94
Tatabanya		101	62
Esztergom		100	57
Komarom		90	52

Country/City	Annual ambient concentrations ($\mu g/m^3$)	
	TSP	SO_2
Poland (TSP data for 1987, SO_2 data for 1987 or 1988)		
Katowice:		
Dabrowa Gorn.	477	36
Chorzow	440	70
Myslowice	342	42
Swietochlowice	336	67
Katowice	311-327	29-75
Ruda	318	55
Chrzanow	315	128
Tarn. Gory	314	112
Zawiercie	297	51
Wodzislaw	288	75
Rybnik	276	45
Gliwice	267	42
Pilica	225	29
Tosek	209	107
Bytom	279	48
Zabrze	174	49
Jelenia Gora:		
Kamienna Gora		129
Bolkow		112
Lubawka		99
Zgorzelec		82
Krakow:		
Krakow	138	105
Legnica:		
Chojnow		115
Piotrkow:		
Tomaszow Maz.		88
Poznan:		
Gniezno		96
Torun:		
Torun		149-584
Walbrzych:		
Zarow		289
Swiebodzice		280
Jaworzyna Sl.		277
Strzegom		271
Swidnica		197
Lazdec		193
Walbrzych		57-187
Dlugopole Zdroj		183
Polanica		179
Wroclaw:		
Wroclaw	105	70

Country/City	Annual ambient concentrations ($\mu g/m^3$) TSP	SO_2
Romania (1990)		
Bucharest	14-285	1-8
Piatra Neamt	250	33
Zlatna	204	128
Drobeta Turnu Severin	188	
Galati	166	34
Craiova	75-140	6-7
Tirgu Jiu	120	16
Tirgu Mures	116	
Slatina	113	15
Medias	107	
Satu Mare	107	
Hunedoara	99	11
Isalnita	84	4
Belarus (1991)		
Orsha	395	8
Vitebsk	166	11
Polotsk	135	19
Mogilev	133	14
Estonia (1990)		
Narva	200	50
Tallinn	100	90
Latvia (1989)		
Ventspils	100	20
Lithuania (1990)		
Kaunas	300	10
Siauliai	300	10
Kedainai	200	10

Country/City	Annual ambient concentrations ($\mu g/m^3$)	
	TSP	SO_2
Russia (European) (TSP data 1991, SO_2 data 1989-90)		
Volsk (Saratov oblast)	400	
Lipetsk	380	
Makachkala	380	
Novgorod	370	
Kaluga	340	
Smolensk	340	
Rostov-na-Dony	310	
Shakhty (Rostov oblast)	310	
Zheleznodorozhnyy (Moscow oblast)	300	
Kashira (Moscow oblast)	300	
Nizhnekamsk (Tatariya)	300	
Segezha (Karelia)	300	
Taganrog (Rostov oblast)	300	
Krasnodar	290	
Ulanovsk	270	
Novorossiysk (Krasnodar kray)	260	
Balakovo (Saratov oblast)	240	
Gubakha (Perm oblast)	220	
Podolsk (Moscow oblast)	220	
Volgodonsk (Rostov oblast)	190	
Novocherkassk (Rostov oblast)	190	
Onega (Arkhangelsk oblast)	180	
Dzerzhinsk (Nizhegorod oblast)		130-250
Saratov		230
Astrakhan gas complex (village of Stepnoy)		150
Novokuybyshevsk (Samara oblast)		110-130
Kirovo-Chepetsk (Kirov oblast)		110
Novocherkassk (Rostov oblast)		100
Zapolyarnyy (Murmansk oblast)		73-88
Syzran (Samara oblast)		80
Tolyatti (Samara oblast)		67-80
Ukraine (1990)		
Donetsk	500	40
Krivoi Rog	400	30
Odessa	300	50
Zaporozhe	300	20
Dneprodzerzhinsk	300	10
Dnepropetrosk	200	10
Marioupol	200	20
Makeeva	160-200	84-250
Kiev	100	100

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Power and Heat Plants

Country	Plant name	Location	Fuel	Electrical capacity (MW)	Heat capacity (MW)
Belarus	Lukomskaya (Lukoml)			2,400	
Bulgaria	Bobov Dol	Sofia		630	
	Devnia	Devnia		166	
	Dimo Ditchev	Haskovo		840	
	Maritsa Iztok 2	Dimitrovgrad, Haskovo		1,020	
	Purva Komsomolska (previously Maritsa 1)	Maritsa		200	
	Iztok	Rousse		400	
	Varna	Varna		1,260	
	Maritsa East	Stara Zagora			
	Republica Power	Pernik			
Czech Republic	Chvaletica	Chvaletce	BC, LF	800	
	Detmorovice	Detmorovice	HC, LF	800	
	Ledvice 1 Ledvice 2	Ledvice	BC, LF	200 440	
	Mělník 1 Mělník 2 Mělník 3	Mělník	BC, LF	330 440 500	
	Počerady 1	Počerady	BC, LF	1,200	
	Prunéřov 1 Prunéřov 2	Prunéřov	BC, LF	640 1,050	
	Tisová 1 Tisová 2	Tisová	BC, LF	220 300	

Power and Heat Plants

Country	Plant name	Location	Fuel	Electrical capacity (MW)	Heat capacity (MW)
Czech Republic (cont)	Komorany	N Bohemia region	BC	196	
	Trebovice 2	Ostrava	HC, LF	80	
	Porici 2	N Bohemia region	HC, LF	165	
	Tusimice 1	N Bohemia region	BC, LF	660	
	Tusimice 2			800	
	Hadonin	Hodonin	BC, LF	210	
	Oslavany	Oslavany	HC, LF	94	
Estonia	Estonskaya, Estonian Thermal Power Plant	Narva		1610	
	Pribaltiiskii Baltic Thermal Power Plant	Narva		1435	
	Kohtla Yarve	Kohtla Yarve			
	Ahtme	Kohtla Yarve			
	Iru	Tallinn			
Hungary	Ajka	Ajka		113	266
	Banhida			100	8
	Borsod	Borsod		171	331
	Gagarin	Gagarin		800	28
	November 7, Inota	Electricity		270	63
	Oroszlany	Oroszlany		235	39
	Pecs	Pecs		245	370
	Tisza No1	Tiszapalkonya		250	237
Hungary (cont)	Tiszai	Tiszapalkonya		860	

Power and Heat Plants

Country	Plant name	Location	Fuel	Electrical capacity (MW)	Heat capacity (MW)
	Dunamenti I			580	394
	Dunamenti II			1,290	
Latvia	Riga			530	
Lithuania	Electrenai	Vilnius (Wilno)		1,800	
Moldova	Moldavia (Moldova Moldavskaya)			2,480	
Poland	Adamov	Konin		600	
	Belchatow	Belchatow, Piotrkow	BC	4,320	
	Dolna Odra	Dolna Odra, Szczecin	HC	1,600	
	Jaworzno I	Jaworzno	HC	146	
	Jaworzno II	Jaworzno	HC	350	
	Jaworzno III	Jaworzno, Katowice	HC	1,200	
	Konin	Konin	BC	583	
	Kozienice	Radom, Kozienice	HC	2,600	
	Lagiska (Lagisza)	Lagiska, Katowice	HC	840	
	Laziska	Laziska, Katowice	HC	1,040	
	Ostroleka B	Ostroleka	HC	600	
	Patnow	Patnow, Adamov, Konin	BC	1,600	
	Polaniec	Polaniec, Tarnow	HC	1,600	
	Rybnik	Rybnik, Katowice	HC	1,600	
	Siersza	Siersza, Trzebinia	HC	740	
Poland (cont)	Skawina	Skawina, Kracow	HC	550	

Power and Heat Plants

Country	Plant name	Location	Fuel	Electrical capacity (MW)	Heat capacity (MW)
	Turow	Turow, Turoszow	BC	2,000	
	Siekierki	Warsaw	HC	622	1,300
	Stalowa Wola			385	
Romania	Borzesti	Onesti	LF	655	
	Craiova-Isalnita		BC	1,035	
	Doicesti		BL, LF, GA	400	
	Mintia	Deva	HC, LF	1,260	
	Paroseni		HC	300	
	Rovinari		BC, LF	1,720	
	Turceni		BC, LF	2,310	
	Braila		LF	960	
	Brazi		LF	510	
	Ludus	Lernut		800	
	Bucuresti-Sud			550	
	Galati			535	
	Fintinele	Fintinele		250	
	Bucuresti V	Bucuresti		250	
	Palas	Constanta		220	
	Govora I	Govora		200	
	Iasi I	Iasi		150	
Romania (cont)	Navodari	Navodari		150	

Power and Heat Plants

Country	Plant name	Location	Fuel	Electrical capacity (MW)	Heat capacity (MW)
	Grozavesti	Bucharest		125	
	Pitesti	Pitesti		136	
	Bucuresti Progresu	Bucharest		150	
	Craiova	Craiova		240	
	Borzesto	Onesti-Bacau		100	
	Borzesti	Onesti-Bacau		150	
	Drobeta Turnu Severin	Drobeta Turnu Severin		205	
	Giurgiu	Giurgiu		150	
	Oradea II	Oradea		150	
	Oradea I	Oradea		205	
	Govora II	Govora		100	
	Iasi II	Iasi		100	
	Suceava	Suceava		100	
Russia	Kashira			2,000	
	Ryazan			2,800	
	Lugansk (formerly Voroshilvgrad)			23,000	
	Nobocherkassk	North Caucasus		2,400	
	Reftinskiy (Refta)			3,800	
	Troitsk			2,500	
	Kolskaya	Karelian ASSR			
Russia (cont)	Petrozavodsk	Karelian ASSR		280	

Power and Heat Plants

Country	Plant name	Location	Fuel	Electrical capacity (MW)	Heat capacity (MW)
	St Petersburg (Leningrad)				
	Kirischi			2,070	
	Moscow				
	Konakowo			2,400	
	Kostromo				
	Nizhny Novgorod				
	Nowomoskowsk				
	Nowoworonez				
	Woloszilograd				
	Saratov				
	Perm			2,400	
	Karmanowo			1,800	
	Yekaterinburg				
	Chelyabinsk				
	Magnitogorsk				
	Stavropol			2,400	
	Inta				
	Archangelsk				
	Zainsk			2,400	
	Tripolye			1,800	
Russia (cont)	Verkhni Tagilsk			1,625	

Power and Heat Plants

Country	Plant name	Location	Fuel	Electrical capacity (MW)	Heat capacity (MW)
	Cherepet			1,500	
	Nevinomiisk			1,430	
	Kurakhovo			1,400	
Slovak Republic	Novāky A	Novāky	BC	130	
	Novāky B			440	
	Vojany 1	Vajany	BC	660	
	Vojany 2			600	
Ukraine	Krivoi Rog 2			3,000	
	Pridneprovsk			2,400	
	Starobeshevo			2,300	
	Zaporozhe			3,600	
	Zmiev (Smijew)			2,400	
	Slavyansk			2,100	
	Burshtyn			2,400	
	Ladyszinskaya			1,800	
	Kanew				
	Uglegorsk			3,600	

Iron and Steel Plants

Country			Plant name	Location	Pig iron	Total steel	OH	BOF	EF
Belarus	1	1	Zhlobin Metallurgical Works	Zhlobin		1,095			1,095
Bulgaria	3	2	Kremikovtsi Iron & Steel Works	Sofia-Botounetz	1,800	2,265		1,765	500
	4	3	Stomana Works (Lenin?)	Pernik	235	1,500	350		1,150
	5	4	Kamet steel plant (new)	Pernik					
	6	5	Kamet steel plant (old)	Pernik					
Czech Republic	7	1	Nova Hut sp	Kuncice, Ostrava	3,500	4,300	3,700	1,000	100
	8	2	Poldi United Steelworks	Kladno, Konev and Drin		1,750	550		1,200
	9	3	Trinec Iron & Steel works	Trinec	2,500	3,000	500	2,100	400
	10	4	Vitkovice Steelworks	Ostrava	1,600	2,250	1,350	500	400
	11	5	Iron and Steelworks	Chomutov					
Hungary	12	1	Csepel Works	Budapest (Csepel Island)		400	250		150
	13	2	Dimag-Diosgyor Metallurgical Stock Corp	Miskolc	600	1,100		700	400
	14	3	Danube Metallurgical Works	Dunaujvaros	1,100	1,815	60	1,200	15
	15	4	Ozd Steelworks Co	Ozd, Borsod-Abauj-Zemiplen	750	1,000	1,000		
Latvia	16	1	Sarkanais Metalurgs	Liepaja, Western Latvia					
	17	2	Red Metal Worker Plant	Liepaja (formerly Libau)		600			
Moldova	18	1	Moldavian Iron and Steel Works	Ribnitsa					
Poland	19	1	Huta Baildon, BHH	Katowice		125	50		75
	20	2	Zaklad Huta Bankowa (Huta Dzierzynski)	Dabrowa Gornicza	150	300	300		
	21	3	Huta Batory	Chorzow-Batory	500	850	800		50

Iron and Steel Plants

Country			Plant name	Location	Pig iron	Total steel	OH	BOF	EF
Poland (cont)	22	4	Huta Bobrek	Konstytucji, Katowice	300	1,300	1,300		
	23	5	Huta Czestochowa (formerly Huta Bierut)	Rakow and Mirow, Chestochowa	700	1,000			
	24	6	Huta Katowice	Wojewodztwo/Dabrowa Gornica, Katowice	5,700	4,500?		4,500	
	25	7	Huta Kosciuszko	Chorsow, Katowice	300	800	800		
	26	8	Huta Ostrowiec (formerly Huta Nowotko)	Ostrowiec-Swietokrzyski		1,000			1,000
	27	9	Huta Pokoj	Ruda					
	28	10	Huta im Tadeusza Sendzimira (formerly Huta im Lenina)	Nowa Huta, NE of Krakow	6,000	6,300	3,000	3,000	300
	29	11	Huta Szczecin	Szczecin					
	30	12	Huta Warszawa	Warsaw		250			
	31	13	Huta Zawiercie	Zawiercie	500	2,700	1,500		1,200
	32	14	Huta Kaziska	Katowice area					
	33	15	Stawola Wola	Stawola Wola		500			500
Romania	34	1	CSR SA Resita	Resita jud Caras-Severin	650	800	800		
	35	2	Siderurgica SA Hunedoara	Hunedoara	2,500	3,200	2,800		400
	36	3	Sidex SA Galati (CSG)	Galati	8,700	10,000		9,800	200
	37	4	Calarasi Iron & Steel Works	Calarasi	3,500	3,800		3,600	200
	38	5	Otelul Rosu Works	Otelul Rosu		600	300		300
	39	6	Tirgovistz/Utas	Tirgovistz		1,000			1,000
	40	7	Uzina Metalurgica Iasi	Iasi		250			250
	41	8	Cimpia Turzii Works	Cimpia Turzii		250	150		100

Iron and Steel Plants

Country			Plant name	Location	Pig iron	Total steel	OH	BOF	EF
Russia	42	1	Amur Steel Works	Komsomolsk on Amur	1,000	1,200	800		1,000
	43	2	Cheliabinsk Tube Rolling Works	Cheliabinsk					
	44	3	Cheliabinsk Iron and Steel Works	Cheliabinsk	5,000	10,000	6,000	3,000	1,000
	45	4	Cherepovets Iron and Steel Works	Cherepovets Volgodonskaya Region	11,500	17,000	5,000	5,000	
	46	5	Elektrostal Metallurgechesky zavod Imeni Tevosyan	Elektrostal (formerly Noginsk)					
	47	6	Izhevsk Iron & Steel Works	Izhevsk					
	48	7	Kirov Works	St Petersburg	3,000	9,200	6,000	3,000	200
	49	8	Magnitogorskiy Iron and Steel Works Combine	Magnitogorsk	12,000	18,000	12,000	6,000	
	50	9	Red October Steel Works	Volgograd					
	51	10	Novolipetsk Iron and Steel Works	Lipetsk	12,000	10,600		10,200	400
	52	11	Novo-Tagil Iron and Steel Works	Nizhniy-Tagil	1,000	5,300	1,800	3,500	
	53	12	Kursk works	Stary Oskol		3,120			1,450
	54	13	Hammer and Sickle Works	Moscow					
	55	14	Serov Iron and Steel Works	Serov					
	56	15	Seversky Tube Works	Polevskoy, Yekaterinburg					
	57	16	Svobodny Sokol Works	Lipetsk					
	58	17	Vyksa Iron and Steel Works	Vyksa, Nizhegorod Region					
	59	18	Zlatoust Iron and Steel Works	Zlatoust					
	60	19	Kostamuksha Iron Pellet Combine						
	61	20	Taganrog Iron and Steel Works	Taganrog					

Iron and Steel Plants

Country			Plant name	Location	Pig iron	Total steel	OH	BOF	EF
Slovakia	62	1	East Slovak Works	Kosice	4,500	4,800		9,800	
Ukraine	63	1	Azovstal Iron and Steel Works	Mariupol (formerly Zhdanov)	6,000	9,200			
	64	2	Dzerzhinsky Works	Dneprodzerzhinsk		2,200		2,200	
	65	3	Dnieper Special Steel Works	Zaporozhye					
	66	4	Donetsk Iron and Steel Works	Donetsk					
	67	5	Elektrostal (Novokramatorsk) Machine Building Works	Kramatorsk					
	68	6	Kommunarsk Iron and Steel Works	Kommunarsk, Luganskaya Region					
	69	7	Konstantinovka Frunze Iron and Steel Works	Konstantinovka					
	70	8	Krivoi Rog Lenin Iron and Steel Works	Krivoi Rog, Dniepropetrovskaya Region	10,000	11,500	3,000	8,500	
	71	9	Kuibyshev Iron and Steel Works	Kramatorsk					
	72	10	Makeevka Iron and Steel Works	Makeevka, Donetskaya Region					
	73	11	Nizhnedneprovsky Tube Rolling Works	Dnepropetrovsk					
	74	12	Carbon steel, stainless steel, alloy steel	Steelmaking 853,000t/a					
	75	13	Petrovsky Iron and Steel Works	Dnepropetrovsk					
	76	19	Yenakiyevo Iron and Steel Works	Yenakiyevo		3,500		3,500	
	77	15	Zaporozhye Steel Works	Zaporozhye					
	78	16	Ilyich Works	Mariupol (formerly Zhdanov)	5,000	5,300	1,300	4,000	
	79	17	Kuznetskiy Met Kombinat	Novokuznetsk	4,000	4,250		3,000	1,250

Non-Ferrous Metal Plants

Country			Plant name	Location	Main products	Capacity
Bulgaria	1	1	Georgi Damanyov Copper Smelter & Refinery	Pirdop	Copper	120,000t/a
	2	2	D Ganev Copper Mining Works		Copper	
	3	3	Isker Ingot Works	Sofia	Copper	
	4	4	Medet Copper Combine		Copper	
	5	5	Dimitar Blagoev Combined Works	Plovdiv	Zinc & Lead	lead 58,000 t/y zinc 90,000 t/y
	6	6	Kurdzhali Lead-Zinc Smelter	Eastern Rhodope Basin	Zinc & Lead	
Czech Republic	7	1	Kovohute Pribram	Pribram	Lead	lead 31,000 t/y
	8	2	Kamenice Remelting Plant	Jihlave, central Bohemia	Lead	
	9	3	Velvary Remelting Plant	Velvary, central Bohemia	Lead	
	10	4	Kovohute Bridlicna	Near Brno, Moravia	Aluminium	
	11	5	Kamenice Remelting Works	Near Jihlave, Central Bohemia	Aluminium	
	12	6	Kovohute Mnisek	Head office - Prague	Aluminium	
	13	7	Velvary Remelting Plant	Velvary, central Bohemia	Aluminium	
	14	8	Rokycany Copper	Plzen		
Hungary	15	1	Almasfuzito refinery	Almasfuzito	Aluminium	Refining 330,000t/a
	16	2	Ajka works	Ajka	Aluminium	Refining 490,000t/a Smelting 345,000t/a
	17	3	Motim works	Motim	Aluminium	Refining 80,000t/a
	18	4	Inota smelter	Inota	Aluminium	
	19	5	Tatabanya smelter	Tatabanya	Aluminium	Smelting 188,000t/a
Poland	20	1	Glogow #1	Glogow	Copper	190,000t/a

Non-Ferrous Metal Plants

Country			Plant name	Location	Main products	Capacity
Poland (cont)	21	2	Glogow #2	Glogow	Copper	130,000t/a
	22	3	Legnica	Legnica	Copper	115,000t/a
	23	4	Zaklady Gorniczo-Hutnicze Bolelsaw	Bukowno, Katowice	Zinc & Lead	Zinc 71,000,000t/a
	24	5	Huta Metali Niezelaznych Szopienice	Szopienice, near Katowice	Zinc & Lead	Lead 35,000 t/y Zinc 60,000 t/y
	25	6	Huta Cynku Miasteczko Slaskie	Tarnowskie, Upper Silesia	Zinc & Lead	Zinc smelting 50,000t/a Lead smelting 30,000t/a
	26	7	Zaklady Cynkowe Silesia	Katowice	Zinc	
	27	8	Konin Aluminium Works	Hutnicza, Konin	Aluminium	
	28	9	Zaklady Metalurgiczne Skawina	Skawina	Aluminium	
	29	10	Zaklady Metali Lekkich Kety	Kety	Aluminium	
Romania	30	1	Phoenix Copper Smelter	Baia-Mare	Copper	
	31	2	Neferal Metallurgical Works	Branesti	Copper & Aluminium	
	32	3		Zlatna	Copper	
	33	4	Copsa-Mica, Sometra	Copsa-Mica	Zinc & Lead	Lead 40,000 t/y Zinc 60,000 t/y
	34	5	Romplumb Lead Smelter	Baia-Mare	Zinc & Lead	Lead 8,800t/a
	35	6	Crisana Alumina Plant	Oradea, Jud. Bihor	Aluminium	
	36	7	Slatina Aluminium Enterprise	Slatina, Jud. Olt	Aluminium	Smelting 263,000t/a
	37	8	Zlatna Aluminium Plant	Zlatna	Aluminium	
	38	9	Tulcea Alumina Plant	Tulcea	Aluminium	
Russia	39	1		Artmovskiy, Yekaterinburg	Copper	
	40	2	Karabashki Gorno Metallurgical Combine	Karabashki, Urals	Copper	

Non-Ferrous Metal Plants

Country			Plant name	Location	Main products	Capacity
Russia (cont)	41	3	Kyshtym Copper Refinery	Kyshtym, Urals	Copper	
	42	4		St Petersburg	Copper	
	43	5	Kirovgradsk Copper Smelter	Kirovgrad	Copper	
	44	6		Kirovsk	Copper	
	45	7	Krasnouralsk Copper Smelter	Krasnouralsk, Urals	Copper	
	46	8	Mednogorsk Copper Combine	Mednogorsk	Copper	
	47	9		Revdensk	Copper	
	48	10	Severonickel	Monchegorsk, Kola Peninsula	Copper	
	49	11	Sredneuralsk Copper Smelter	Sredneuralsk (Sibai), Urals	Copper	Smelting 100,000t/a
	50	12	Pyshma Copper Refinery	Pyshma, Urals	Copper	Refining 280,000t/a
	51	13	Verkhnaia Pyshma Copper Refinery	Pyshma, Sverdlosk region	Copper	
	52	14	Moscow		Copper	Refining 40,000t/a Smelting 40,000t/a
	53	15	Pechenga		Copper	
	54	16	Chelyabinsk Zinc Refinery	Chelyabinsk, Central Urals	Zinc	200,000 t/y
	55	17	Bogoslovsk Aluminium Works (BAZ)	Krasnoturinsk	Aluminium	Refining 535,000t/a Smelting 160,000t/a
	56	18	Chelyabinsk Secondary Aluminium Works	Chelyabinsk, Urals	Aluminium	
	57	19	Kandalaksha Aluminium Smelter	Kandalaksha, Murmansk region	Aluminium	Smelting 70,000t/a
	58	20	Leningrad Secondary Aluminium Smelter	St Petersburg	Aluminium	
	59	21	Moscow Secondary Aluminium Smelter	Moscow	Aluminium	
	60	22	Nadvoytsy Aluminium Smelter	Karelia	Aluminium	Smelting 60,000t/a

Non-Ferrous Metal Plants

Country			Plant name	Location	Main products	Capacity
Russia (cont)	61	23	Yekaterinburg	Voroshilovgrad Oblast	Aluminium	
	62	24	Ural Aluminium Smelter (UAZ)	Kamensk, Central Urals	Aluminium	
	63	25	Volgograd Aluminium Works (VgAZ)	Volgograd	Aluminium	Smelting 125-300,000t/a
	64	26	Volkhov Aluminium Smelter	Zvanka	Aluminium	Smelting 20-60,000t/a
	65	27	Khalilovsk Nickel Smelter	Khalikovsk, Urals	Nickel	
	66	28	Rezhevsk Nickel Smelter	Rezhevsk, Urals	Nickel	
	67	29	Severonickel	Monchegorsk, Kola Peninsula	Nickel	
	68	30	Ufaleisk Nickel Smelter	Urals	Nickel	
Slovakia	69	1	Kovohute Krompachy	Krompachy	Copper	
	70	2	ZSNP Ziar nad Hronom	Ziar, Slovakia	Aluminium	Smelting 170,000t/a
	71	3	Niklova Huta	Sered	Nickel	
Ukraine	72	1	Podolsk Chemical-Metallurgical Works	Podolsk	Copper & Zinc	
	73	2	Electrozinc plant	Ordzhonikidze, Caucasus	Zinc & Lead	
	74	3	Ukrzinc Lead-Zinc Plant	Konstantinovka	Zinc & Lead	Lead 50,000t/a Zinc 80,000 t/a
	75	4	Dnieper Aluminium Smelter (DAZ)	Zaporozhye	Aluminium	
	76	5	Brovary Aluminium Smelter	Brovary, Kiev region	Aluminium	

Oil Refineries and Petrochemical Plants

Country			Plant Name	Location	R/P	Crude Capacity ('000 t/y)	Petrochemical Capacity ('000 t/y)			
							Ethyl	Benzene	Toluene	Xylene
Belarus	1	1		Mozyr	R	321.28 b/cd				
	2	2	Petroleum Organic Synthesis Production Association	Polotsk, Novopolotsk	P	510.26 b/cd				
Bulgaria	3	1	Neftochim	Burgas	P	240 b/cd	380(+150)	148	45	32
	4	2	Plama	Pleven	R	30 b/cd				
	5	3	Bimas	Ruse		30 b/cd				
Czech Republic	6	1	Paramo	Pardubice	R	28 b/cd				
	7	2	Chemopetrol	Litvinov	P	28 t/a	450	250		30
	8	3	Chemicke Zavody Litvinov	Most, Litvinov	P	15 t/a	450 t/a			
	9	4	Deza (formerly Urxovy Works)	Ostrava	R/P			20	5	
	10	5	Kaucuk s.p.	Kralupy	R	70 b/cd				
	11	6	Ostramo	Ostrava	R					
	12	7	Benzina	Prague	P					
	13	8	Koramo Kolin	Kolin	R	5.555 b/cd				
	14	9	Novaky		P		50			
Hungary	15	1	Dunai kv, Danubia Refinery	Százhalombatta	R	165 b/cd				
	16	2	Dunamont, Dunastyr	Szazhalombatta	P			110	110	95
	17	3	Tiszai KV, TKV-TIFO Refinery	Tiszaujvaros (Leninváros)	R/P	60 b/cd	260			
	18	4	Zalai KV	Zalaegerszeg	R	10 b/cd				
	19	5	Komarom Refinery	Komarom	R					

Oil Refineries and Petrochemical Plants

Country			Plant Name	Location	R/P	Crude Capacity ('000 t/y)	Petrochemical Capacity ('000 t/y)			
							Ethyl	Benzene	Toluene	Xylene
Hungary (cont)	20	6	Dunau/Varos (coal-based)		P		10			
Lithuania	21	1		Mazeikiai	R	226.6 b/cd				
Poland	22	1		Kralaty, L. Warynski		41.190 b/cd				
	23	2	PP Rafineria Nafty Czechowice	Czechowice		13.200 b/cd				
	24	3	PP Rafineria Nafty Glinik Mariampolski	Gorlice	R	2.470 b/cd				
	25	4	Blanchownia		P		40(+100)	100	60	
	26	5	PP Rafineria Nafty Jedlicze	Jedlicze	R	3.880 b/cd				
	27	6	PP Rafineria Nafty Jaslo	Jaslo	R	2.660 b/cd				
	28	7	PP Rafineria Nafty Trzebinia	Trzebina	R	9.500 b/cd				
	29	8	Mazovian Refinery & Petrochemical works	Plock	R/P	200 b/cd	365(+15)	160	55	100
	30	9	Petroleum Refinery Gdansk	Gdansk	R	60 b/cd				
	31	10	Planned petrochemicals site	Kedzierzyn	R/P	6,000 t/a Petrochemical 2,500t/a				
Romania	32	1	Arpechim SA	Pitesti	R	125 b/cd	130.534			
	33	2	Astra SA	Pitesti	R	56 b/cd				
	34	3	Petrotel, Petrotel	Ploiesti	P	104 b/cd	200 t/a			
	35	4	Darmanesti Refinery	Darmanesti	R	33.0 b/cd				
	36	5	Petrobrazi	Ploiesti	P/R	159 b/cd				

Oil Refineries and Petrochemical Plants

Country			Plant Name	Location	R/P	Crude Capacity ('000 t/y)	Petrochemical Capacity ('000 t/y)			
							Ethyl	Benzene	Toluene	Xylene
Romania (cont)	37	6	Petrolsub	Bacau	R	8 b/cd				
	38	7	Petromidia	Navodari	P/R	110 b/cd				
	39	8	Rafo	Onesti	R	108.78 b/cd				
	40	9	Chimcomplex SA Borzesti/Carom	Onesti	P					
	41	10	Steaua	Cimpina	R	9.272 b/cd				
	42	11	Vega	Plocisti		18.516 b/cd				
	43	12	Brasov							
	54	13	Rimnicul-Sarat		R					
Russia	45	1		Perm	R/P	278.4 b/cd	60			
	46	2		Grozny	R/P	387.72 b/cd	30			
	47	3		Ishimbai	R	160 b/d 12m t/year				
	48	4		Izhevsk						
	49	5		Kirishi	R/P	386 b/cd		100		120
	50	6		Magnitogorsk						
	51	7		Michurinsk						
	52	8		Moscow	R/P	243 b/cd		220		
	53	9		Nizhnekamsk	R/P	120 b/cd	450	200		
	54	10		Nizhny Novgorod	R	435.06 b/cd				
	55	11		Omsk	R	564 b/cd				

Oil Refineries and Petrochemical Plants

Country			Plant Name	Location	R/P	Crude Capacity ('000 t/y)	Petrochemical Capacity ('000 t/y)			
							Ethyl	Benzene	Toluene	Xylene
Russia (cont)	56	12		Angarsk	R	462 b/cd				
	57	13		Achinsk	R	139 b/cd				
	58	14		Khabarovsk	R	90 b/cd				
	59	15		Khomsomolsk	R	116.14 b/cd				
	60	16		Salavat	R	246.16 b/cd				
	61	17		Novo-Ufa	R	377.64 b/cd				
	62	18		Grozny-Sheripov	R	40 b/cd				
	63	19		Orenburg						
	64	20		Ryazan	R/P	370.6 b/cd		125		
	65	21		Saratov	R/P	176.2 b/cd	30			
	66	22		Syzran	R	210.3 b/cd				
	67	23		Tuapse	R	45 b/cd				
	68	24		Ufa	R	483.74 b/cd				
	69	25		Ukhta	R	125.7 b/cd				
	70	26		Volgograd	R	188.92 b/cd				
	71	27		Yaroslavl	R	357 b/cd				
	72	28		Pyatigorsk						
	73	29		Krasnodar	R/P	33.98 b/cd		130		
	74	30		Samara (formerly Kuibyshev)	R	119.58 b/cd				

Oil Refineries and Petrochemical Plants

Country			Plant Name	Location	R/P	Crude Capacity ('000 t/y)	Petrochemical Capacity ('000 t/y)			
							Ethyl	Benzene	Toluene	Xylene
Russia (cont)	75	31		Gubakha	P			20		
	76	32		Orsk	R	144.2 b/cd				
	77	33		Novokuibysten	R/P	307.4 b/cd	60			
	78	34		Cherepovets	P			90		
	79	35		Gorkiy	P		300	180		
	80	36		Kazan	P		360	210	200	
	81	37		Lipetsk	P			70		
	82	38		Budyennovsk	P		250	100		
Slovakia	83	1	Slovnaft	Bratislava	R/P	144 b/cd	260(+40)	92	55	160
	84	2	Zyolen							
	85	3	Petrochema Dubova	Dubova	R					
	86	4		Stratzje						
Ukraine	87	1		Drogovych	R	77.6 b/cd				
	88	2		Kherson	R	172.86 b/cd				
	89	3		Kremenchug	R	372.5 b/cd				
	90	4		Lisichansk	R/P	469.22 b/cd	350			
	91	5		Lvov						
	92	6		Nadvornaya	R	73.20 b/cd				
	93	7		Odessa	R	78.340 b/cd				
	94	8		Vinnitsa						

Oil Refineries and Petrochemical Plants

Country			Plant Name	Location	R/P	Crude Capacity ('000 t/y)	Petrochemical Capacity ('000 t/y)			
							Ethyl	Benzene	Toluene	Xylene
Ukraine (cont)	95	9		Vannovskiy		40 b/cd				
	96	10		Zaporozhye						
	97	11		Kalush	P		250	120		
	98	12		Severodonetsk	P			100		
	99	13		Gorlovka	P			25		
	100	14		Donestsk	P			30		
	101	15		Dneprodzerzhinsk	P			50		
	102	16		Avdayevka	P			25		
	103	17		Dnepropetrovsk	P			65		
	104	18		Kharkov	P			20		
	105	19		Kommunarsk	P			20		
	106	20		Krivoi - Rog	P			20		
	107	21		Miskayevka	P			25		
	108	22		Yasnov	P			60		
	109	23		Yenakijeva	P			25		

Chemical Plants

Country			Plant name	Location	Main products	Capacity	Output
Belarus	1	1	Gomel Chemical Plant	Gomel	Phosphates	Phosphoric acid 328,000t/a	
	2	2	Grodno Nitrogen Production Association		Nitrogenous products	Ammonia 808t/aN	
Bulgaria	3	1	Agrobiochim	Stara Zagora	Nitrogenous and phosphatic products and others	Fertilizers 900,000t/a product	
	4	2	Asotnotorov Zavod (Nitrogen Fertilizer Works)	Stara Zagora	Nitrogenous products	Fertilizers 793,000t/a product	
	5	3	Polichim	Devnia	Nitrogenous and phosphatic products PVC	Fertilizers 120,000t/a product NP 350,000t/a	
	6	4	Polymeri (This is probably the same plant as Polichim)	Devnia	Chloralkali products		
	7	5	Chimko?, Vratsa Chemical Combine	Vratsa	Nitrogenous products and others	Fertilizers 800,000t/a urea	Urea 787,000t/a
	8	6	Neochim	Dimitrovgrad	Nitrogenous and phosphatic products		
	9	7	Agropolchim	Povelyanovo	Nitrogenous and phosphatic products	Nitrogenous fertilizers 600,000t/a Phosphatic fertilizers 290,000t/a	
	10	8	Sodi (This is part of Agropolichim and Sodi complex)	Devnia	Chloralkali products	Soda ash 1,760,000t/a	Soda ash 1,013,000t/a
Czech Republic	11	1	Moravske Chemicke Zavody	Ostrava	Fertilizers and others	Fertilizers 114,000 tpa product	Sulphuric acid 80,000t/a
	12	2	Severoceske Chemicke Zavody, North Czech Chemical Works	Lovosice	Fertilizers and others	Fertilizers 1,280,000t/a product	
	13	3	Vychodoceske Chemicke Zavody, Synthesia	Pardubice-Semtin	Fertilizers and others	Fertilizers 200,000t/a product	

Chemical Plants

Country			Plant name	Location	Main products	Capacity	Output
Czech Republic (cont)	14	4	Spolana Chemical Works	Neratovice	PVC, VCM and others	Caprolactam 44,000t/a	
	15	5	Spolchemie Chemical Plant, United Chemical and Metallurgical Works	Usti nad Labem	PVC and others		
	16	6	Sokolov Chemical Works	Sokolov		Fertilizers and acrylic acids and esters	
	17	7	Precheza	Prerov	Titanium dioxide	24,000 t/a	
Estonia	18	8	Salvo	Tallinn	Industrial chemicals		
	19	9	Shale Chemical Production Association, Slantsekhimicheskoe Obednenie PO	Kohtla Jarve	Nitrogenous and phosphatic products	Ammonia 388,000 t/a N	
	20	10	Kivoli	Kohtla Jarva			
Hungary	21	1	Borsodchem (Borsodi Vegyi Kombinat until 1991) (BVK)	Kazincbarcika	Nitrogenous products, PVC and others	Fertilizers 314,000t/a	
	22	2	Peremarton Vegyipari Vallala, Peremarton Chemical Company	Peremarton	Phosphatic products	Fertilizers 565,000 t/a	
	23	3	Pet Nitrogenmuvek	Varpalota, Postafiok	Nitrogenous, phosphatic products and others	NP/NPK fertilizer 430,000 t/a	
	24	4	Budapest Chemical Works	Budapest	Fertilizers and others		
	25	5	Tiszamenti Vegyimuvek	Szolnok	Phosphatic fertilizers		
	26	6	Tiszai Vegyi Kombinat (Formerly Leninvaros)	Tiszaujvaros	Nitrogenous products, polymers and others	Fertilizers 540,000 t/a product	
	27	7	Chemolomplex	Leninvaros			
Latvia	28	1	SKTB Non-Organic Materials	Riga	Industrial chemicals		

Chemical Plants

Country			Plant name	Location	Main products	Capacity	Output
Latvia (cont)	29	2	Ventspils Plant	Ventspils	Nitrogenous and phosphatic fertilizers		
Lithuania	30	1	Ionava Nitrogen Fertilizer Plant/Industrial Amalgamation Azotas	Ionava/Jonava	Nitrogenous products	Fertilizer 1,000,000 t/a	
	31	2	Kedainiai Chemical Combine	Kedainiai	Phosphatic products	Phosphoric acid 235,000 t/a P205	
Poland	32	1	Chorzow	Chorzow			
	33	2	Zaklady Chemiczne Oswiecim	Oswiecim	Polymers and others	Synthetic rubbers & latexes 103,000 t/a; solvents 104,000 t/a; other chemicals 100,000 t/a	
	34	3	Zakl. Chem. Blachownia	Blachownia	LDPE and aromatic compounds	Ethylene 40,000 t/a Propylene 20,000 t/a	
	35	4	Gdanskie Zaklady Nawozow Fosforowych, Fosfory Gdansk	Gdansk	Phosphatic products	Fertilizers 862,000 t/a	Triple superphospate 150,000 t/a
	36	5	Police Zaklady Chemicze	Police, Szczecin	Nitrogenous and phosphatic products	Fertilizers 1,450,000 t/a	Ternary fertilizer 445,000 t/a
	37	6	Zaclady Azotowe Pulawy	Pulawi	Caprolactum, nitrogenous products	Fertilizers 2,430,000 t/a product	
	38	7	Kombinat Koplan Tarnobrzeg, Siarkopol	Machow, Zakladow, Tarnobrzeg	Phosphatic products	Single superphosphate 160,000t/a P_2O_5	
	39	8	Wloclawek	Wloclawek, Bydgoszcz	VCM, PVC and nitrogenous products	Fertilizers 939,000t/a PVC 150,000 t/a	
	40	9	Zaklady Azotowe Kedzierzyn	Katowice, Kedzierzyn	Nitrogenous products	Fertilizers 965,000 t/a	Calcium nitrate 471,030 t/a Urea 150,253 t/a
	41	10	Zaklady Azotowe W Tarnowie-Moscicach	Tarnow	PVC, nitrogenous products	All products 2,500,000 t/a	

Chemical Plants

Country			Plant name	Location	Main products	Capacity	Output
Poland (cont)	42	11	Krakowskie Zaclady Sodowy	Krakow	Chloralkali products		
	43	12	Fosfory Lubon	Lubon	Single superphosphate		
	44	13	Fosfory Szczecin	Torun	Single superphosphate		
	45	14	Fosfory Torun	Ubocz	Single superphosphate		
	46	15	Fosfory Ubocz	Wroclaw	Single superphosphate		
	47	16	Fosfory Wroclaw	Police	Titanium dioxide	36,000 t/a	
Romania	48	1	Oltchim (Combinatul Chimic Rimnicu Vilcea until 1990)	Rimnicu Vilcea	PVC, chloralkali products	Polymerisation 173,600 t/a	
	49	2	Govora Soda Ash Plant, Uzinele Sodice Govora	Govora	Soda ash		
	50	3	SC Solventul	Timisoara	Polymers and others	Polymerisation 60,000 t/a	
	51	4	UCT (Formerly Intreprinderea Chimica Turda)	Turda	PVC and others	Polymerisation 7,000 t/a	
	52	5	Arad Chemical Fertilizers Combine, Archim	Arad	Nitrogenous products	Ammonia 247,000 t/a N	
	53	6	Bacau Fertilizer Combine	Bacau	Nitrogenous products	Fertilizers 420,000 t/a product	
	54	7	Combinatul Chimic Craiova, Doljchim	Craiova, Oltenia	Nitrogenous products	Fertilizers 1,470,000 t/a product	
	55	8	Combinatul de Ingrasaminte Asotase, Azomures	Tirgu Mures	Nitrogenous products and others	Fertilizers 1,470,000 t/a product	
	56	9	Combinatul de Ingrasaminte Chimice, Azochim	Piatra Neamt, Moldavia	Nitrogenous products	Fertilizers 1,000,000 t/a product	

Chemical Plants

Country			Plant name	Location	Main products	Capacity	Output
Romania (cont)	57	10	Combinatul de Ingrasaminte Chimice Turnu Magurele	Orasul Turnu Magurele, Bucharest	Nitrogenous and phosphatic products	Fertilizers 2,800,000 t/a product	
	58	1	Fagaras Fertilizer and Chemical Combine, Nitramonia	Fagaras	Nitrogenous products	Fertilizers 312,000 t/a product	
	59	2	(Same as Fagaras Fertilizer and Chemical Combine?)	Fagaras	Phenol	Phenol 10,000 t/a	
	60	3	Navodari Usina de Superfosfati, Fertilchim	Navodari	Phosphatic products	Fertilizers 503,000 t/a product	
	61	4	Petru Poni - Uzinele de Ingrasaminte Chimice, Romfosfochim	Valea Calugareasca -Regiunea Ploiesti	Phosphatic fertilizers	Fertilizers 490,000 t/a product	
	62	5	Slobozia Fertilizer plant, Amonil	Slobozia	Nitrogenous products	Fertilizers 1,070,000 t/a product	
	63	6	Biocapa	Tirnaveni	VCM, PVC and others		
	64	7	Mining complex	Zlatna	Sulphuric acid and sulphates		
	65	8	Carbosin	Copsa Mica	Carbon black and others		
	66	9	Verachim	Giurgiu	Chloralkali products		
	67	10	Sofert	Bacau	Nitrogenous and phosphatic products		
Russia	68	1	Orgsteklo Production Amalgamation	Gorkovskoy Oblast, Nizhny Novgorod	Agrochemicals and Industrial chemicals		
	69	2	Balakovo Phosphate Fertilizer Plant	Balakovo, Saratov, Volga Region	Nitrogenous and phosphatic products	Phosphoric acid 440,000 t/a P_2O_5	
	70	3	Berezniki Nitrogen Fertilizer Plant	Berezniki	Nitrogenous products	Ammonia 867,000 t/a N	
	71	4	Krasnodar Chemical Plant	Byleorechensk, Krasnodar	Nitrogenous and phosphatic products	Phosphoric acid 330,000 t/a P_2O_5	

Chemical Plants

Country			Plant name	Location	Main products	Capacity	Output
Russia (cont)	72	5	Cherepovets Chemical Combine	Cherepovets	Nitrogenous and phosphatic products	Ammonia 797,000 t/a N Phosphoric acid 765,000 t/a P_2O_5	
	73	6	Dorogobuzh Nitrogen Fertilizer Plant	Dorogoduzh, Smolensk	Nitrogenous products	Ammonia 878,000 t/a N	
	74	7	Kingisepp-Fosforit Combine	Kingisepp, St Petersburg	Nitrogenous and phosphatic fertilizers	Phosphoric acid 218,000 t/a P_2O_5	
	75	8	Kuibyshev Chemical Plant	Togliatti, Kuybyshev	Nitrogenous and phosphatic products	Ammonia 642,000 t/a N Phosphoric acid 170,000 t/a P_2O_5	
	76	9	Nevinnomyssk Chemical Combine	Nevinnomyssk, Stavropol	Nitrogenous products	Ammonia 1,029,000 t/a N	
	77	10	Novgorod Chemical Combine	Novgorod	Nitrogenous products	Ammonia 920,000 t/a N	
	78	11	Novomoskovsk-Lenin Chemical Combine	Novomoskovsk, Tula	Chloralkali, PVC and nitrogenous products	Ammonia 1,600,000 t/a N Phosphoric acid 55,000 t/a P_2O_5	
	79	12	Rossosh-Pridonsk Chemical Works	Rossoch, Voronezh	Nitrogenous and phosphatic products	Ammonia 738,000 t/a N	
	80	13	Togliatti complex	Togliatti	Nitrogenous products	Ammonia 1,850,000 t/a N	
	81	14	Uvarovo Chemical Plant	Uvarovo	phosphatic products	Phosphoric acid 219,000 t/a P_2O_5	
	82	15	Voskresensk Chemical Combine	Voskresensk, Moscow	Nitrogenous and phosphatic products	Ammonia 265,000 t/a N Phosphoric acid 460,000 t/a P_2O_5	
	83	16	Meleuz Plant	Meleuz			

Chemical Plants

Country			Plant name	Location	Main products	Capacity	Output
Russia (cont)	84	17		Yaroslavl	Titanium dioxide	4,000 t/a	
Slovakia	85	1	Novacke chemicke zavdy	Novaky	PVC and VCM and others	PVC and VCM 90,000 t/a	
	86	2	Chemko Strazske	Strazske	Nitrogenous and phosphatic products	Fertilizers 950,000 t/a product	
	87	3	Juraja Dimitrova Chimicke Zavody	Dimitrova, Bratislava	Fertilizers and others		
	88	4	Povazske Chemicke HZ	Zilina	Polymers	Caprolactam 4,500,000 t/a	
	89	5	Duslo Sala	Sala, Galanta, Ostrava	Fertilizers and others		
	90	6	Istrochem	Bratislava	Fertilizers, polymers and others		
	91	7	Biogema Cooperative, Biogema VD	Kosice	Basic chemicals		
	92	8	Slovensky Hodvab	Semica/Senica		Viscose and polyester	4,900,000 t/a
Ukraine	93	1	Cherkassy Chemical Combine	Cherkassy	Nitrogenous and phosphatic products	Ammonia 983,000 t/a N	
	94	2	Chemorechensk Plant	Dzerzhinsk	Nitrogenous and phosphatic products	Ammonia 539,000 t/a	
	95	3	Dneprodzerzhinsk Metallurgical Combine	Dneprodzerzhinsk	Nitrogenous products	Ammonia 769,000 t/a N	
	96	4	Gorlovka Chemical Combine	Gorlovka, Donets	Nitrogenous products, polymers	Ammonia 1,586,000 t/a N	
	97	5	Odessa New Fertilizer Combine	Odessa	Nitrogenous products	Ammonia 738,000 t/a N	

Chemical Plants

Country			Plant name	Location	Main products	Capacity	Output
Ukraine (cont)	98	6	Rovno Chemical Combine	Rovno	Nitrogenous and phosphatic products	Ammonia 435,000 t/a N Phosphoric acid 120,000 t/a P_2O_5	
	99	7	Severodonetsk Chemical Combine, Azot Fertilizer and Chemicals Combine	Severodonetsk, Voroshilovgrad	Nitrogenous products	Ammonia 1,100,000 t/a N	
	100	8	Sumy Khimprom Enterprise	Sumy	Nitrogenous and phosphatic products	Phosphoric acid 260,000 t/a P_2O_5	
	101	9		Sumy	Titanium dioxide	115,000 t/a	
	102	10		Armyansk	Titanium dioxide	200,000 t/a	
	103	11		Krym	Titanium dioxide		
	104	12	Lysichansk Soda Works	Lysichansk	Sodium carbonate		Sodium carbonate 400,000 t/a

Paper Pulp Plants

Country			Plant name	Location	Total pulp capacity th.t/y	Principal grades
Belarus	1	1	Svetlogogorsk pulp & paper mill	Svetlogorsk	34	
Bulgaria	2	1	Darjavna Knijna Fabrika, Vassil Kolarov Mill	Kostenetz	10	SG
	3	2	Kombinat za Tzeluloza i Hartia, Mizia Mill	Mizia	10	SG, BSK
	4	3	Kombinat za Tzeluloza i Hartia, Stephan Kiradjiev Mill	Stamboliiski	45	NSSC, U/SB SK
	5	4	Pirinhart, Vladimir Poptomov Mill	Razlog	70	U/SB SK, RF
	6	5	Rullon-Iskaz AD, Gara Iskar Mill	Sofia		NSSC
	7	6	ZKMO-Kotcherinovo, Nikla Waptzarov Mill	Kocherinovo	5	SG
Czech Republic	8	1	Jihočeské Papíry a.p.	Vtěrní u Ceského Krumlova	100	SG, U/SB SS
	9	2	Jihočeské Papíry, Papíry Vltavský Mlýn	Loucovice		
	10	3	Olšanské Papírny a.s.	Lukavice		
	11	4	Severočeské Papírny a.s., Ceská Kamenice	Ceská Kamenice	15	
	12	5	Severočeské Papírniy Steti a.p., Sepap Stetí	Stětí	350	SG, BSK, U/SB SK, RF
Estonia	13	1	Kekhra Pulp & Paper Combine	Kehra	50	U/SB SK
	14	2	Tallinn Pulp & Paper Combine	Tallinn	47	
Hungary	15	1	Dunapack AG, Dunaújvárosi Papirgyár	Dunaujvaros	95	SG, NSSC, St
	16	2	Dunapack Co, Csepel Papírgyár	Budapest	15	NSSC, Soda
Latvia	17	1	Slokaky Pulp & Paper Mill	Yurmala	66	USS, SG
Lithuania	18	1	Grigishky Experimental Paper Combine	Grigishkes	31	SG, RF
	19	2	Klaipeda Pulp & Paperboard Mill	Klaipeda	53	

Paper Pulp Plants

Country			Plant name	Location	Total pulp capacity th.t/y	Principal grades
Poland	20	1	Bydgoskie Zaklady Papiernicze	Bydgoszcz	5	St
	21	2	Glucholaskie Zaklady Papiernicze	Rudawa, Opole	11	SG
	22	3	Kaletanskfe Zaklady Celulozowa Papiernicze	BoruszowiceKatowice	2	SG
	23	4	Karkonoskie Paper Mill, Fabryka Papierce Karpacz	Karpacz	1	SG
	24	5	Kluczewskie Zaklady Papiernicze	Olkusz, Katowice	4	SG
	25	6	Kostrzynskie Zaklady Papiernicze	Kostrzyn, Gorzow	57	BSK, USK
	26	7	Glucholaskie Zaklady Papiernicze	Glucholazy, Opole	8	SG
	27	8	Krapkowice, Zaklady Celulozowo-Papiernicze	Krapkowice, Opole	40	UBK, U/SB SK, Soda
	28	9	Lodzkie Zaklady Papiernicze	Lodz	20	SG
	29	10	Myszkowskie Zaklady Papiernicze	Myszków, Czestochowa	67	SG
	30	11	Zaklady Celulozowo-Papiernicze w Kwidzynie	Kwidzyn, Elblag	220	NSSC, BSK, RF
	31	12	Myszkowskie Zaklady Papiernicze	Czestochowa	2.5	SG
	32	13	Szczecinskie Zaklady Papiernicze	Szczecin	60	SG
	33	14	Warszawskie Zaklady Papiernicze s.a.	Jeziorna, Warszawa	..	SG, BSK, BHK, U/SB SK, BSS, U/SB SS
	34	15	Swiecie Pulp & Paper Mill	Swiecie	288	NSSC, U/SB SK
	35	16	Zaklady Papiernicze	Wloclawek	12	SG
	36	17	Kaletanskie Zaklady Celulozowo-Papiernicze	Kalety, Czestochova	23	U/SB SK
	37	18	Slaskie Zaklady Papiernicze	Tychy, Katowice	15	SG
Romania	38	1	Ambro s.a., Suceava Pulp and Paper Integrated Mill	Suceava	120	USK, RF
	39	2	D.I.L., SC Celohart s.a.	Zarnesti, Judet Brasov	50	BSS, U/SB SS, RF

Paper Pulp Plants

Country			Plant name	Location	Total pulp capacity th.t/y	Principal grades
Romania (cont)	40	3	ICPCH, "Comuna Din Paris", Piatra Neamt Paper and Board	Piatra Neamt, Judet Neamt	6	SG
	41	4	ICPCH, "Letea" Bacau Pulp and Paper Integrated Mill	Bacau, Judet Bacau	110	SG, BSS, U/SB SS
	42	5	ICPCH "Reconstructia" Piatra Neamt Pulp and Paper	Piatra Neamt, Judet Neamt	40	BSK, U/SB SS
	43	6	ICPCH Braila Pulp and Paper Integrated Mill	Braila, Judet Braila	105	BSK
	44	7	ICPCH Dej Pulp and Paper Integrated Mill	Dej, Judet Cluj	120	BSK, USK
	45	8	ICPCH Petresti Paper Mill	Petresti, Judet Alba	25	SG
	46	9	ICPCH, SC Comceh s.a.	Calarasi, Judet Ialomita	37.5	BSK, St
	47	10	S.C. Celrom s.a.	Drobeta-Tr. Severin, Mehedinti	140	NSSC, BHK, U/SB HK, SCP
	48	11	S.C. Vrancea s.a., Adjud Pulp and Paper Integrated Mill	Adjud, Vrancea	95	USK
	49	12	S.C. "Palas" Constanta Pulp and Paper Mill	Constanta	7	St
	50	13	S.C. "Hicart" s.a.	Bistrita Nasaud	2	SG
	51	14	S.C. "Hirtia" s.a. Busteni, Busteni Paper Mill	Busteni, Judetul Prahova	70	SG
Russia	52	1	Arkangelsk Pulp & Paper Combine	Novodvinsk, Arkangelskaya obl.	924	K
	53	2	Astrakhan Pulp & Paperboard Combine	Astrakhan	111	
	54	3	Balakhna Pulp & Paper Combine	Pravdinsky, Gorkovskaya obl.	564	SG, TMP
	55	4	Balakhna Pulp & Paper Combine	Balakhna, Gorkovskaya obl.	53	
	56	5	Kaisky Pulp Mill	Sozimsky, Kirovskaya obl.	3.5	
	57	6	Kaliningrad Pulp & Paper Mill	Kaliningrad, Kaliningradskaya obl.	118	UB/SB HS
	58	7	Kaliningrad Pulp & Paper Mill No. 2	Kaliningrad, Kaliningradskaya obl.	5	
	59	8	Kamsky Pulp & Paper Combine	Krasnokamsk, Permskaya obl.	220	

Paper Pulp Plants

Country			Plant name	Location	Total pulp capacity th.t/y	Principal grades
Russia (cont)	60	9	Kotlas Pulp & Paper Combine	Koryazhma, Arkhangelshaya obl.	993	K
	61	10	Lyskelsky Paper Mill	Lyaskelya, Karelia	32	
	62	11	Mariysky Pulp & Paper Combine	Volzhsk	112	
	63	12	Neman Pulp & Paper Mill	Neman, Kaliningradskaya obl.	100	
	64	13	Okulovka Pulp & Paper Combine	Okulovka, Novgorodskaya obl.	30	
	65	14	Perm Pulp & Paper Combine	Perm	190	
	66	15	Pitkyaranta Pulp Mill	Pitkyaranta, Karelia	80	
	67	16	Segezha Pulp & Paper Combine	Segezha, Karelia	660	K
	68	17	Sokol Pulp & Paper Combine	Sokol, Vologodskaya obl.	106	
	69	18	Solikamsk Pulp & Paper Combine	Solikamsk, Permskaya obl.	673	SG, TMP
	70	19	Solombalsky Pulp & Paper Combine	Arkangelsk	322	
	71	20	Sovetsk Pulp & Paper Mill	Sovetsk, Kaliningradskaya obl.	92	
	72	21	Sukhonsky Pulp & Paper Mill	Sokol, Vologodskaya obl.	65	
	73	22	Svetogorsk Pulp & Paper Combine	Svetogorsk, St. Petersburgskaya obl.	417	K, NP
	74	23	Syassky Pulp & Paper Combine	Syastroy, St. Petersburgskaya obl.	184	
	75	24	Vishera Pulp & Paper Mill	Krasnoviishersk, Permskaya obl.	47	
	76	25	Vyborsky Pulp & Paper Combine	Sovetsky, St. Petersburgskaya obl.	50	BSK
Slovakia	77	1	Biocel s.p.	Paskov, North Morovia	210	BSS
	78	2	Bukoza a.s.	Vranov n.T.	72	BHK
	79	3	Chemiceluloza s.p., Zilina	Zilina	70	BHS
	80	4	Harmanecke Papierne a.s.	Harmanec	35	SG, U/SB SS

Paper Pulp Plants

Country			Plant name	Location	Total pulp capacity th.t/y	Principal grades
Slovakia (cont)	81	5	Juhoslovenske Celulozky a Papierne a.s.	Sturovo	245	BSCM, NSSC, RF
	82	6	Severoslovenske Celulozky a Papierne a.s.	Ružomberok	200	SG, BSK, BHK, USK
	83	7	Slavosovske Papierne s.p.	Slavošovce	6	SG
Ukraine	84	1	Izmail Pulp & Paper Mill	Izmail, Odesskaya obl.	34	
	85	2	Kherson Pulp & Paper Mill	Tsyurupinsk, Khersonskaya obl.	35	
	86	3	Kievsky Pulp & Paperboard Combine	Obukhov, Kievskaya obl.	210	
	87	4	Lvov Paperboard Mill	Lvov	22	
	88	5	Zhidachev Pulp & Paperboard Mill	Zhidachev, Lvovskaya obl.	48	

Abbreviations

BHK bleached hardwood kraft
BHS bleached hardwood sulphite
BSS bleached softwood sulphite
BSK bleached softwood kraft (pulp)
CTMP chemi-thermomechanical pulp
K kraft (pulp)
RF recycled fibre
DP dissolving pulp
NP non-paper (pulp)
NSSC neutral sulphite semi-chemical (pulp)
SC semi-chemical (pulp)
TMP thermo-mechanical pulp
SB semi-bleached
SG stone groundwood
SS softwood sulphite (pulp)
St straw
UB unbleached

Source: International Pulp and Paper Directory, 1993

MODELLING THE IMPACT OF ECONOMIC REFORM AND INDUSTRIAL RESTRUCTURING

A detailed model has been developed to examine the combined impact of structural and pricing changes on total emissions of various pollutants in each country. It is based on an input-output framework using input-output tables for various years aggregated to 48 sectors. However, a distinction is drawn between the input-output coefficients for plant and equipment resulting from new investment and the capital stock inherited from the past. The technical coefficients for new capital are assumed to be the same as those prevailing in Western Europe in the mid-1980s except in the case of the slow reform scenario. On the other hand, the technical coefficients for old capital change in response to exogenous reductions in overmanning and the use of material inputs (x-efficiency gains) and to changes in relative prices according to a standard cost function. There is no single energy price elasticity since substitution between energy, labour and materials and between fuels depends upon the initial shares of the factor and fuels in total costs.

Five scenarios have been examined:

A. The "main scenario" whose key assumptions are outlined below. This is regarded as the most plausible outcome over the next 20 years on the basic premise that a reasonably comprehensive reform program will be pursued in Belarus over the next 5 years. The environmental performance of new capital equipment is assumed to be equivalent to the environmental standards operative in Western Europe and the US during the early 1980s. This means that the emissions from new plants will be similar to the average level of emissions from West European or US plants operating today.

B. The "slow/delayed reform scenario" which assumes that pricing and other market reforms are delayed until 1995/96 and that the reform process proceeds rather slowly so that incentives to reduce energy consumption and to invest in new, more efficient, capital are much weaker and operate over a longer time period. This scenario implies that any economic recovery after 1995 will be much weaker and that growth in the decade 2000-2010 will also be lower. Environmental standards are as for the main scenario.

C. The "accelerated reform scenario" assumes that the government presses ahead with radical economic reforms and strict enforcement of hard budget constraints for enterprises. These pressures, combined with an active policy to encourage foreign investment, will shorten the period of adjustment to new incentives and higher prices. The immediate decline in employment and output will be greater because more of the old capital stock is scrapped but the subsequent recovery will more rapid with faster economic growth through the decade 2000-2010.. Environmental standards are as for the main scenario.

D. The "EC standards for new plants scenario" -- referred to as EC new plant --is based on the same economic assumptions as the main scenario but assumes that all new capital equipment is required to meet emission standards equivalent to those applied in the European Community in the early 1990s (rather than the early 1980s).

E. The "EC standards for all plants scenario" -- referred to as EC all plant --adds to the previous scenario the assumption that all plants are gradually required to conform to current EC emission standards by 2010 by the installation of end-of-pipe controls or by appropriate changes in process technology.

Comparison of the first three scenarios illustrates the impact of differences in the nature and speed of economic reform on Belarus' environmental problems, while comparison of the scenarios specified in A, D and E illustrates the contribution of alternative environmental policies.

The key assumptions characterizing the different scenarios are:

(a) The paths for GDP follow current World Bank estimates up to 1995. For most countries GDP levels out between 1993 and 1995 at 65-75 percent of its pre-transition level. In the main scenario GDP is assumed to increase at 6.5 percent per person per year over 1995-2000 and at 4 percent per person per year over 2000-2010. These growth rates are high but historical experience suggests that they can be achieved if the necessary reforms are implemented. The accelerated growth scenario follows an East Asian pattern, whereas the slow/delayed reform is based on growth rates post 1995 that are similar to those achieved by the former Soviet Union.

(b) The share of investment in GDP falls sharply to 1995 and recovers thereafter but only to 20 percent in 2000 and 25 percent in 2010 - well below past levels. Slower or faster growth implies correspondingly lower or higher investment shares.

(c) The composition of private and public consumption gradually shifts by 2010 towards the pattern typical of middle income countries with similar incomes measured in terms of purchasing power parity.

(d) Improvements in x-efficiency and the adjustment of energy and other inputs per unit of output producing using old capital are phased over a period of 10 years in the main scenario. This adjustment period is 20 years for the slow/delayed reform scenario and 5 years for the accelerated reform scenario. Under the latter it is assumed that 20 percent of the initial capital stock is scrapped by 1995 as enterprises contract or close down. Under the slow/delayed reform scenario it is assumed that new investment has input-output coefficients based on typical Soviet technology rather than Western technology.

(e) The long run aggregate elasticity of energy use in industry is approximately -0.5 for the main and accelerated reform scenarios. This is typical of the long run responses of West European economies to the two oil shocks. Under the slow/delayed reform scenario it is only -0.075 which is more typical of the response of centrally planned economies to price changes in the past. Note that the short run price elasticities are much lower because the adjustment to higher prices is phased over 5, 10 or 20 years as appropriate.

(f) Lags have been built into the adjustment process to reflect the slow initial response of industrial energy consumption to changes in output, so that energy-related pollution declines more slowly than might be expected from a simple link between industrial output and energy demand.

(g) The detailed assumptions about the manner in which the stricter environmental standards in the ECS NP and ECS AP scenarios will affect various emission coefficients are described in a Background Paper to the Action Programme. In particular, the coefficients relating to emissions of NOx and lead from household use of oil products, which is assumed to be almost entirely comprised of gasoline in automobiles, do not imply that all new automobiles will be fitted with catalytic converters. For the ECS AP scenario it has been assumed that 50% of the vehicle fleet will run on unleaded gasoline.

A selection of the results generated by running the model for 11 of the countries in the region are shown in the main text. Because the model is based upon detailed projections at an industry level, it is possible to distinguish between those industries -- referred to as heavy industry -- which are typically characterized by large individual sources and other production whose emissions derive from many small sources. The distinction is important because it is much easier to monitor and enforce emission standards for a limited number of large sources in the paper, chemical, cement, metallurgy and heavy engineering industries than for the much greater number of medium and small enterprises in other branches of the industrial sector as well as agriculture, services and households. The relative contributions of different types of source to total emissions of some key pollutants are shown in the following figures.

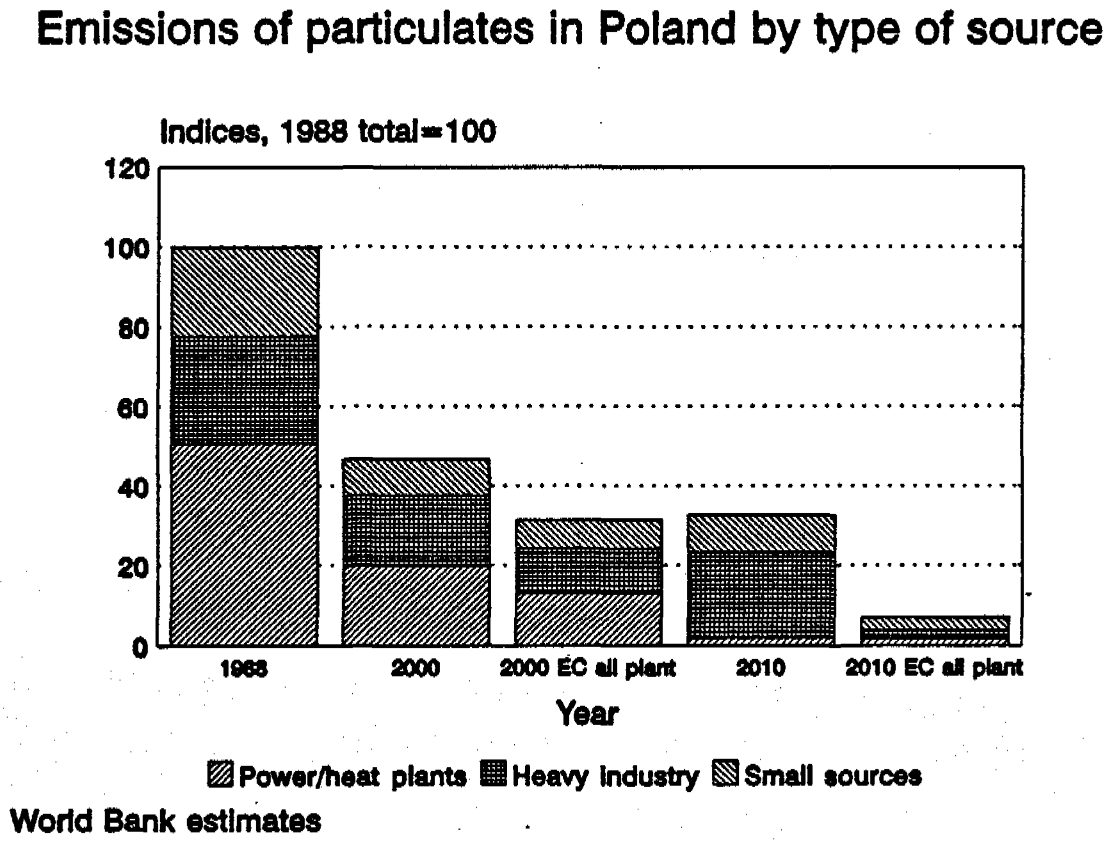
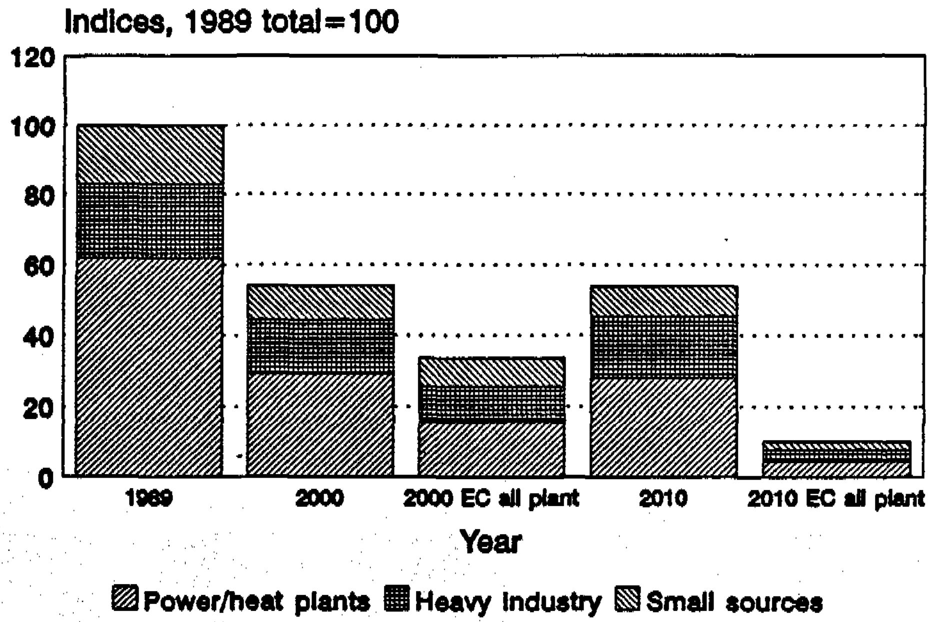


Figure 1. For particulates, investment in new power and heat plants or in rehabilitating existing ones will greatly reduce the contribution of these sources to total emissions in countries like Poland. Remember, also, that this reduction in the share due to power and heat plants accompanies a large fall in total emissions. The reduction in emissions from large industrial sources is less than for total emissions, unless stricter standards are applied to existing as well as new plants. If strict standards are applied to all plants, then it is small sources - households, services and small industry - which make the largest contribution to total emissions. Still the overall level of emissions is so much lower that this would hardly warrant stricter environmental controls on small sources over the time period considered.

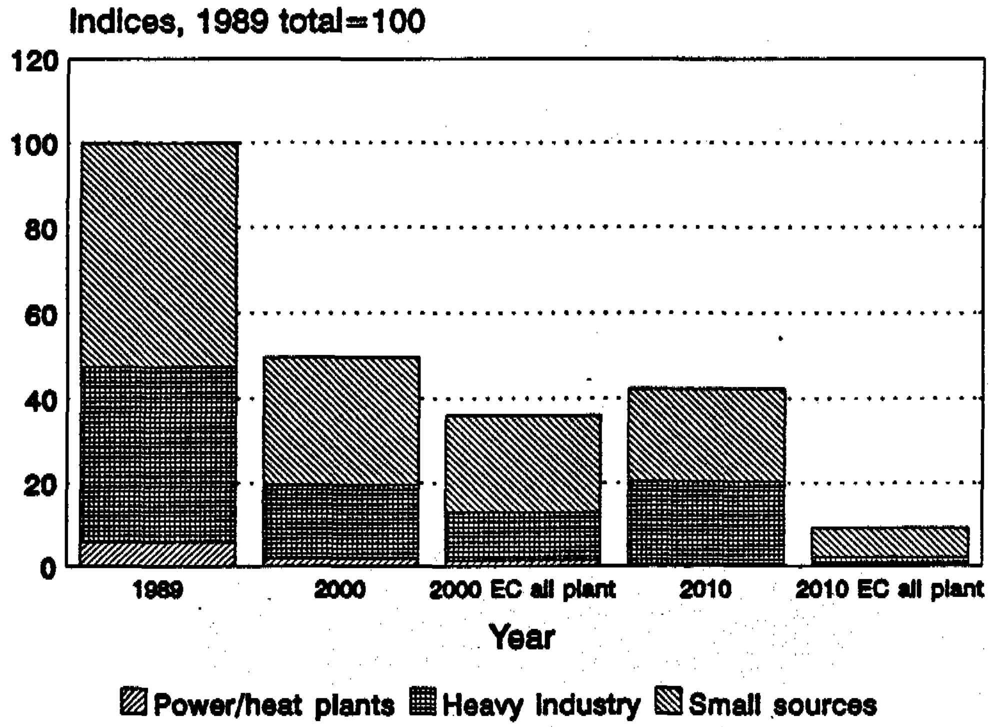
Emissions of sulfur dioxide in the Czech and Slovak Republics by type of source



World Bank estimates
(Data was not available on the separate republics)

Figure 2. For sulfur dioxide, as for particulates, large reductions in total emissions are not uniformly spread across different types of source. The share of power and heat plants tends to fall, especially when stricter standards are applied to all such plants. The share of heavy industry tends to rise in the absence of stricter standards, wherease with stricter standards it is the share of small sources that tends to rise. However, small sources never become the largest contributor to total emissions of sulfur dioxide, so that environmental policies and controls should focus on the power and heat sector and on large industrial plants.

Emissions of lead in Bulgaria by type of source



World Bank estimates

Figure 3. In Bulgaria, as in all countries, vehicles are the major source of lead emissions. Emissions from heavy industrial plants originate both from non-ferrous metal smelters, some of which can be cleaned up at a reasonable cost, and from the combustion of coal and oil. The latter can only be reduced by installing controls to reduce all dust and particulate emissions. Thus, changes in the contribution of large industrial sources to total lead emissions after the initial economic downturn depend upon the relative strictness of controls on vehicle emissions and dust emissions from large plants. For vehicles, improvements in average fuel efficiency combined with an upgrading of gasoline quality will bring about a gradual decline in the share of lead emissions from small sources under the main scenario and the scenario with EC controls applied only to new equipment. On the other hand, strict controls applied to all large industrial plants mean that an increasing share of (the much lower) lead emissions will come from small sources. This implies that reducing lead emissions even further will depend upon an almost complete shift to the use of lead-free gasoline.

WHY RAISE ENERGY PRICES?

Until 1990, energy prices were set well below market levels in all Central and Eastern European countries. Raising energy prices is the classic win-win policy which improves economic efficiency and generates large environmental benefits. This report emphasizes the environmental consequences of adjusting energy prices to world market levels. But what are the economic arguments? In summary, most sources of energy are prime examples of commodities which can be traded freely. This means that a country which sells energy at domestic prices below the world market price is sacrificing the difference between the domestic selling price and the world price.

Consider the case of crude oil in Russia. In mid-1992 this was being sold to Russian refineries at a price of Rb 2200 per ton while the equivalent export price was US$120 per ton or Rb 15000 at the *then prevailing* market exchange rate of US$1 = Rb 125. This would not matter if the level of oil demand in Russia were unaffected by the domestic price, since the price differential would simply represent an income transfer from oil producers or the government to oil consumers. However, Russia is now the most energy-intensive economy in the world with total energy consumption amounting to 6,000 kilograms of oil-equivalent per person for a GNP per person of about US$2,500. It uses about 8 times as much energy per dollar of GDP as the average for Western Europe. Even allowing for harsh weather it is clear that low prices lead to higher levels of consumption and wasteful use of energy.

Simple calculations suggest that an immediate decision to raise energy prices to the world market level should, over a period of 5-6 years, halve that level of energy-intensity. This would enable Russia to export an additional 90 million tons of crude oil per year worth more than US$10 billion (after allowing for changes in total GDP). Since Russia's revenue from exports of goods and services outside the former Soviet Union was about US$53 billion in 1991 and is expected to be little more than US$35 billion in 1992, the additional oil exports would imply a substantial increase in Russia's ability to import capital equipment or consumer goods from the rest of the world. This is a simple measure of the potential gains from increasing domestic energy prices to world market levels. There would, of course, be some capital investment (and social) costs involved in raising energy efficiency to adjust to higher energy prices, so that the net gains are somewhat more difficult to estimate. But the difficulties of adjusting to higher energy prices are usually exaggerated, and US$10 billion per year can buy a large amount of energy conservation.

Russia is an oil exporter, but the story is essentially similar for Ukraine which is a large net importer of oil. In its case the burden of low domestic energy prices (for a given level of world prices) is felt in a reduced capacity to import goods and services from the rest of the world. Similar calculations suggest that the cost of its oil imports could fall by US$2-3 billion per year over the next 5-6 years. While information on Ukraine's trade balance is lacking, this figure may be compared with the country's total foreign debt in convertible currencies which was estimated to be about US$10 billion in late 1991.

Source: Based on material in **Russian Economic Reform: Crossing the Threshold of Structural Change** (Washington, DC: The World Bank, 1992).

SURVEY ON INDUSTRIAL INVESTMENT AND ENVIRONMENTAL ISSUES - PRELIMINARY RESULTS (MAY, 1992)

Introduction

Preliminary results from a survey conducted by The World Bank and OECD in February-April, 1992, appear to support anecdotal reports that corporate concern about environmental issues is one cause of cautious investment by large Western industrial companies in Central and Eastern Europe. While analysis of survey responses continues, initial results suggest that large Western multinational corporations look closely at environmental issues in their industrial investment decisions and that unresolved issues relating to environmental liability and environmental standards are making foreign investment more difficult. In some cases, corporations have rejected potential investments because of the environmental problems they posed.

Survey Results

The survey covered the 1,000 largest manufacturing, mining, and construction companies based in North America and Western Europe. Key preliminary survey results, based on 191 usable questionnaire responses and a dozen telephone interviews, include the following:

- Environmental issues such as potential liability for clean-up of soil contamination and uncertainty about emissions standards present important impediments to Western direct investment in Central and Eastern Europe.

- Companies in certain industrial sectors indicate that inadequate water and sewer systems and inadequate infrastructure for solid and hazardous waste management are important impediments to investment in Central and Eastern Europe. Some companies interviewed were willing to share in the costs of environmentally-related infrastructure improvements, but await government leadership.

- Nearly 62% of survey respondents indicated that environmental issues are equally important impediments as non-environmental issues such as the risk of unstable economic reforms and exchange rate risks. This figure is even higher for (i) companies in more polluting industries; (ii) companies that view lower costs as their primary investment goal; (iii) companies with relatively strict environmental policies; and (iv) companies that have previously considered and rejected investment opportunities in the region. Most companies interviewed explained that they consider environmental issues at a later stage in evaluating potential investments, but that unresolved environmental issues can either break a deal or result in a more cautious investment plan.

- The issue of potential liability arising from past environmental practices appears to be the most important issues for investors. Nearly 66% of respondents indicated that the issue of past liability was more important in *their company's investment decisions* than other environmental issues. Overall, however, the issue of past liability is not significantly more important than other issues involving environmental liability and standards.

- Indemnifications from private sellers and governments are the most favored methods of managing environmental liability, but Western companies also view a number of alternative or supplemental measures as important. These include: (i) reducing purchase price to cover potential liability; (ii) increasing management control to reduce actual risks; (iii) building on greenfield (unused) sites; and (iv) remediating site contamination.

- In acquiring industrial facilities abroad, large Western companies routinely assess potential liability arising from past environmental practices. Only 11 respondents indicated they do not make significant site assessments, while over half of the respondents indicated that they perform site assessments using in-house experts or outside auditors. Inability to make such assessments is an impediment to investment.

- An overwhelming majority of large Western companies -- nearly 77% of survey respondents -- claim to follow internal corporate environmental standards or environmental standards of their headquarter country, when such standards are stricter than those of a foreign country. Moreover, most companies interviewed assumed that CSFR, Hungary and Poland, as part of an effort to join the European Communities, would soon attempt to reach Western European levels of enforcement of environmental standards.

Conclusions

While environmental policies in Central and Eastern Europe must respond to interests far beyond those of Western investors, it may still be helpful, when designing such policies, to consider the experiences and expectations of Western corporations. Preliminary survey results suggest the following tentative conclusions:

- Central and Eastern European governments can make industrial investment opportunities more attractive by addressing Western investors' environmental concerns.

- Addressing investors' primary concerns, such as the risk of unstable economic reforms, is clearly important in order to attract investor interest, but policies are also needed to address secondary concerns, such as uncertainty about potential environmental liability, that are also important for the completion of investment deals.

- In addressing investors' concerns about environmental issues, Central and Eastern European governments may wish to treat the issue of past liability as a priority, but action is also needed on issues such as liability for future environmental practices and uncertain environmental standards and levels of enforcement.

- Government policies for resolving issues of environmental liability can and should go beyond blanket indemnifications. Governments may wish to encourage investors to avail themselves of alternative and supplemental means of managing liability, such as allowing reductions in purchase price to cover the costs of remediating site contamination, encouraging increased management control to reduce environmental risks, and allowing and encouraging transfer of labor and capital from old facilities to new ones.

- Governments can facilitate the sale of state enterprises by providing investors with information adequate to assess potential environmental costs.

- To the extent that Western investors expect to follow environmental standards stricter than those currently enforced in Central and Eastern Europe, transaction documents that call for adherence to such standards could present a win-win situation for governments and investors.

- Partnerships between governments and investors to meet certain industries' environmental infrastructure needs, such as development of hazardous waste management facilities, may facilitate investment in those industries.

Methodology

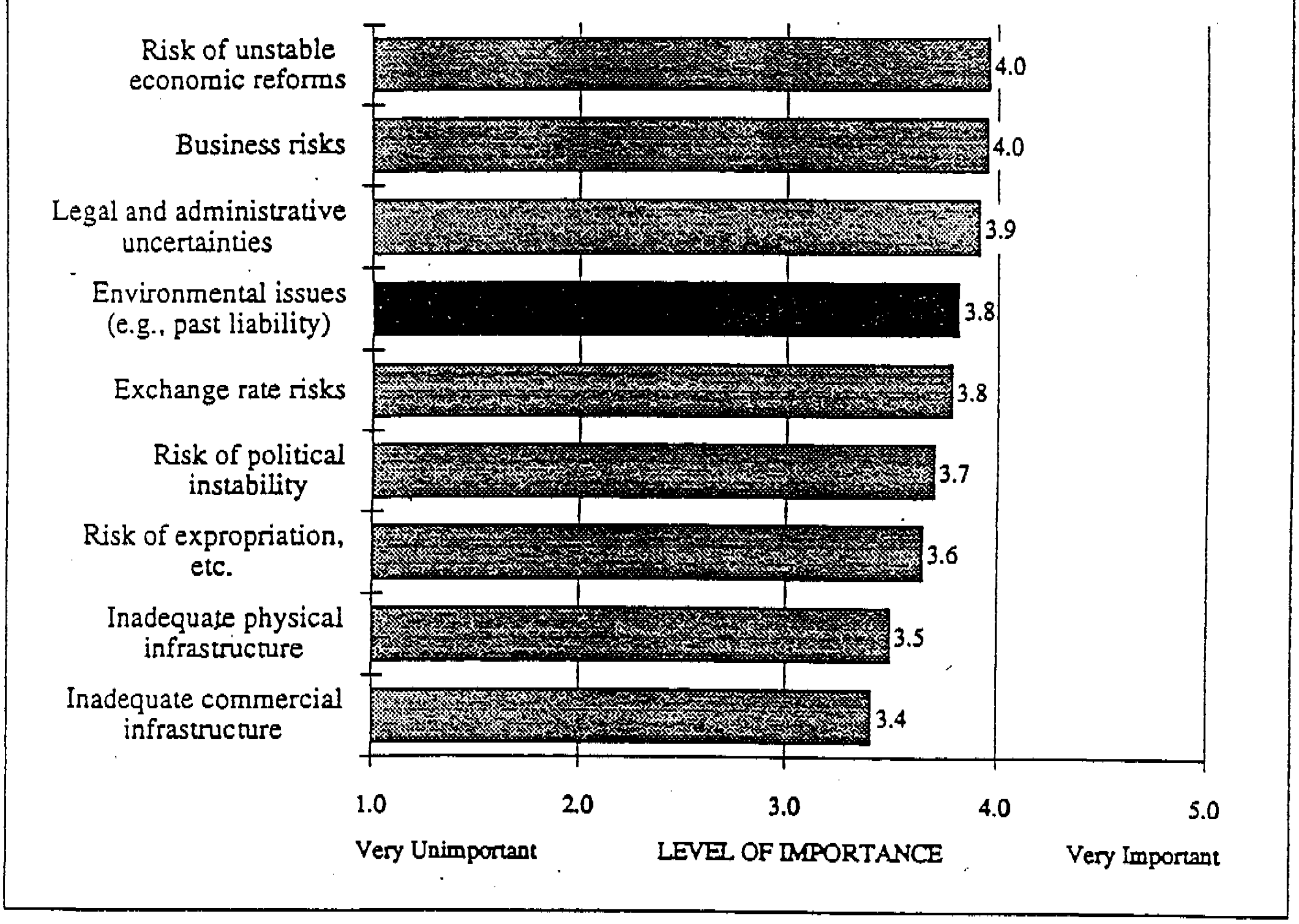
The World Bank/OECD survey consisted of a written questionnaire mailed to CEO-level executives at the 1,000 largest industrial corporations in North America and Western Europe, with a slightly larger share of the questionnaires going to Western European companies. The target population included all companies listed by a commercial database as having over $1 billion in net sales with activity in the manufacturing, mining, and construction industries.

By April 14, there was a 19% response rate, with 191 usable responses, a relatively high response rate for an unsolicited questionnaire sent to major corporations. Nearly all respondents were multinational corporations. Of the 152 respondents who provided information on their positions, 96% were CEO-level executives or executives with responsibility for evaluating foreign direct investment opportunities. As many as 146 respondents had made or considered direct industrial investment in Central and Eastern Europe or the Soviet Union (mostly in CSFR, Hungary, and Poland) at some point from 1989 to the present. Respondents were relatively well distributed in terms of investment activity in CSFR, Hungary, and Poland: 51 respondents had current investments; 99 were considering investments; 58 had previously considered and rejected investment opportunities; and 60 had never made or considered direct industrial investment in these three countries. Similarly, responses also appeared to represent the views of investors with different primary investment goals. With information from 149 respondents, nearly 66% indicated that access to new markets in the region was more important as an investment goal than reducing production costs for exports. Finally, respondents appeared to be interested enough in the survey to answer with care -- only 26 responses were anonymous and fully 116 respondents were willing to accept follow-up questions.

While the large number of responses permits some generalization about the target population, the ability to make generalizations is even stronger because the current sample appears to be approximately representative of the 1,000 target population in terms of geographic distribution, size, and industry. There was, however, a disproportionately high number of responses from corporations based in Northern Europe and a disproportionately low number of responses from those based in Canada, France, Italy and Spain.

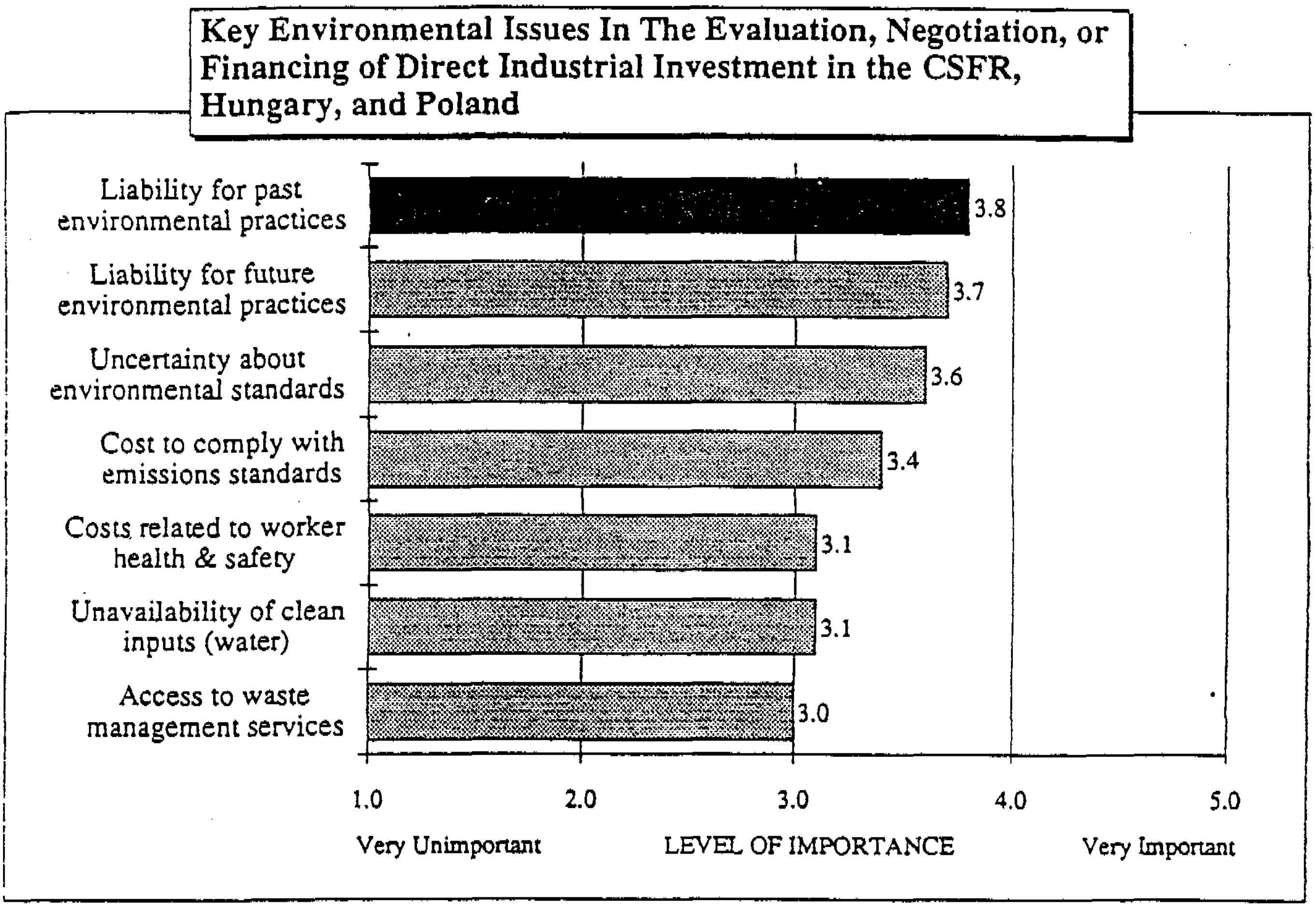
There are several possible sources of bias. Respondents may have attempted to provide "environmentally friendly" answers, although the survey contained many value-neutral questions such as those concerning who should pay for clean-up of existing contamination. Respondents may also have used the survey to advocate for desired environmental policies, such as encouraging governments to accept liability for past contamination, but, in part, this is what the survey was designed to elicit. There was also evidence that companies did not exaggerate their concerns. As expected, for example, those companies interested primarily in access to new markets were less likely to view environmental issues as impediments equal in importance to non-environmental issues. Lastly, the Western European responses may be biased by the high share of companies based in Scandinavia and other regions in Northern Europe, where companies generally are thought to be more aware of environmental issues.

Key Issues Impeding Western Direct Investment in the CSFR, Hungary, and Poland by Rank of Importance



Source: 1992 World Bank/OECD Corporate Survey on Western Direct Investment and Environmental Issues in Central and Eastern Europe.

Notes: The number of companies answering these questions ranged from 124 to 128, with standard errors ranging from .08 to .11.



Source: 1992 World Bank/OECD Corporate Survey on Western Direct Investment and Environmental Issues in Central and Eastern Europe.

Notes: The number of companies answering these questions ranged from 125 to 127, with standard errors ranging from .10 to .12. Because the questionnaire was aimed at companies with a variety of direct investment experiences in CSFR, Hungary, and Poland, this set of questions was introduced in different ways. For example, companies that had previously rejected investment opportunities were asked about the importance of these environmental issues as "obstacles to investment." Companies that had never considered investments were asked about the importance of these issues in their decisions not to consider direct investment in CSFR, Hungary, or Poland. Companies that fit into more than category (such as those currently invested and currently considering investment) ranked environmental issues more than once. In such cases, we calculated an average score for each respondent for each environmental issue.

Status of European Countries with respect to the

BASEL CONVENTION

ALBANIA:	FA
AUSTRIA:	FA & C
BELGIUM:	FA & C
BULGARIA:	FA
CYPRUS:	FA, C, R & EiF
CZECH & SLOVAK REPUBLIC:	FA, R & EiF
DENMARK:	FA & C
ESTONIA:	R & EiF
FINLAND:	FA, C, R & EiF
FRANCE:	FA, C, R & EiF
GERMANY:	FA & C
GREECE:	FA & C
HUNGARY:	FA, C, R & EiF
IRELAND:	FA & C
ISRAEL:	FA & C
ITALY:	FA & C
LATVIA:	R & EiF
LIECHTENSTEIN:	FA, C, R & EiF
LUXEMBOURG:	FA & C
MONACO:	R & EiF
NETHERLANDS:	FA & C
NORWAY:	FA, C, R & EiF
POLAND:	C, R, & EiF
PORTUGAL:	FA & C
ROMANIA:	FA, R & EiF
RUSSIAN FEDERATION:	FA & C
SPAIN:	FA & C
SWEDEN:	FA, C, R & EiF
SWITZERLAND:	FA, C, R & EiF
TURKEY:	FA & C
UNITED KINGDOM:	FA & C
FORMER YUGOSLAVIA:	FA
EUROPEAN ECONOMIC COMMUNITY:	FA & C

Key to Code:
FA = Signed Final Act at Basel
C = Signed the Convention
R = Ratified the Convention
Eif = Convention entered into force

European Countries that have signed the

BIODIVERSITY CONVENTION

ARMENIA
AUSTRIA
AZERBAYJAN
BELARUS
BELGIUM
BULGARIA
CROATIA
CYPRUS
DENMARK
ESTONIA
FINLAND
FRANCE
GERMANY
GREECE
HUNGARY
ICELAND
IRELAND
ISRAEL
ITALY
KAZAKHSTAN
LATVIA
LIECHTENSTEIN
LITHUANIA
LUXEMBOURG
MALTA
MOLDOVA
MONACO (Signed & Ratified)
NETHERLANDS
NORWAY
POLAND
PORTUGAL
ROMANIA
RUSSIAN FEDERATION
SAN MARINO
SLOVENIA
SPAIN
SWEDEN
SWITZERLAND
TURKEY
UKRAINE
UNITED KINGDOM
FORMER YUGOSLAVIA
EUROPEAN ECONOMIC COMMUNITY

European Countries that have signed the

CLIMATE CHANGE CONVENTION

ARMENIA
AUSTRIA
AZERBAYJAN
BELARUS
BELGIUM
BULGARIA
CROATIA
CYPRUS
DENMARK
ESTONIA
FINLAND
FRANCE
GERMANY
GREECE
HUNGARY
ICELAND
IRELAND
ISRAEL
ITALY
KAZAKHSTAN
LATVIA
LIECHTENSTEIN
LITHUANIA
LUXEMBOURG
MALTA
MOLDOVA
MONACO (Signed & Ratified)
NETHERLANDS
NORWAY
POLAND
PORTUGAL
ROMANIA
RUSSIAN FEDERATION
SAN MARINO
SLOVENIA
SPAIN
SWEDEN
SWITZERLAND
UKRAINE
UNITED KINGDOM
FORMER YUGOSLAVIA
EUROPEAN ECONOMIC COMMUNITY

Status of European Countries with respect to the

VIENNA CONVENTION

AUSTRIA:	S, R & EiF
BELARUS:	S, R & EiF
BELGIUM:	S, R & EiF
BULGARIA:	R & EiF
CROATIA:	EiF (by succession)
CYPRUS:	R & EiF
CZECH & SLOVAK REPUBLIC:	R & EiF
DENMARK:	S, R & EiF
FINLAND:	S, R & EiF
FRANCE:	S, R & EiF
GERMANY:	S, R & EiF
GREECE:	S, R & EiF
HUNGARY:	R & EiF
ICELAND:	R & EiF
IRELAND:	R & EiF
ISRAEL:	R & EiF
ITALY:	S, R & EiF
LIECHTENSTEIN:	R & EiF
LUXEMBOURG:	S, R & EiF
MALTA:	R, & EiF
NETHERLANDS:	S, R, EiF
NORWAY:	S, R & EiF
POLAND:	R & EiF
PORTUGAL:	R & EiF
RUSSIAN FEDERATION:	S, R & EiF
SLOVENIA:	EiF (by succession)
SPAIN:	R & EiF
SWEDEN:	S, R & EiF
SWITZERLAND:	S, R & EiF
UKRAINE:	S, R & EiF
UNITED KINGDOM:	S, R & EiF
FORMER YUGOSLAVIA:	R & EiF
EUROPEAN ECONOMIC COMMUNITY:	S, R & EiF

Key to Code:
S = Signed the Convention
R = Ratified the Convention
Eif = Convention entered into force

Status of European Countries with respect to the

MONTREAL PROTOCOL

AUSTRIA:	S, R & EiF
BELARUS:	S, R & EiF
BELGIUM:	S, R & EiF
BULGARIA:	R & EiF
CROATIA:	EiF (by succession)
CYPRUS:	R & EiF
CZECH & SLOVAK REPUBLIC:	R & EiF
DENMARK:	S, R, EiF
FINLAND:	S, R & EiF
FRANCE:	S, R & EiF
GERMANY:	S, R & EiF
GREECE:	S, R & EiF
HUNGARY:	R & EiF
ICELAND:	R & EiF
IRELAND:	S, R & EiF
ISRAEL:	R & EiF
ITALY:	S, R & EiF
LIECHTENSTEIN:	R & EiF
LUXEMBOURG:	S, R & EiF
MALTA:	S, R & EiF
NETHERLANDS:	S, R & EiF
NORWAY:	S, R & EiF
POLAND:	R & EiF
PORTUGAL:	S, R & EiF
RUSSIAN FEDERATION:	S, R & EiF
SLOVENIA:	EiF (by succession)
SPAIN:	S, R & EiF
SWEDEN:	S, R & EiF
SWITZERLAND:	S, R & EiF
UKRAINE:	S, R & EiF
UNITED KINGDOM:	S, R & EiF
FORMER YUGOSLAVIA:	R & EiF
EUROPEAN ECONOMIC COMMUNITY:	S, R & EiF

Key to Code:
S = Signed the Convention
R = Ratified the Convention
Eif = Convention entered into force

Status of the Convention on Long-Range Transboundary Air Pollution (LRTAP)
(As of 31 December 1992)

	Convention (a)		EMEP Protocol (b)		Sulphur Protocol (c)		NOx Protocol (d)		VOC Protocol (e)	
	Signature	Ratification*	Signature	Ratification*	Signature	Ratification*	Signature	Ratification*	Signature (1)	Ratification* (2)
Austria	13.11.1979	16.12.1982 (R)		04.06.1987 (Ac)	9. 7.1985	04.06.1987 (R)	1.11.1988	15.01.1990 (R)	19.11.1991	
Belarus	14.11.1979	13.06.1980 (R)	28.09.1984	04.10.1985 (At)	9. 7.1985	10.09.1986 (At)	1.11.1988	08.06.1989 (At)		
Belgium	13.11.1979	15.07.1982 (R)	25.02.1985	05.08.1987 (R)	9. 7.1985	09.06.1989 (R)	1.11.1988		19.11.1991	
Bulgaria	14.11.1979	09.06.1981 (R)	04.04.1985	26.09.1986 (Ap)	9. 7.1985	26.09.1986 (Ap)	1.11.1988	30.03.1989 (R)	19.11.1991	
Canada	13.11.1979	15.12.1981 (R)	03.10.1984	04.12.1985 (R)	9. 7.1985	04.12.1985 (R)	1.11.1988	25.01.1991 (R)	19.11.1991	
Croatia		08.10.1992(Sc)		08.10.1992(Sc)						
Cyprus		20.11.1991 (Ac)		20.11.1991 (Ac)						
Czechoslovakia	13.11.1979	23.12.1983 (R)		26.11.1986 (Ac)	9. 7.1985	26.11.1986 (Ap)	1.11.1988	17.08.1990 (Ap)		
Denmark	14.11.1979	18.06.1982 (R)	28.09.1984	29.04.1986 (R)	9. 7.1985	29.04.1986 (R)	1.11.1988	01.03.1993 (At)(2)	19.11.1991	
Finland	13.11.1979	15.04.1981 (R)	07.12.1984	24.06.1986 (R)	9. 7.1985	24.06.1986 (R)	1.11.1988	01.02.1990 (R)	19.11.1991	
France	13.11.1979	03.11.1981 (Ap)	22.02.1985	30.10.1987 (R)	9. 7.1985	13.03.1986 (Ap)	1.11.1988	20.07.1989 (Ap)	19.11.1991	
Germany	13.11.1979	15.07.1982 (R)(2)	26.02.1985	07.10.1986 (R)(2)	9. 7.1985	03.03.1987 (R)(2)	1.11.1988	16.11.1990 (R)	19.11.1991	
Greece	14.11.1979	30.08.1983 (R)		24.06.1988 (Ac)			1.11.1988		19.11.1991	
Holy See	14.11.1979									
Hungary	13.11.1979	22.09.1980 (R)	27.03.1985	08.05.1985 (Ap)	9. 7.1985	11.09.1986 (R)	3.05.1989	12.11.1991 (Ap)	19.11.1991	
Iceland	13.11.1979	05.05.1983 (R)								
Ireland	13.11.1979	15.07.1982 (R)	04.04.1985	26.06.1987 (R)			1.05.1989			
Italy	14.11.1979	15.07.1982 (R)	28.09.1984	12.01.1989 (R)	9. 7.1985	05.02.1990 (R)	1.11.1988	19.05.1992 (R)	19.11.1991	
Liechtenstein	14.11.1979	22.11.1983 (R)		01.05.1985 (Ac)	9. 7.1985	13.02.1986 (R)	1.11.1988		19.11.1991	
Luxembourg	13.11.1979	15.07.1982 (R)	21.11.1984	24.08.1987 (R)	9. 7.1985	24.08.1987 (R)	1.11.1988	04.10.1990 (R)	19.11.1991	
Netherlands	13.11.1979	15.07.1982 (At)(3)	28.09.1984	22.10.1985 (At)(3)	9. 7.1985	30.04.1986 (At)(3)	1.11.1988	11.10.1989 (At)(3)	19.11.1991	
Norway	13.11.1979	13.02.1981 (R)	28.09.1984	12.03.1985 (At)	9. 7.1985	04.11.1986 (R)	1.11.1988	11.10.1989 (R)	19.11.1991	07.01.1993 (R)
Poland	13.11.1979	19.07.1985 (R)(2)		14.09.1988 (Ac)			1.11.1988			
Portugal	14.11.1979	29.09.1980 (R)		10.01.1989 (Ac)					02.04.1992	
Romania	14.11.1979 (1)	27.02.1991 (R)								
Russian Federation	13.11.1979	22.05.1980 (R)	28.09.1984	21.08.1985 (At)	9. 7.1985	10.09.1986 (At)	1.11.1988	21.06.1989 (At)		
San Marino	14.11.1979									
Slovenia		06.07.1992 (Sc)		06.07.1992 (Sc)						
Spain	14.11.1979	15.06.1982 (R)		11.08.1987 (Ac)			1.11.1988	04.12.1990 (R)	19.11.1991	
Sweden	13.11.1979	12.02.1981 (R)	28.09.1984	12.08.1985 (R)	9. 7.1985	31.03.1986 (R)	1.11.1988	27.07.1990 (R)	19.11.1991	
Switzerland	13.11.1979	06.05.1983 (R)	03.10.1984	26.07.1985 (R)	9. 7.1985	21.09.1987 (R)	1.11.1988	18.09.1990 (R)	19.11.1991	
Turkey	13.11.1979	18.04.1983 (R)	03.10.1984	20.12.1985 (R)						
Ukraine	14.11.1979	05.06.1980 (R)	28.09.1984	30.08.1985 (At)	9. 7.1985	02.10.1986 (At)	1.11.1988	24.07.1989 (At)	19.11.1991	
United Kingdom	13.11.1979	15.07.1982 (R)(4)	20.11.1984	12.08.1985 (R)			1.11.1988	15.10.1990 (R)(4)	19.11.1991	
United States	13.11.1979	30.11.1981 (At)	28.09.1984	29.10.1984 (At)			1.11.1988 (1)	13.07.1989 (At)	19.11.1991	
Yugoslavia	13.11.1979	18.03.1987 (R)		28.10.1987 (Ac)						
European Community	14.11.1979	15.07.1982 (Ap)	28.09.1984	17.07.1986 (Ap)					02.04.1992	
Total:	34	35	22	33	20	20	26	21	23	1

(a) Convention on Long-range Transboundary Air Pollution, adopted 13.11.1979, entry into force 16.3.1983.
(b) Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Long-term Financing of the Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP), adopted 28.9.1984, entry into force 28.1.1988.
(c) Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 percent, adopted 8.7.1985, entry into force 2.9.1987.
(d) Protocol to the 1979 Convention on Long-range Transboundary Air Pollution concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes, adopted 31.10.1988, entry into force 14.2.1991.
(e) Protocol to the 1979 Convention on Long-range Transboundary Air Pollution concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes, adopted 18.11.1991.

Notes: * *R = Ratification, Ac = Accession, Ap = Approval, At = Acceptance, Sc = Succession*
(1) With declaration upon signature.
(2) With declaration upon ratification.
(3) For the Kingdom in Europe.
(4) Including the Bailiwick of Guernsey, the Isle of Man, Gibraltar, the United Kingdom Sovereign Base Areas of Akrotiri and Dhekhelia on the Island of Cyprus.

EUROPEAN COMMUNITY ENVIRONMENTAL DIRECTIVES

(Directives marked with an * are summarized in this Annex)

Air Pollution

Legislation Involving Sources

- * Air pollution from industrial plants (1984)
- * Limitation of emission of certain pollutants into the air from large combustion plants (1988) (Large Combustion Plant Directive)
- Prevention of air pollution from new municipal waste incineration plants (1989)
- Reduction of air pollution from existing waste-incineration plants (1989)

Legislation Involving Pollutants

- Approximation of the laws of the Member States relating to the sulphur content of certain liquid fuels (1975)
- * Air quality limit values and guide values for sulphur dioxide and suspended particulates (1980)
- * Air quality standards for nitrogen dioxide (1985)
- * Limit value for lead in the air (1982)
- Approximation of the laws of the Member States concerning the lead content of petrol (1985)
- Prevention and reduction of environmental pollution by asbestos (1987)

Water Pollution

Water Quality

- * Quality of fresh waters needing protection or improvement in order to protect fish life (1978)
- Quality required of shellfish waters (1979)
- * Quality of bathing water (1975)
- * Quality of surface water intended for the abstraction of drinking water in the Member States (1975)
- * Methods of measurement and frequencies of sampling and analysis of surface water intended for the abstraction of drinking water in the Member States (1979)
- * Quality of water intended for human consumption (1980)

Discharges of Dangerous Substances

Pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (1979)

Limit values and quality objectives for discharges of certain dangerous substances included in List I of the Annex to Directive (1986)

Limit values and quality objectives for mercury discharges by the chlor-alkali electrolysis industry (1982)

Limit values and quality objectives for mercury discharges by sectors other than the chlor-alkali electrolysis industry (1984)

Limit values and quality objectives for cadmium discharges (1983)

Limit values and quality objectives for discharges of hexachlorocyclohexane (1984)

* Protection of groundwater against pollution caused by certain dangerous substances (1979)

Waste Water Treatment

* Urban waste water treatment (1989)

Waste Management

In General

Waste (1975)

Waste amended (1975)

Toxic and dangerous waste (1978)

Hazardous waste (1991)

Supervision and control within the European Community of the transfrontier shipment of hazardous waste (1984)

Legislation Involving Specific Wastes

Disposal of polychlorinated biphenyls and polychlorinated terphenyls (1976)

Disposal of waste oils (1975)

Waste from the titanium dioxide industry (1978)

Procedures for the surveillance and monitoring of environments concerned by waste from the titanium dioxide industry (1978)

Dangerous Substances and Biotechnology

Classification, Packaging, and Labeling

Approximation of the laws, regulations, and administrative programs relating to the classification, packaging and labelling of dangerous substances (1967)

List of chemical substances notified pursuant to the Directive on the approximation of the laws, regulations, and administrative programs relating to the classification, packaging and labelling of dangerous substances (1984)

Approximation of the laws, regulations, and administrative provisions relating to the classification, packaging and labelling of dangerous preparations (solvents) (1973)

Approximation of Member States' laws, regulations, and administrative provisions of the Member States relating to the classification, packaging and labelling of paints, varnishes, printing inks, adhesives and similar products (1977)

Approximation of the laws of the Member States relating to the classification, packaging and labelling of dangerous preparations (pesticides) (1978)

Approximation of the laws, regulations, and administrative provisions relating to the classification, packaging and labelling of dangerous preparations (1988)

Marketing and Use

Approximation of the laws, regulations, and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (1976)

Export and Import

Export from and import into the Community of certain dangerous chemicals (1988)

Export of certain chemical products (1989)

Biotechnology

Contaminated use of genetically modified micro-organisms (1990)

Deliberate release into the environment of genetically-modified organisms (1990)

Proposed Legislation

Civil liability for damage caused by waste

Supervision and control of shipments of waste within, into and out of the European Community

Landfill of waste

Community award scheme for an Eco-label

Voluntary participation by companies in the industrial sector in a Eco-audit scheme

AIR QUALITY STANDARDS, EUROPEAN COMMUNITY

Limit Values for Suspended Particulates, Sulphur Dioxide, Oxides of Nitrogen, and Lead

Pollutant	Reference period	Limit value ($\mu g/m^3$)	Associated particulate value ($\mu g/m^3$)	Reference method
TSP [1] (black smoke method)	year	80 [a]		([5])
	winter (1 October to 31 March)	130 [b]		
	year (made up of measuring periods of 24 hours)	250 [c]		
TSP (gravimetric method)	year	150 [f]		*Method of sampling*: ([7])
	year (made up of measuring periods of 24 hours)	300 [g]		*Method of analysis*: weighing
Sulphur dioxide [2] (black smoke method)	year	80 [a] 120 [a]	> 40 [a] ≤ 40 [a]	*Method of sampling*: uses equipment described in International Standard ISO-4219. The sampling period is normally 24 hours.
	winter (1 October to 31 March)	130 [b] 180 [b]	> 60 [b] ≤ 60 [b]	
	year (made up of measuring periods of 24 hours)	250 [c] 350 [c]	> 150 [c] ≤ 150 [c]	*Method of analysis*: TCM/pararosaniline [4]
Sulphur dioxide [3] (gravimetric method)	year	80 [a] 120 [a]	> 150 [a] ≤ 150 [a]	*Method of sampling*: uses equipment described in International Standard ISO-4219. The sampling period is normally 24 hours.
	winter (1 October to 31 March)	130 [b] 180 [b]	> 200 [b] ≤ 200 [b]	
	year (made up of measuring periods of 24 hours)	250 [c] 350 [c]	> 350 [c] ≤ 350 [c]	*Method of analysis*: TCM/pararosaniline [4]
Nitrogen dioxide [6]	year	200 [d]		*Method of analysis*: chemiluminescence (described in ISO standards DIS 7996) [8]
Lead	year	2 [e]		*Method of sampling*: ([9]) *Method of analysis*: atomic absorption spectrometry

Guide Values for Sulphur Dioxide, Suspended Particulates, and Oxides of Nitrogen

Pollutant	Reference period	Guide value (μg/m³)
TSP [1] (black smoke method)	year 24 hours	40-60 [f] 100-150 [h]
Sulphur dioxide [1] (black smoke method)	year 24 hours	40-60 [f] 100-150 [h]
NOx [6]	year	50 (50th percentile) [i] 135 (98th percentile) [i]

1/ The results of the measurements of black smoke taken by the OECD method have been converted into gravimetric units.
2/ Associated values for suspended particulates, measured by the black smoke method.
3/ Associated values for suspended particulates, measured by the gravimetric method.
4/ TCM: tetrachloromercurate. The method of analysis is based on the principle of the colorimetric reaction with paraosaniline (detailed in Annex V of Directive 80/779 of July 15, 1980).
5/ For the determination of black smoke and its conversion into gravimetric units, the method standardized by the OECD working party on methods of measuring air pollution and survey techniques is considered to be the reference method.
6/ The volume must be standardized at 293° K and 101,3 kPa.
7/ The suspended particulates are collected on a membrane or glass-fiber filter with an efficiency of more than 99% for particles with an aerodynamic diameter of 0.3 μm. The sampling duration is 24 hours. There must be at least 100 uniformly distributed samplings per year.
8/ For details, see Annex IV of Directive 85/203 of March 7, 1985.
9/ The atmospheric particles must be collected on a filter with a collection efficiency of more than 99% for particles with an aerodynamic diameter of 0.3 μm. For details, see Annex of Directive 82/884 of December 3, 1982.

a/ median of daily mean values taken throughout the year.
b/ median of daily mean values taken throughout the winter.
c/ 98th percentile of all daily mean values taken throughout the year. Member States must take all appropriate steps to assure that this value is not exceeded for more than three consecutive days.
d/ 98th percentile calculated from the mean values per hour or per period of less than an hour taken throughout the year.
e/ annual mean concentration.
f/ arithmetic mean of daily mean values taken throughout the year.
g/ 95th percentile of all daily mean values taken throughout the year.
h/ daily mean value.
i/ calculated from the mean values per hour or per period of less than an hour recorded throughout the year.

Definitions

- *Limit value*: the concentration of the pollutant which, in order to protect human health in particular, must not be exceeded in the territory of the Member States during the specified periods.

- *Guide value:* the concentration of the pollutant which intended to serve as long-term precautions for health and the environment and as reference points for the establishment of specific schemes within zones determined by the Member States.

Sources: For sulphur dioxide and particulates, European Communities Directive 80/779 (July 15, 1980) and amending Directive 89/427 (July 14, 1989). For lead, European Communities Directive 82/884 (December 3, 1982). For nitrogen dioxide, European Communities Directive 85/203 (March 7, 1985).

COMBATING AIR POLLUTION FROM INDUSTRIAL PLANTS

This Directive provides for measures and procedures designed to prevent or reduce air pollution from industrial plants within the Community, particularly those of categories listed below. The Directive does not apply to industrial plants serving national defense.

I. Categories of Plants

A. Energy industry

- Coke ovens
- Oil refineries (excluding undertakings manufacturing only lubricants from crude oil)
- Coal gasification and liquifaction plants
- Thermal power stations (excluding nuclear) and other combustion installations with a nominal heat output of more than 50 MW

B. Production and processing of metals

- Roasting and sintering plants with a capacity of more than 1,000 tons of metal ore per year
- Integrated plants for the production of pig iron and crude steel
- Ferrous metal foundries having melting installations with a local capacity of over 5 tonnes
- Plants for the production and melting of non-ferrous metals having installations with a total capacity of over 1 tonne for heavy metals or 0.5 tonne for light metals

C. Manufacture of non-metallic mineral products

- Plants for the production of cement and rotary kiln lime production
- Plants for the production and processing of asbestos and manufacture of asbestos-based products
- Plants for the manufacture of glass fiber or mineral fiber
- Plants for the production of glass (ordinary and special) with a capacity of more than 5,000 tonnes per year
- Plants for the manufacture of coarse ceramics notably refactory bricks, stoneware pipes, facing and floor bricks and roof tiles

D. Chemical industry

- Chemical plants for the production of olefins, derivatives of olefins, monomers and polymers
- Chemical plants for the manufacture of other organic intermediate products
- Plants for the manufacture of basic inorganic chemicals

E. Waste disposal

- Plants for the disposal of toxic and dangerous waste by incineration
- Plants for the treatment by incineration of other solid and liquid waste

F. Other industries

- Plants for the manufacture of paper pulp by chemical methods with a production capacity of 25,000 tonnes or more per year

II. List of the Most Important Polluting Substances

- Sulphur dioxide and other sulphur compounds
- Oxides of nitrogen and other nitrogen compounds
- Carbon monoxide
- Organic compounds, in particular hydrocarbons (except methane)
- Heavy metals and their compounds
- Dust; asbestos (suspended particulates and fibers), glass and mineral fibers
- Chlorine and its compounds
- Fluorine and its compounds

III. General Rules

A. Member States shall take the necessary measures to ensure that prior authorization is required to operate new plants belonging to the above-listed categories. Member States must also require prior authorization in the case of substantial alteration of any plant in the above-listed categories, or which, as a result of the alteration, will fall into those categories.

B. Authorization to operate a plant may be issued only when the competent authority is satisfied that:

- all preventive measures against air pollution have been taken, including the application of the best available technology, provided that the application of such measures does not entail excessive costs;

- the use of the plant will not cause significant air pollution particularly of the substances listed above;

- none of the emission limit values applicable will be exceeded;

- all of the air quality limit values applicable will be taken into account.

C. Member States shall implement policies and strategies for the gradual adaptation of existing plants belonging to the above-listed categories to the best available technology, taking into account in particular:

- the plant's physical characteristics;

- its rate of utilization and length of its remaining life;

- the nature and volume of polluting emissions from it;

- the desirability of not entailing excessive costs for the plant concerned, having regard in particular to the economic situation of undertakings belonging to the category in question.

Source: European Communities Directive 84/360 (June 28, 1984).

LARGE COMBUSTION PLANT DIRECTIVE

(November 1988)

This Directive applies to combustion plants with rated thermal input of at least 50 MW, regardless of the type of fuel used. The Directive applies only to combustion plants designed for the production of energy with the exception of those which make direct use of the products of combustion in manufacturing processes.

I. Existing Plants

EMISSION CEILINGS AND REDUCTION TARGETS FOR SO_2 FROM EXISTING PLANTS (1) (2)

	0	1	2	3	4	5	6	7	8	9
Member State	SO_2 emission by large combustion plants 1980 ktonnes	emission ceiling (ktonnes/yr)			% reduction over 1980 emissions			% reduction over adjusted 1980 emissions		
		phase 1	phase 2	phase 3	phase 1	phase 2	phase 3	phase 1	phase 2	phase 3
		1993	1998	2003	1993	1998	2003	1993	1998	2003
Belgium	530	318	212	159	-40	-60	-70	-40	-60	-70
Denmark	323	213	141	106	-34	-56	-67	-40	-60	-70
Germany	2,225	1,335	890	668	-40	-60	-70	-40	-60	-70
Greece	303	320	320	320	+6	+6	+6	-45	-45	-45
Spain	2,290	2,290	1,730	1,440	0	-24	-37	-21	-40	-50
France	1,910	1,146	764	573	-40	-60	-70	-40	-60	-70
Ireland	99	124	124	124	+25	+25	+25	-29	-29	-29
Italy	2,450	1,800	1,500	900	-27	-39	-63	-40	-50	-70
Luxembourg	3	1.8	1.5	1.5	-40	-50	-60	-40	-50	-50
Netherlands	299	180	120	90	-40	-60	-70	-40	-60	-70
Portugal	115	232	270	206	+102	+135	+79	-25	-13	-34
United Kingdom	3,883	3,106	2,330	1,553	-20	-40	-60	-20	-40	-60

1/ Additional emissions may arise from capacity authorized on or after July 1, 1987.

2/ Emissions coming from combustion plants authorized before July 1, 1987 but not yet in operation before that date and which have not been taken into account in establishing emission ceilings fixed by this Annex shall either comply with the requirements established by this Directive for new plants or be accounted for in the overall emissions from existing plants that must not exceed the ceilings fixed in this Annex.

EMISSION CEILINGS AND REDUCTION TARGETS FOR NO_x FROM EXISTING PLANTS (1) (2)

	0	1	2	3	4	5	6
Member State	NO_x emissions by large combustion plants 1980 ktonnes	NO_x emission ceilings (ktonnes/yr)		% reduction over 1980 emissions		% reduction over adjusted 1980 emissions	
		phase 1	phase 2	phase 1	phase 2	phase 1	phase 2
		1993 3	1998	1993 3	1998	1993 3	1998
Belgium	110	88	66	-20	-40	-20	-40
Denmark	124	121	81	- 3	-35	-10	-40
Germany	870	696	522	-20	-40	-20	-40
Greece	36	70	70	+94	+94	0	0
Spain	366	368	277	+1	-24	-20	-40
France	400	320	240	-20	-40	-20	-40
Ireland	28	50	50	+79	+79	0	0
Italy	580	570	428	- 2	-26	-20	-40
Luxembourg	3	2.4	1.8	-20	-40	-20	-40
Netherlands	122	98	73	-20	-40	-20	-40
Portugal	23	59	64	+157	+178	- 8	0
United Kingdom	1,016	864	711	-15	-30	-15	-30

1/ Additional emissions may arise from capacity authorized on or after July 1, 1987.

2/ Emissions coming from combustion plants authorized before July 1, 1987 but not yet in operation before that date and which have not been taken into account in establishing emission ceilings fixed by this Annex shall either comply with the requirements established by this Directive for new plants or be accounted for in the overall emissions from existing plants that must not exceed the ceilings fixed in this Annex.

3/ Member States may for technical reasons delay for up to two years the phase 1 date for reduction in NO_x emissions by notifying the Commission within one month of the notification of this Directive.

II. New Plants

EMISSION LIMIT VALUES FOR SO_2 FOR NEW PLANTS (1) SOLID FUELS

Thermal capacity (MW)	Emission limit values (mg SO_2/Nm^3)
50-100	(1)
100-400 2	-4(MWth)+2,400
≥ 400 2	800
100-500 3	-4(MWth)+2,400
≥ 500 3	400

1/ In 1990, on the basis of a Commission report on the availability of low-sulphur fuel and a relevant Commission proposal, the Council will decide on emission limit values for plants between 50 and 100 MWth.

2/ Plants operated less than 2,200 hours/year.

3/ Plants operated more than 2,200 hours/year.

EMISSION LIMIT VALUES FOR SO_2 FOR NEW PLANTS LIQUID FUELS

Thermal capacity (MW)	Emission limit values (mg SO_2/Nm^3)
$50 \leq MW < 300$	1,700
$300 \leq MW < 500$	-6.5(MWth)+3,650
≥ 500	400

EMISSION LIMIT VALUES FOR SO_2 FOR NEW PLANTS GASEOUS FUELS

Type of fuel	Limit values (mg SO_2/Nm^3)
Gaseous fuels in general	35
Liquefied gas	5
Low calorific gases from gasification of refinery residues, coke oven gas, blast-furnace gas	800
Gas from gasification of coal	([1])

1/ The Council will fix the emission limit values applicable to such gas at a later stage on the basis of proposals from the Commission to be made in light of further technical experience.

EMISSION LIMIT VALUES FOR NO_x FOR NEW PLANTS

Type of fuel	Limit values (mg NOx/Nm^3)
Solid in general	650
Solid with less than 10% volatile compounds	1,300
Liquid	450
Gaseous	350

EMISSION LIMIT VALUES FOR DUST FOR NEW PLANTS

Type of Fuel	Thermal capacity (MW)	Emission limit values (mg dust/Nm³)
Solid	≥ 500 < 500	50 100
Liquid	all plants	50
Gaseous	all plants	5 as a rule 10 for blast furnace 50 for gases produced by the steel industry which can be used elsewhere

III. New Plants Exempt from Emission Limit Values (See V. (A), General Exceptions below)

RATES OF DESULFURIZATION

Thermal capacity (MW)	Rates of desulphurization
100≤MW<175	.4 (i.e. 40% reduction)
167≤MW<500	.0015(MW)+.15
≥ 500	.9 (i.e. 90% reduction)

IV. General Rules

A. Multi-fuel firing units

1. For the purpose of granting the license for a new plant with a multi-fuel firing unit, the emission limit values are set as follows:

a) For plants using two or more fuels simultaneously,

- firstly by taking the emission limit value relevant for each individual fuel and pollutant corresponding to the rated thermal input of the combustion plant,

- secondly by determining fuel-weighted emission limit values, obtained by multiplying the thermal input delivered by each fuel, then dividing by the total thermal input delivered by all fuels,

- thirdly by aggregating the fuel-weighted limit values.

b) For plants using two or more fuels alternatively, the emission limit values for each fuel used apply.

2. a) In multi-fuel firing units using the distillation and conversion residues from crude-oil refining for own consumption, alone or with other fuels, the provisions for the fuel with the highest emission limit value (determinative fuel) shall apply, if that fuel contributes at least 50% to the total thermal input.

Where the proportion of the determinative fuel is less than 50%, the emission limit value is determined on a pro rata basis of the heat input supplied by the individual fuels in relation to the sum of the thermal inputs delivered by all fuels as follows:

- firstly by taking the emission limit value relevant for each individual fuel and pollutant corresponding to the rated heat input of the combustion plant,

- secondly by calculating the emission limit value of the determinative fuel (in the case of two fuels having the same emission limit value, the fuel with the higher thermal input), obtained by multiplying the emission limit value for that fuel by two, then subtracting the emission limit value of the fuel with the lowest emission value,

- thirdly by determining the fuel-weighted emission limit values, obtained by multiplying the calculated fuel emission limit value by the thermal input delivered by each fuel, then dividing by the total thermal input delivered by all fuels,

- fourthly by aggregating the fuel-weighted emission limit values.

2. b) As an alternative, an emission limit value for sulphur dioxide of 1,000 mg/Nm^3 can be applied, averaged over all new plants of the refinery and irrespective of the fuel combination used, provided this does not lead to an increase in emissions from existing plants.

B. Plant expansion

Where a combustion plant is expanded by at least 50 MW, the emission limit value to be applied to the new part of the plant shall be fixed in relation to the thermal capacity of the entire plant. This provision does not apply to some multi-fuel firing plants.

C. Measuring methods and equipment

The measuring methods and/or equipment used to determine the concentrations of SO_2, dust, NOx and the other values in order to monitor compliance with this Directive, and all other equipment used in order to evaluate the results, shall consist of the best industrial measurement technology and shall provide reproducible and comparable results.

D. Determining compliance with emission limits

1. With continuous measurements, the emission limit values set out in the Directive shall be regarded as having been complied with if the evaluation of the results indicates, for operating hours within a calendar year, that:

a) none of the calendar monthly means exceeds the emission limit values; and

b) in the case of:

- sulphur dioxide and dust: 97% of all the 48 hourly mean values do not exceed 110% of the emission limit values,

- oxides of nitrogen: 95% of all the 48 hourly mean values do not exceed 110% of the emission limit values.

2. With discontinuous measurements or other appropriate procedures, the emission limit values shall be regarded to have been complied with if the results of each of the series of measurements or of the other procedures defined and determined according to the rules laid down by the authorities do not exceed the emission limit values.

3. In the case of plants which must comply with the desulphurization rates fixed by the Directive, the rates of desulphurization shall be regarded as having been complied with if all of the calendar monthly mean values or all of the rolling monthly mean values achieve the required desulphurization rates.

V. General exceptions to the emission limit values contained in the Directive

A. New plants which burn indigenous solid fuel, the nature of which makes it difficult to comply with the emission limits for SO_2 without using excessively expensive technology, may exceed the limit values laid down in the Directive.

Such plants shall at least achieve the rates of desulphurization laid down in the Directive.

B. Member States may authorize plants burning indigenous lignite to exceed the emission limit values if, notwithstanding the application of best available technology not entailing excessive costs, major difficulties connected with the nature of the lignite so require and provided that lignite is an essential source of fuel for the plants.

C. In the event of 1) a malfunction or breakdown of pollution abatement equipment, 2) a supply disruption of low-sulphur fuel or of gas, or 3) a substantial and unexpected change in energy demand or the availability of certain generating installations, the rules regarding emission limit values may be temporarily suspended.

VI. Country exceptions to the emission limit values contained in the Directive

A. Spain has been given until December 31, 1999, to comply with EC emission limits of SO_2 from new plants, since Spain needs a particularly large amount of new generating capacity to allow for its energy and industrial growth. In particular, Spain may build new power plants with a rated thermal input equal to or greater than 500 MW burning indigenous or imported solid fuels, commissioned before the end of 2005 complying with the following requirements:

- in the case of imported solid fuels, an SO_2 emission limit value of 800 mg/Nm^3,
- in the case of indigenous solid fuels, at least 60% rate of desulphurization,

provided that the total authorized capacity of such plants does not exceed:

- 2,000 MWe in the case of plants burning indigenous solid fuels,
- in the case of plants burning imported solid fuels either 7,500 MWe or 50% of the new capacity of all plants burning solid fuels authorized up to December 31, 1999, whichever is lower.

VII. Methods of Measurement of Emissions

A. Procedures for measuring and evaluating emissions from new plants

1. a) For new plants with a rated thermal input of more than 300 MW, concentrations of SO_2, dust, NOx, and oxygen shall be measured continuously. However, where the authorities approve, discontinuous measurements or appropriate determination procedures may be used.

   b) For new plants with a rated thermal input of less than or equal to 300 MW, the authorities may require continuous measurements where considered necessary.

2. For plants which must comply with the Directive's desulphurization rates, the requirements concerning SO_2 emission measurements established under paragraph 1 apply. Moreover, the sulphur content of the fuel which is introduced into the combustion plant facilities must be regularly monitored.

3. The instruments for the measurement of concentrations of SO_2, dust, NOx, and oxygen shall undergo basic calibration and an examination of their operation at appropriate regular intervals. The continuously-operating measuring equipment shall be calibrated in accordance with a reference measuring method approved by the competent authority.

B. Determination of total annual emissions of new plants

With continuous monitoring, the operator of the combustion plant shall add up separately for each pollutant the mass of pollutant emitted each day, on the basis of the volumetric flow rates of waste gases. Otherwise, the operator will estimate the total annual emissions to the satisfaction of the competent authorities.

C. Determination of the total annual emissions of existing plants

1. Member States shall establish, starting in 1990 and for each subsequent year, a complete emission inventory for existing plants covering SO_2 and NOx:

   - on a plant-by-plant basis for plants above 300 MWth and for refineries;

   - on an overall basis for other combustion plants to which the Directive applies.

2. The methodology used for the inventories shall be consistent with that used to determine SO_2 and NOx emissions from combustion plants in 1980.

VIII. Definitions

- *emission:* the discharge of substances from the combustion plant into the air.

- *waste gases:* gaseous discharges containing solid, liquid or gaseous emissions; their volumetric flow rates expressed in cubic meters per hour at standard temperature (273 K) and pressure (101,3 kPa) after correction for the water vapor content, hereinafter referred to as (Nm^3/h) or normal cubic meters per hour.

- *emission limit value:* the permissible quantity of a substance contained in the waste gases from the combustion plant which may be discharged into the air during a given period, calculated in terms of mass per volume of the waste gases expressed in mg/Nm^3, assuming an oxygen content by volume in the waste gas of 3% in the case of liquid and gaseous fuels and 6% in the case of solid fuels.

- *rate of desulphurization:* the ratio of the quantity of sulphur which is separated out at the combustion plant site over a given period by processes especially designed for this purpose, to the quantity of sulphur contained in the fuel used at the combustion plant same period.

- *operator:* any natural or legal person who operates the combustion plant, or who has or has been delegated decisive powers over it.

- *fuel:* any solid, liquid or gaseous combustible material used to fire the combustion plant, with the exception of domestic refuse and toxic or dangerous waste.

- *combustion plant:* any technical apparatus in which fuels are oxidized in order to use the heat thus generated.

  Where two or more separate new plants are installed in such a way that, taking technical and economic factors into account, their waste gases could, in the judgment of the competent authorities, be discharged through a common stack, the combination formed by such plants is to be regarded as a single unit.

- *multi-fuel firing unit:* any combustion plant which may be fired simultaneously or alternately by two or more types of fuel.

- *new plant:* any combustion plant for which the original construction license or, in the absence of such a procedure, the original operating license was granted on or after 1 July 1987.

- *existing plant:* any combustion plant for which the original construction license or, in the absence of such a procedure, the original operating license was granted before 1 July 1987.

Source: European Communities Directive 88/609 (November 24, 1988).

QUALITY OF FRESH WATERS SUPPORTING FISH LIFE [1]

This Directive concerns the quality of fresh waters designated by the Member States as needing protection or improvement to support fish life. Its purpose is to protect or improve the quality of running or standing waters which support or which, if less polluted, would support indigenous species of fish offering a natural diversity, or species that the Member States deem desirable. The Directive does not apply to waters in natural or artificial fish ponds used for intensive fish-farming.

Parameter	Salmonid waters [2]		Cyprinid waters [3]		Methods of analysis or inspection	Minimum sampling and measuring frequency [4]
	Guide	Mandatory	Guide	Mandatory		
temperature (°C)	1. Temperature measured downstream of a point of thermal discharge (at the edge of the mixing zone) must not exceed the unaffected temperature by more than:				Thermometry	Weekly, both upstream and downstream of the point of thermal discharge
		1.5°C		3°C		
	Derogations limited in geographical scope may be decided by Member States in particular conditions if the competent authority can prove that there are no harmful consequences for the balanced development of the fish population.					
	2. Thermal discharges must not cause the temperature downstream of the point of thermal discharge (at the edge of the mixing zone) to exceed the following:					
		21.5°C [5] 10°C [5]		28°C [5] 10°C [5]		
	The 10°C temperature limit applies only to breeding periods of species which need cold water for reproduction and only to waters which may contain such species.					
	Temperature limits may be exceeded for 2% of the time.					
dissolved oxygen (mg/l)	50% > 9 100% > 7	50% > 9 [6]	50% > 8 100% > 5	50% > 7 [7]	Winkler's method or specific electrodes (electro-chemical method)	Monthly, minimum one sample representative of low oxygen conditions of the day of sampling. [8]
pH		6-9 [5,9]		6-9 [5,9]	Electrometry calibration by means of two solutions with known pH values, preferably on either side of, and close to the pH being measured	Monthly
suspended solids (mg/l)	< 25 [5]		< 25 [5]		Filtration through a 0.45 μm filtering membrane, or centrifugation, drying at 105°C and weighing [10]	
BOD_5 (mg/l)	< 3		< 6		Determination of O_2 by the Winkler method before and after 5 days incubation in complete darkness at 20 ± 1°C [11]	

Parameter	Salmonid waters [2]		Cyprinid waters [3]		Methods of analysis or inspection	Minimum sampling and measuring frequency [4]
	Guide	Mandatory	Guide	Mandatory		
total phosphorus (mg/l) [12]					Molecular absorption spectrophotometry	
nitrates (mg/l)	< 0.01		< 0.03		Molecular absorption spectrophotometry	
phenolic compounds (mg/l)		([13])		([13])	By taste	
petroleum hydro-carbons		([14])		([14])	Visual or By taste	Monthly
Non-ionized ammonia (mg/l)	< 0.005	< 0.025	< 0.005	< 0.025	Molecular absorption spectrophotometry using indophenol blue or Nessler's method associated with pH and temperature determination	Monthly
	In order to diminish the risk of toxicity due to non-ionized ammonia, of oxygen consumption due to nitrification and of eutrophication, the concentrations of total ammonium should not exceed the following:					
total ammonium (mg/l)	< 0.04	< 1 [15]	< 0.2	< 1 [15]		
total residual chlorine (mg/l)		< 0.005		< 0.005	DPD-method (diethyl-*p*-phenylenediamene)	Monthly
total zinc [16] (mg/l)		< 0.3		< 1.0	Atomic absorption spectrometry	Monthly
dissolved copper [17] (mg/l)	< 0.04		< 0.04		Atomic absorption spectrometry	

1/ Member States shall not set values less stringent than those listed in the "mandatory" column and shall endeavor to achieve the levels listed in the "guide" column.
2/ Waters which support or are capable of supporting fish belonging to species such as salmon, trout, grayling, and whitefish.
3/ Waters which support or are capable of supporting fish belonging to the cyprinids, or other species such as pike, perch, and eel.
4/ Where water quality is considerably higher than the objectives set in this Directive, Member States may reduce the frequency of sampling. Where there is no pollution or no risk of deterioration in the quality of the waters, the competent authority may decide that no sampling is necessary.
5/ Exceptions are possible 1) because of exceptional weather or special geographical conditions, or 2) when designated waters undergo natural enrichment in certain substances. Natural enrichment means the process whereby, without human intervention, a given body of water receives from the soil certain substances contained therein.
6/ When the oxygen concentration falls below 6 mg/l, Member States shall establish whether this is by chance, a natural phenomenon, or pollution, and shall take appropriate measures.
7/ When the oxygen concentration falls below 4 mg/l, Member States shall establish whether this is by chance, a natural phenomenon, or pollution, and shall take appropriate measures.
8/ However, where major daily variations are suspected, a minimum of two samples in one day shall be taken.
9/ Artificial pH variations with respect to the unaffected values shall not exceed $\pm$ 0.5 of a pH unit within the limits falling between 6.0 and 9.0 provided that these variations do not increase the harmfulness of other substances present in the water.
10/ Five minute minimum, average acceleration of 2,800 to 3,200 g.
11/ Nitrification should not be inhibited.
12/ In the case of lakes of average depth between 18 and 300 m, the following formula could be applied:

$L < 10 (Z/T_w)(1 + \sqrt{(T_w)})$ where:

L = loading expressed as mg P per square meter lake surface in one year.

Z = mean depth of lake in meters
Tw = theoretical renewal time of lake water in years

In other cases limit values of 0.2 mg/l for salmonid and 0.4 mg/l for cyprinid waters, expressed as PO_4, may be regarded as indicative in order to reduce eutrophication.

13/ Phenolic compounds must not be present in such concentrations that they adversely affect fish flavor.

14/ Petroleum products must not be present in water in such quantities that they:
- form a visible film on the surface of the water or form coatings on the beds of water-courses and lakes;
- impart a detectable 'hydrocarbon' taste to fish;
- produce harmful affects in fish.

15/ In particular geographical or climatic conditions and particularly in cases of low water temperature and of reduced nitrification or where the competent authority can prove that there are no harmful consequences for the balanced development of the fish population, Member States may fix values greater than 1 mg/l.

16/ The mandatory-values correspond to a water hardness of 100 mg/l $CaCO_3$. For hardness levels between 10 and 500 mg/l, the corresponding limits are listed in the table below.

17/ The guide-values correspond to a water hardness of 100 mg/l $CaCO_3$. For hardness levels between 10 and 300 mg/l, the corresponding limits are listed in the table below.

PARTICULARS REGARDING TOTAL ZINC AND DISSOLVED COPPER

Total Zinc

Zinc concentrations (mg/l Zn) for different water hardness values between 10 and 50aCO$_2$

	Water hardness (mg/l $CaCO_2$)			
Salmonid waters (mg/l Zn)	0.03	0.2	0.3	0.5
Cyprinid waters (mg/l Zn)	0.03	0.7	1.0	2.0

Dissolved Copper

Dissolved copper concentrations (mg/l Cu) for different water hardness values between 10 and 300 mg/l $CaCO_3$

	Water hardness (mg/l $CaCO_2$)			
	10	50	100	300
mg/l Copper	0.005 [1]	0.022	0.04	0.112

1/ The presence of fish in water containing higher concentrations of copper may indicate a predominance of dissolved organo-cupric complexes.

Rules

A. Member States designate salmonid and cyprinid waters. They may make additional designations or revise earlier ones in the event of factors unforeseen at the time of the designation.

B. The designated waters shall be deemed to conform to the provisions of the Directive if samples of such waters, taken at the minimum frequency specified at the sampling point and over a period of 12 months, show that they conform to both the values set by the Member States, in the case of:

- 95% of the samples for pH, BOD_5, non-ionized ammonia, total ammonium, nitrates, total residual chlorine, total zinc, and dissolved copper. When the sampling frequency is lower than one sample per month, both the aforementioned values and comments shall be respected for all the samples;

- the percentages listed for temperature and dissolved oxygen;

- the average concentration set for suspended solids.

Values exceeding those set by the Member States, when the result of floods or other natural disasters, shall not be considered when calculating the percentages listed above.

C. The exact sampling point, the distance form this point to the nearest point where pollutants are discharged and the depth at which samples are to be taken shall be fixed by the competent authority of each Member State on the basis of local environmental conditions.

Source: European Communities Directive 78/659 (July 18, 1978).

QUALITY OF BATHING WATER [1,2]

This Directive concerns the quality of bathing waters, excluding water intended for therapeutic purposes and water used in swimming pools.

Parameter	Guide	Mandatory	Methods of analysis or inspection	Minimum sampling and
MICROBIOLOGICAL PARAMETERS				
total coliforms (cells/100 ml)	500	10,000	- fermentation in multiple tubes. Subculturing of the positive tubes on a confirmation medium. Count according to most probable number (MPN). - membrane filtration and culture on an appropriate medium such as Teritol lactose agar, endo agar, 0.4% Teepol broth, subculturing and identification of the suspect colonies.	Fortnightly [3]
fecal coliforms (cells/100 ml)	100	2,000		Fortnightly [3]
fecal streptococci (cells/100 ml)	100	-	- Litsky method. Count according to MPN. - filtration on membrane. Culture on an appropriate medium.	(4)
salmonella (cells/l)	-	0	- concentration by membrane filtration. Inoculation on a standard medium. Enrichment - subculturing on isolating agar - identification.	(4)
entero viruses (PFU/10 l)	-	0	- concentration by filtration, flocculation or centrifuging and confirmation.	(4)
PYSICO-CHEMICAL PARAMETERS				
pH		6-9 [6]	- electrometry with calibration at pH 7 and 9.	(4)
color	- -	no abnormal change in color [6] -	- visual inspection or photometry with standards on the Pt.Co scale.	Fortnightly [3] (4)
mineral oils (mg/l)	- ≤ 0.3	No film visible on the surface of the water and no odor -	- visual and olfactory inspection or extraction using an adequate volume and weighing the dry residue.	Fortnightly [3] (4)
Surface-active substances reacting with methylene blue (mg/l)	- ≤ 0.3	no lasting foam -	- visual inspection - absorption spectrophotometry with methylene blue.	Fortnightly [3]

Parameter	Guide	Mandatory	Methods of analysis or inspection	Minimum sampling and
phenols (phenol index) (mg/l)	- ≤ 0.005	no specific odor 0.05	- verification of the absence of specific odor due to phenol - absorption spectrophotometry 4-aminoantipyrine method	Fortnightly [3] ([4])
transparency (m)	2	1 [6]	- Secchi's disc.	Fortnightly [3]
dissolved oxygen (% sat. O_2)	80-120	-	- Winkler's method - electrometric method (oxygen meter)	([4])
tarry residues and floating materials such as wood, plastic articles, bottles, etc.	none	-	- visual inspection	Fortnightly [3]
ammonia (mg/l)	-	-	- absorption spectrophotometry - Nessler's method - indophenol blue method	([5])
nitrogen Kjeldahl (mg/l)	-	-	- Kjeldahl method	([5])
OTHER				
pesticides (mg/l)	-	-	- extraction with appropriate solvents and chromatographic determination	([4])
heavy metals such as: - arsenic - cadmium - chrome VI - lead - mercury	-	-	- atomic absorption possibly preceded by extraction	([4])
cyanide (mg/l)	-	-	- absorption spectrophotometry using a specific reagent	([4])
nitrates and phosphates (mg/l)	-	-	- absorption spectrophotometry using a specific reagent	([4])

1/ Member States shall not set values less stringent than those listed in the "mandatory" column and shall endeavor to achieve the levels listed in the "guide" column.

2/ 'Bathing water' refers to all running or fresh water or parts thereof and sea water, in which 1) bathing is explicitly authorized by the competent authorities of each Member State, or 2) bathing is not prohibited and is traditionally practiced by a large number of bathers.

3/ When a sampling taken in previous years produced results which are appreciably better than the goals set those in the Directive, Member States may reduce the sampling frequency by a factor of 2.

4/ Concentration to be checked by the competent authorities when an inspection in the bathing area shows that the substance may be present or that the quality of the water has deteriorated.

5/ These parameters must be checked by the competent authorities when there is a tendency towards the eutrophication of the water.

6/ Exceptions are possible 1) because of exceptional weather or special geographical conditions; or 2) when bathing water undergoes natural enrichment in certain substances, provided these do not constitute a risk to public health. Natural enrichment means the process whereby, without human intervention, a given body of water receives from the soil certain substances contained therein.

Rules

A. Bathing water shall be deemed to conform to the provisions of the Directive if samples of such waters, taken at the minimum frequency specified at the sampling point and at intervals specified in the Directive, show that they conform to the parametric values for the quality of the water concerned, in the case of:

- 95% of the samples for the "mandatory" parameters specified in the Directive;

- 90% of the samples in other cases with the exception of the total coliform and fecal coliform parameters where the percentage may be 80%;

and if, in the case of the 5, 10, or 20% of the samples which do not comply:

- the water does not deviate from the parametric values in question by more than 50%, excluding microbiological parameters, pH, and dissolved oxygen;

- consecutive water samples taken at statistically suitable intervals do not deviate from the relevant parametric values.

  Values exceeding those specified in the Directive, when the result of floods or other natural disasters, shall not be considered when calculating the percentages listed above.

B. Samples should be taken at places where the average density of bathers is highest. Samples should preferably be taken 30 cm below the surface of the water except for mineral oil samples which should be taken at surface level. Sampling should begin two weeks before the start of the bathing season.

   If there is a discharge or other problem likely to lower the quality of bathing water, Member States must carry out additional sampling.

Source: European Communities Directive 76/160 (December 8, 1975).

EUROPEAN COMMUNITY DRINKING WATER STANDARDS
(United States Standards Included for Reference)

Pollutant	Ambient Standard Concentration (mg/l)			Reference method of measurement (EC)
	US [1,2,3]	EC [4,5,6]		
		Guide level	Maximum admissible concentration	
A. ORGANOLEPTIC PARAMETERS				
coloration (after simple filtration)	15 color units *	1	20	- photometric method calibrated on the Pt/co scale.
turbidity	([7])	10 [8] 0.4 [9]	10 [8] 4 [9]	- Silica method - Formazine test - Secchi's method
odor (dilution number)	3 threshold odor nos.*	0	2 at 12° C 3 at 25° C	- successive dilutions, tested at 12° C or 25° C.
taste (dilution number)		0	2 at 12° C 3 at 25° C	- successive dilutions, tested at 12° C or 25° C.
B. PYSICO-CHEMICAL PARAMETERS				
temperature (° C)		12	25	- thermometry
pH	6.5-8.5 *	6.5-8.5		- electrometry
electrical conductivity (μs/cm at 20° C)		400		- electrometry
chlorides	250 *	25		- titration (Mohr's method) - molecular absorption spectrophotometry
sulphates	400/500	25	250	- gravimetric analysis - EDTA complexity - molecular absorption spectrophotometry
silica			([10])	- absorption spectrophotometry
calcium		100		- atomic absorption - complexometry
magnesium		30	50	- atomic absorption
sodium		20	150 [11]	- atomic absorption
potassium		10	12	- atomic absorption
aluminum	0.05-0.2 *	0.05	0.2	- atomic absorption - absorption spectrophotometry
dry residues (after drying at 180° C)			1,500	- dessication at 180° C and weighing
dissolved oxygen (DO) (% O_2)	> 5	>75% sat.		- Winkler's method - specific electrochemical method

Pollutant	Ambient Standard Concentration (mg/l)			Reference method of measurement (EC)
	US [1,2,3]	EC [4,5,6]		
		Guide level	Maximum admissible concentration	
C. UNDESIRABLE SUBSTANCES				
nitrates [25]	10	25	50	- molecular absorption spectrophotometry
nitrites	1		0.1	- absorption spectrophotometry
ammonia		0.05	0.5	- absorption spectrophotometry
Kjeldahl nitrogen	≤ .90		1	- oxidation with Titrimetry - absorption spectrophotometry
oxidizability ($K Mn O_4$)		2	5	- boiling for 10 minutes with $KMnO_4$ in acid medium
total organic carbon [12]				
hydrogen sulphide			undetectable organoleptically	- absorption spectrophotometry
substances extractable in chloroform	0.1	0.1		- liquid/liquid extraction using purified chloroform at neutral pH, weighing the residue
dissolved or emulsified hydrocarbons (after extraction by petroleum ether)			0.01	- infra-red spectrophotometry after extraction by carbon tetrachloride - gravimetry after extraction by petroleum ether
phenols (phenol index)			0.0005	- molecular absorption spectrophotometry 4 aminoantipyrine method - paranitraniline method
boron		1		- atomic absorption spectrophotometry - molecular absorption spectrophotometry
surfacants (reacting with methyl blue)			0.2	- molecular absorption spectrophotometry
dissolved iron	0.3 *	0.05	0.2	- atomic absorption spectrophotometry after filtering through a filter membrane (0.45 μm) - molecular absorption spectrophotometry after filtering through a filter membrane (0.45 μm)
manganese	0.05 *	0.02	0.05	- atomic absorption spectrophotometry - molecular absorption spectrophotometry
copper	1.3 [13]	0.1 [14] 3 [15]		- atomic absorption spectrophotometry - polarography - molecular absorption spectrophotometry
zinc	5 *	0.1 [14] 5 [15]		- atomic absorption spectrophotometry - molecular absorption spectrophotometry - polarography
phosphorous	≤ .180	0.4	5	- molecular absorption spectrophotometry

Pollutant	Ambient Standard Concentration (mg/l)			Reference method of measurement (EC)
	US [1,2,3]	EC [4,5,6]		
		Guide level	Maximum admissible concentration	
fluorides	4		0.7-1.5 [16]	- molecular absorption spectrophotometry after distillation if necessary - ion selective electrodes
suspended solids		none		- method of filtration through a 0.45 μm filter membrane, drying at 105° C and weighing - centrifuging (for at least 15 minutes with an average acceleration of 2,800 to 3,200), drying at 105° C and weighing
residual chlorine			([10])	
barium	2	0.1		- atomic absorption spectrophotometry
silver	0.10 *		0.01 [17]	- atomic absorption
D. TOXIC SUBSTANCES				
arsenic	0.05		0.05	- atomic absorption spectrophotometry - molecular absorption spectrophotometer
cadmium	0.005		0.005	- atomic absorption spectrophotometry - polarography
cyanides	0.2		0.05	- absorption spectrophotometry
total chromium	0.1		0.05	- atomic absorption spectrophotometry - molecular absorption spectrophotometry
mercury	0.002		0.001	- flameless atomic absorption spectrophotometry (cold vaporization)
nickel	0.1		0.05	- atomic absorption
lead	0.005 [18]		0.05 [19]	- atomic absorption spectrophotometry - polarography
antimony	0.01/0.005		0.01	- absorption spectrophotometry
selenium	0.05		0.01	- atomic absorption spectrophotometry
total pesticides			0.0005 [20]	- gas-phase or liquid-phase chromatography after extraction by suitable solvents and purification [21]
other organochlorine compounds		0.001		- gas-phase or liquid-phase chromatography after extraction by suitable solvents and purification [21]
polycyclic aromatic hydrocarbons	0.0001-0.0002		0.0002	- measurement of intensity of fluorescence UV after extraction using hexane - gas-phase chromatography - measurement in UV after thin layer chromatography [22]

Pollutant	Ambient Standard Concentration (mg/l)			Reference method of measurement (EC)
	US [1,2,3]	EC [4,5,6]		
		Guide level	Maximum admissible concentration	
		E. MICROBIOLOGICAL PARAMETERS		
total coliforms 37° C (cells/100 ml)	([23])		MPN < 1 [24]	- fermentation in multiple tubes. Subculturing of the positive tubes on a confirmation medium. Count according to most probable number. Incubation temp: 37° C. - membrane filtration and culture on an appropriate medium such as Tergitol lactose agar, endo agar, 0.4% Teepol broth, subculturing and identification of the suspect colonies
fecal coliform bacteria (cells/100 ml)	$\leq$ 200		MPN < 1 [24]	- fermentation in multiple tubes. Subculturing of the positive tubes on a confirmation medium. Count according to most probable number. Incubation temp: 44° C. - membrane filtration and culture on an appropriate medium such as Tergitol lactose agar, endo agar, 0.4% Teepol broth, subculturing and identification of the suspect colonies
fecal streptococci (cells/100 ml)			MPN < 1 [24]	- sodium azide method (Litsky). Count according to most probable number. - membrane filtration and culture on an appropriate medium.
sulphite-reducing clostridia (cells in 20 ml)			MPN $\leq$ 1 [24]	- a spore count after heating the sample to 80° C by: - seeding in a medium with glucose, sulphite and iron, counting the black-halo colonies; - membrane filtration, deposition of the inverted filter on a medium with glucose, sulphite an iron covered with agar, count of black colonies; - distribution in tubes of differential reinforced clostridial medium, subculturing of the black tubes in a medium of litmus-treated milk, count according to MPN.
total bacteria counts for water supplied for human consumption (no. in 1 ml)		10 [25] 100 [26]		- inoculation by placing in nutritive agar
total bacteria counts for water in closed containers (no. in 1 ml)		5 [25] 20 [26]	20 [25] 100 [26]	- inoculation by placing in nutritive agar
		OTHER		
biochemical oxygen demand	$\leq$ 9			
total hardness			60 [27]	
alkalinity			30 [27]	

1/ Unless otherwise noted, all US standards are maximum permissible levels of a contaminant in water which is delivered to any user of a public water system (MCL). Where noted with an asterisk, standards are secondary maximum contaminant levels.

2/ Effluent and emissions standards in the United States are based on what is achievable with available technology rather than on some other criteria such as what should be done to achieve ambient water quality standards. In particular, the Clean Water Act of 1977 mandated that effluent limitations for conventional pollutants (organic material, suspended solids, bacteria and pH) were to be based on best conventional pollution control technology (BCT), while those for toxic pollutants were to be based on best available technology (BAT).

3/ US standards are included only for substances covered in the EC Directive.

4/ Standards for the EC apply to water intended for human consumption, whether in its original state or after treatment, and whether used for drinking. In addition, the values for toxic and microbiological parameters apply to water used in the production of food. The Directive does not apply to 1) natural mineral waters or 2) to medicinal waters recognized or defined as such by the competent national authorities.

5/ Water intended for human consumption must not exceed the "maximum permissible concentration". In fixing the values, Member States shall take as a basis the "guide values".

6/ The Directive may be waived: a) in situations arising from the nature and structure of the ground in the area from which the supply comes; and b) situations arising from exceptional meteorological conditions. In the event of an emergency, the competent national authorities may, for a limited time, permit higher concentrations than otherwise permitted, provided this does not constitute a risk to public health, and provided the supply of water for human consumption cannot be maintained any other way.

7/ With *conventional or direct filtration*, turbidity levels in the filtered water must not exceed 0.5 nephelometric turbidity units (NTU) in more than 5 percent of the measurements taken each month. With *slow sand filtration*, turbidity levels in the filtered water must not exceed 1 NTU in more than 5 percent of the samples each month.

8/ $\mu g/l\ SiO_2$.

9/ Jackson units.

10/ Member States shall take all necessary measures to ensure that any substances used in the preparation of water for human consumption do not remain in concentrations higher than the MAC for these substances, and that they do not constitute a public health hazard.

11/ As from 1987 and with a percentile of 80. 175 as from 1984 and with a percentile of 90.

12/ Any unusual increases must be investigated.

13/ An MCL of 1.3 mg/l has been proposed. Currently copper is regulated as a secondary contaminant with a secondary MCL of 1.

14/ At outlets of pumping and/or treatment works and their substations.

15/ After the water has been standing for 12 hours in the piping and at the point where the water is made available to the consumer.

16/ MAC varies according to average temperature in geographical area concerned.

17/ If silver, exceptionally, is used non-systematically to process the water, a MAC value of 0.08 mg/l may authorized.

18/ A regulation establishig an MCL of 0.005 mg/l following treatment (replacing the former standard of 0.05 mg/l) will take effect December 7, 1992, along with monitoring at the tap and treatment requirements if lead is too high.

19/ In running water.

20/ When substances are considered separately, the MAC is 0.0001.

21/ Identification of the constituents of the mixture, quantitative analysis.

22/ Comparative measurement in relation to a mixture of six control substances with the same concentration.

23/ No more than 5% of the samples per month may be positive. For systems collecting fewer than 40 samples per month, no more than 1 sample per month may be positive.

24/ Using the multiple tube method. Using the membrane filter method, the maximum permissible concentration is 0. Water intended for human consumption should not contain pathogenic organisms.

25/ At 37° C.

26/ At 22° C.

27/ Minimum required concentration.

28/ US standard expressed as NO_3-N; EC standard expressed as NO_3. The EC standard expressed as NO^3-N would be approximately 11 mg/l.

PATTERNS AND FREQUENCY OF STANDARD ANALYSES

	Parameters	Minimum monitoring (C 1)	Current monitoring (C 2)	Periodic monitoring (C 3)	Occasional monitoring in special situations or in case of accidents (C 4)
A	organoleptic parameters	- odor - taste	- odor - taste - turbidity	Current monitoring analyses + other parameters[1]	The competent national authorities of the Member States will determine the parameters according to circumstances, taking account of all the factors which might have an adverse affect on the quality of drinking water supplied to consumers.
B	physico-chemical parameters	- conductivity or other physico-chemical parameter - residual chlorine	- temperature - conductivity or other physico-chemical parameter - pH - residual chlorine		
C	undesirable parameters		- nitrates - nitrites - ammonia		
D	Toxic parameters				
E	micro-biological parameters	- total coliforms or total counts of 22° and 37° - fecal coliforms	- total coliforms - fecal coliforms - total counts of 22° and 37°		

1/ These will be determined by the competent national authorities, taking account of all factors which might affect the quality of drinking water supplied to users and which could enable the ionic balance of the constituents to be assessed.

MINIMUM FREQUENCY OF STANDARD ANALYSES [1]

Volume of water produced or distributed in m^3/day	*Population concerned (assuming 200 l/day per person)*	*Analysis C 1*	*Analysis C 2*	*Analysis C 3*	*Analysis C 4*
		Number of samples/year	Number of samples/year	Number of samples/year	
100	500	(1)	(1)	(1)	Frequency to be determined by the competent national authorities as the situation requires
1,000	5,000	(1)	(1)	(1)	
2,000	10,000	12	3	(1)	
10,000	50,000	60	6	1	
20,000	100,000	120	12	2	
30,000	150,000	180	18	3	
60,000	300,000	360 [2]	36	6	
100,000	500,000	360 [2]	60	10	
200,000	1,000,000	360 [2]	120 [2]	20 [2]	
1,000,000	5,000,000	360 [2]	120 [2]	20 [2]	

1/ Frequency left to the discretion of the competent national authorities. However water intended for the food-processing industries must be monitored at least once a year.

2/ The competent health authorities should endeavor to increase this frequency as far as their resources allow.

3/ (a) In the case of water which must be disinfected, microbiological analysis should be twice as frequent.

(b) Where analyses are very frequent, it is advisable to take samples at the most regular intervals possible.

(c) Where the values of the results obtained from samples taken during the preceding years are constant and significantly better than the limits laid down in the Directive, and where no factor likely to cause a deterioration in the quality of the water has been discovered, the minimum frequencies of the analyses referred to above may be reduced: (i) for surface waters, by a factor of 2 with the exception of the frequencies laid down for microbiological analyses; (ii) for ground waters, by a factor of 4, but without prejudice to the provision of point (a) above.

Sources:

For water quality standards, reference methods and frequencies of sampling for the EC, European Communities Directive 80/778 (July 15, 1980).

For water quality standards for the US, U.S. Environmental Protection Agency, Office of Water, "Drinking Water Regulations and Health Advisories, Washington, D.C., April 1992.

For US effluent standards, Paul Portney, *Public Policies for Environmental Protection*, Resources for the Future, Washington, DC, 1990.

QUALITY OF SURFACE WATER INTENDED FOR THE ABSTRACTION OF DRINKING WATER

This Directive applies to surface water used or intended to be used for drinking water, and not to ground water, brackish water and water intended to replenish water bearing beds.

Pollutant	EC [1,2,3,4]		Reference method of measurement (EC)
	Guide	Mandatory	
pH	A_1 6.5-8.5 A_2 5.5-9 A_3 5.5-9		- electrometry [5]
Coloration (after simple filtration)	A_1 10 A_2 50 A_3 50	A_1 20 [10] A_2 100 [10] A_3 200 [10]	- filtering through a glass fiber membrane [6]
suspended solids	A_1 25		- filtering through a 0.45 μm filter membrane, drying at 105° C and weighing - centrifuging, drying at 105° C and weighing
temperature (° C)	A_1 22 A_2 22 A_3 22	A_1 25 [10] A_2 25 [10] A_3 25 [10]	- thermometry [5]
electrical conductivity (μs/cm at 20° C)	A_1 1000 A_2 1000 A_3 1000		- electrometry
Odor (dilution factor at 25° C)	A_1 3 A_2 10 A_3 20		- by successive dilutions
nitrates	A_1 25	A_1 50 [10] A_2 50 [10] A_3 50 [10]	- molecular absorption spectrophotometry
fluorides	A_1 0.7-1 A_2 0.7-1.7 A_3 0.7-1.7	A_1 1.5	- molecular absorption spectrophotometry after distillation if necessary - ion selective electrodes
dissolved iron	A_1 0.1 A_2 1.0 A_3 1.0	A_1 0.3 A_2 2.0	- atomic absorption spectrophotometry after filtering through a filter membrane (0.45 μm) - molecular absorption spectrophotometry after filtering through a filter membrane (0.45 μm)
manganese	A_1 0.05 A_2 0.1 A_3 1.0		- atomic absorption spectrophotometry - molecular absorption spectrophotometry
copper	A_1 0.02 A_2 0.05 A_3 1.0	A_1 0.05 [10]	- atomic absorption spectrophotometry - polarography - molecular absorption spectrophotometry
zinc	A_1 0.5 A_2 1.0 A_3 1.0	A_1 3.0 A_2 5.0 A_3 5.0	- atomic absorption spectrophotometry - molecular absorption spectrophotometry - polarography
boron	A_1 1.0 A_2 1.0 A_3 1.0		- atomic absorption spectrophotometry - molecular absorption spectrophotometry

Pollutant	EC [1,2,3,4] Guide	EC [1,2,3,4] Mandatory	Reference method of measurement (EC)
arsenic	A_1 0.01	A_1 0.05	- atomic absorption spectrophotometry
		A_2 0.05	- molecular absorption spectrophotometer
	A_3 0.05	A_3 0.10	
cadmium	A_1 0.001	A_1 0.005	- atomic absorption spectrophotometry
	A_2 0.005	A_2 0.005	- polarography
	A_3 0.005	A_3 0.005	
total chromium		A_1 0.05	- atomic absorption spectrophotometry
		A_2 0.05	- molecular absorption spectrophotometry
		A_3 0.05	
lead		A_1 0.05	- atomic absorption spectrophotometry
		A_2 0.05	- polarography
		A_3 0.05	
selenium		A_1 0.01	- atomic absorption spectrophotometry
		A_2 0.01	
		A_3 0.01	
mercury	A_1 0.0005	A_1 0.001	- flameless atomic absorption spectrophotometry (cold vaporization)
	A_2 0.0005	A_2 0.001	
	A_3 0.0005	A_3 0.001	
barium		A_1 0.1	- atomic absorption spectrophotometry
		A_2 1.0	
		A_3 1.0	
cyanide		A_1 0.05	- molecular absorption spectrophotometry
		A_2 0.05	
		A_3 0.05	
sulphates	A_1 150	A_1 250	- gravimetric analysis
	A_2 150	A_2 250 [10]	- EDTA complexity
	A_3 150	A_3 250 [10]	- molecular absorption spectrophotometry
chlorides	A_1 200		- titration (Mohr's method)
	A_2 200		- molecular absorption spectrophotometry
	A_3 200		
surfacants (reacting with methyl blue)	A_1 0.2		- molecular absorption spectrophotometry
	A_2 0.2		
	A_3 0.5		
phosphates	A_1 0.4		- molecular absorption spectrophotometry
	A_2 0.7		
	A_3 0.7		
phenols		A_1 0.001	- molecular absorption spectrophotometry 4 aminoantipyrine method
	A_2 0.001	A_2 0.005	
	A_3 0.01	A_3 0.1	- paranitraniline method
dissolved or emulsified hydrocarbons		A_1 0.05	- infra-red spectrophotometry after extraction by carbon tetrachloride
		A_2 0.2	
	A_3 0.5	A_3 1.0	- gravimetry after extraction by petroleum ether
polycyclic aromatic hydrocarbons		A_1 0.0002	- measurement of fluorescence in the UV after thin layer chromatography [7]
		A_2 0.0002	
		A_3 0.001	

Pollutant	EC [1,2,3,4]		Reference method of measurement (EC)
	Guide	Mandatory	
total pesticides		A_1 0.001 A_2 0.0025 A_3 0.005	- gas or liquid chromatography after extraction by suitable solvents and purification [8]
chemical oxygen demand (COD)	A_3 30		- potassium dichromate method
Dissolved oxygen (DO) (% O_2)	A_1 >70% sat. A_2 >50% sat. A_3 >30% sat.		- Winkler's method - electrochemical method
Biochemical oxygen demand (BOD)	$A_1 \leq 3.0$ $A_2 \leq 5.0$ $A_3 \leq 7.0$		- determination of dissolved oxygen before and after 5-day incubation at 20° C ± 1° C, in complete darkness. Addition of a nitrification inhibitor.
Kjeldahl nitrogen	A_1 1.0 A_2 2.0 A_3 3.0		- mineralization, distillation by Kjeldahl method and ammonium determination by means of molecular absorption spectrophotometry or titration
ammonia	A_1 0.05 A_2 1.0 A_3 2.0	 A_2 1.5 A_3 4.0	- molecular absorption spectrophotometry
substances extractable with chloroform	A_1 0.1 A_2 0.2 A_3 0.5		- extraction at neutral pH value by purified chloroform, evaporation in vacuo at room temperature, weighing of residue
total coliforms 37° C (cells/100 ml)	A_1 50 A_2 5,000 A_3 50,000		- culture at 37° C on an appropriate specific solid medium with or without filtration and colony count. [9] - method of dilution with fermentation in liquid substrates in at least 3 tubes in 3 dilutions. Subculturing of the positive tubes on a confirmation medium. Count according to most probable number. Incubation temp: 37° C ± 1° C.
fecal coliform bacteria (cells/100 ml)	A_1 20 A_2 2,000 A_3 20,000		- culture at 44° C on an appropriate specific solid medium with or without filtration and colony count. [9] - method of dilution with fermentation in liquid substrates in at least 3 tubes in 3 dilutions. Subculturing of the positive tubes on a confirmation medium. Count according to most probable number. Incubation temp: 44° C ± 0.5° C.
fecal streptococci (cells/100 ml)	A_1 20 A_2 1,000 A_3 10,000		- culture at 37° C on an appropriate specific solid medium with or without filtration and colony count. [9] - method of dilution in sodium azide broth in at least 3 tubes with 3 dilutions. Count according to most probable number.
salmonella	A_1 not present in 5,000 ml A_2 not present in 1,000 ml		- concentration by filtration (on membrane or appropriate filter). - inoculation into pre-enrichment medium. enrichment and transfer into isolating gelese-identification

1/ Mandatory values concern parameters considered to have a significant effect upon public health. Member States must not set values less stringent than these. Guide values concern parameters considered to have a peripheral effect on health and are set as long-run goals.

2/ Surface water is considered to conform to the relevant parameters if 95% of the samples for parameters conform to those specified the "Mandatory" column, and 90% of the samples in all other cases, and if in the case of the 5 or 10% of the samples which do not comply: a) the water does not deviate from the parametric values in question by more than 50%, except for temperature, pH, dissolved oxygen and microbiological parameters; b) there is no resultant danger to public health; and c) consecutive water samples taken at statistically suitable intervals do not deviate from the relevant parametric values.

3/ The Directive may be waived a) in the case of floods or other natural disasters; b) where surface water undergoes natural enrichment in certain substances causing it to exceed the limits laid down in the Directive; and c) in the case of surface water in shallow lakes or virtually stagnant surface water (into which there is no discharge of waste water) for nitrates, dissolved iron, manganese, phosphates, COD, dissolved oxygen saturation rate, and BOD. In no case can these exceptions disregard the requirements of public health protection.

4/ *Standard methods of treatment for transforming surface water of qualities A1, A2, and A3 into drinking water:*

Category A1	Simple physical treatment and disinfection, e.g. rapid filtration and disinfection.
Category A2	Normal physical treatment, chemical treatment and, e.g. pre-chlorination, coagulation, flocculation, decantation, filtration, disinfection (final chlorination).
Category A3	Intensive physical and chemical treatment, extended treatment and disinfection, e.g. chlorination to break-point, coagulation, flocculation, decantation, filtration, absorption (activated carbon), disinfection (ozone, final chlorination).

Surface water of poorer quality than type A_3 may not be used for drinking water except in exceptional circumstances.

5/ Measured in situ at the time of sampling without prior treatment of the sample.

6/ Photometric method using the platinum-cobalt scale.

7/ Comparative measurement in relation to a mixture of six control substances with the same concentration.

8/ Identification of the constituents of the mixture, quantitative analysis.

9/ Samples must be diluted or where appropriate, concentrated in such a way as to contain between 10 and 100 colonies. If necessary, identification with gasification.

10/ Exceptional climatic or geographical conditions.

MINIMUM ANNUAL FREQUENCY OF SAMPLING AND ANALYSIS FOR WATER QUALITY PARAMETERS [1,2]

Population served	A_1			A_2			A_3		
	I	II	III	I	II	III	I	II	III
≤ 10,000	(*)	(*)	(*)	(*)	(*)	(*)	2	1	(*) [3]
> 10,000 to ≤ 30,000	1	1	(*)	2	1	(*)	3	1	1
> 30,000 to ≤ 100,000	2	1	(*)	4	2	1	6	2	1
> 100,000	3	2	(*)	8	4	1	12	4	1

*/ Frequency to be determined by the competent national authorities.

1/ Where a survey by the competent authorities show that the water quality for certain parameters is considerably superior than those specified by Directive 75/440, the Member State concerned may reduce the frequency of sampling and analysis for these parameters. If there is no pollution in these cases and no risk of the water quality deteriorating, the authorities may decide no regular analysis is necessary.

2/ The Roman numerals refer to classification of parameters according to frequency.

3/ The Member States are encouraged to carry out at least one annual sampling of this category of water.

CATEGORIES

I	II	III
Parameter	Parameter	Parameter
pH	Dissolved oxygen	Fluorides
Coloration	Manganese	Boron
Total suspended solids	Copper	Arsenic
Temperature	Zinc	Cadmium
Conductivity	Sulphates	Total chromium
Odor	Surfacants	Lead
Nitrates	Phenols	Selenium
Chlorides	Nitrogen by Kjeldahl method	Mercury
Phosphates	Total coliforms	Barium
Chemical oxygen demand	Fecal coliforms	Cyanide
Dissolved oxygen saturation rate		Dissolved or emulsified hydrocarbons
Biochemical oxygen demand		Polycyclic aromatic hydrocarbons
Ammonium		Total pesticides
		Substances extractable with chloroform
		Fecal streptococci
		Salmonella

Sources: For water quality standards for the EC, European Communities Directive 75/440 (June 16, 1975). For reference methods and frequencies of sampling for the EC, European Communities Directive 79/869 (October 9, 1979).

PROTECTION OF GROUNDWATER FROM CERTAIN DANGEROUS SUBSTANCES

The purpose of this Directive is to prevent the pollution of groundwater by substances belonging to the families and groups of substances listed below, and as far as possible to check or eliminate the consequences of pollution that has already occurred. The Directive does not apply to 1) discharges of domestic effluents from isolated dwellings not connected to a sewerage system and situated outside areas protected for the abstraction of drinking water for human consumption; 2) discharges found by the competent authority of the Member State concerned to contain the specified substances in a quantity and concentration too small to represent a present or future threat to the quality of the receiving groundwater; 3) discharges of matter containing radioactive substances.

I. List I: Families and groups of substances considered to present relatively high risk of toxicity, persistence, and bioaccumulation:

- Organohalogen compounds and substances which may form such compounds in the aquatic environment
- Organophosporous compounds
- Organotin compounds
- Substances which possess carcinogenic mutagenic or teratogenic properties in or via the aquatic environment [1]
- Mercury and its compounds
- Cadmium and its compounds
- Mineral oils and hydrocarbons
- Cyanides

II. List II: Families and groups of substances considered to be of lower risk than those on list I but which may have a harmful affect on groundwater:

- The following metalloids and metals and their compounds:

Zinc	Tin
Copper	Barium
Nickel	Beryllium
Chrome	Boron
Lead	Uranium
Selenium	Vanadium
Arsenic	Cobalt
Antimony	Thallium
Molybdenum	Tellurium
Titanium	Silver

- Biocides and their derivatives not included on list I
- Substances which have a deleterious effect on the taste and/or odor of groundwater, and compounds liable to cause the formation of such substances in such water and to render it unfit for human consumption
- Toxic or persistent organic compounds of silicon, and substances which may cause the formation of such compounds in water, excluding those which are biologically harmless or are rapidly converted in water into harmless substances
- Inorganic compounds of phosphorous or elemental phosphorous
- Fluorides
- Ammonia and nitrates

1/ List II substances which are carcinogenic, mutagenic, or teratogenic are included here.

III. General Rules

A. Member States must take the necessary steps to:

   1. prevent the introduction into groundwater of substances on list I; and

   2. limit the introduction into groundwater of substances on list II.

B. For list I substances, Member States must:

   1. prohibit all direct discharge of substances on the list;

   2. subject to prior investigation any disposal or tipping for the purpose of disposal of these substances which might lead to indirect discharge. In the light of that investigation, Member States shall prohibit such activity or shall grant authorization provided that all the technical precautions necessary to prevent such discharge are observed;

   3. take all appropriate measures deemed necessary to prevent any indirect discharge of substances on list I due to activities on or in the ground other than those mentioned above.

C. For list II substances, Member States must:

   1. subject to prior investigation all direct discharge of substances on the list, so as to limit such discharges;

   2. subject to prior investigation the disposal or tipping for the purpose of disposal of these substances which might lead to indirect discharge. In the light of that investigation, Member States may grant an authorization, provided that all the technical precautions for preventing groundwater pollution by these substances is observed.

   3. take all appropriate measures deemed necessary to limit all indirect discharge of substances on list II due to activities on or in the ground other than those mentioned above.

D. When direct discharge or waste water disposal causing indirect discharge is authorized (in accordance with III. B (2), and C (2) above and IV. A and B below), the authorization shall specify:

   - the place of discharge;

   - the method of discharge;

   - essential precautions, particularly of the nature and concentration of the substances present in the effluents, the characteristics of the receiving environment and the proximity of water catchment areas, in particular those for drinking, thermal and mineral water;

   - the maximum quantity of the substance permissible in an effluent during one or more specified periods of time and the requirements concerning the concentration of these substances;

   - the arrangements for monitoring the effluents discharged into groundwater;

   - if necessary, measures for monitoring groundwater, and in particular its quality.

E. When disposal or tipping for the purpose of disposal which might lead to indirect discharge is authorized (in accordance with III. B (2), and C (2) above and IV. A and B below), authorization shall specify:

   - the place where such disposal or tipping is done;

- the methods of disposal or tipping used;

- essential precautions, particularly the nature and concentration of the substances present in the matter to be tipped or disposed of, the characteristics of the receiving environment and the proximity of water catchment areas, (particularly drinking, thermal and mineral waters);

- the maximum quantity permissible, during one or more specified periods of time, of the matter containing substances in lists I or II and, where possible, of those substances themselves, to be tipped or disposed of and the requirements concerning the concentration of those substances;

- In the cases referred to in B (1) and C (1) above, the technical precautions to be implemented to prevent any discharge into groundwater of substances in list I and any pollution of water by substances in list II;

- if necessary, the measures for monitoring the groundwater, and in particular its quality.

IV. Exceptions

A. Should prior investigation reveal that the groundwater into which the discharge of substances in list I is considered is permanently unsuitable for other uses, especially domestic or agricultural, the Member State may authorize the discharge of these substances provided (a) their presence does not impede exploitation of ground resources, and (b) all technical precautions have been taken to ensure that these substances cannot reach other aquatic systems or harm other ecosystems.

B. Member States may, after prior investigation, authorize discharges due to re-injection into the same aquifer of water used for geothermal purposes, water pumped out of mines and quarries or water pumped out for civil engineering works.

The authorizations referred to in (A) and (B) above may be granted for a limited period only, and must be reviewed at least every four years. They may be renewed, amended or withdrawn.

C. Artificial recharges for the purpose of groundwater management shall be subject to a special authorization issued by the Member States on a case-by-case basis. Such authorization shall be granted only if there is no risk of polluting the groundwater.

V. Definitions

- *groundwater:* water which is below the surface of the ground in the saturation zone and in direct contact with the ground or sub-soil.

- *direct discharge:* the introduction into groundwater of substances in lists I or II without percolation through the ground or subsoil.

- *indirect discharge:* the introduction into groundwater of substances in lists I or II after percolation through the ground or subsoil.

- *pollution:* the discharge by man, directly or indirectly, of substances or energy into groundwater, the results of which are such as to endanger human health or water supplies, harm living resources and the aquatic ecosystem or interfere with other legitimate uses of water.

Source: European Communities Directive 80/68 (December 17, 1979).

URBAN WASTE WATER TREATMENT

This Directive concerns the collection, treatment, and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. Its objective is to protect the environment from the adverse effects of the above mentioned waste water discharges.

I. Requirements for urban waste water

A. Collecting systems [1]

1. All agglomerations must have systems for collecting urban waste water as specified below: [2]

Population equivalent (p.e.)	Deadline
2,000-15,000	December 31, 2005
> 15,000	December 31, 2000
> 10,000: discharges into "sensitive areas"	December 31, 1998

2. The design, construction and maintenance of collecting systems shall be undertaken in accordance with the best technical knowledge not entailing excessive costs, notably regarding:

- volume and characteristics of urban waste water,
- prevention of leaks,
- limitation of pollution of receiving waters due to storm water overflows.

B. Discharge from urban waste water treatment plants to receiving waters [1]

1. Urban waste water entering collecting systems must be subject to secondary treatment or equivalent as follows as specified below:

Population equivalent (p.e.)	Deadline
10,000-15,000	December 31, 2005
> 15,000	December 31, 2000
2,000-10,000: discharges to fresh water and estuaries	December 31, 2005
< 2,000: discharges to fresh water and estuaries [1]	December 31, 2005
< 10,000: discharges to coastal waters [1]	December 31, 2005
> 10,000: discharges to "sensitive areas" [2]	December 31, 1998

1/ These discharges are subject to "appropriate treatment" (defined in V., below).
2/ Urban waste water discharges to "sensitive areas" (defined in II. (A)) must satisfy the requirements stated in I. (B).

2. Waste water treatment plants shall be designed or modified so that representative samples of the incoming waste water and of treated effluent can be collected before discharge to receiving waters.

1/ Since it is not possible to construct systems capable of handling all waste water in situations such as unusually heavy rainfall, Member States shall decide on measures to limit pollution from storm water overflows.

2/ Where the establishment of a collecting system is not justified, either because it would produce no environmental benefit or because it would involve excessive costs, individual systems or other appropriate systems which achieve the same level of environmental protection shall be used.

3. Discharges from urban waste water treatment plants subject to treatment in accordance with this Directive shall meet the requirements shown in Table 1, below.

4. Discharges from urban waste water treatment plants to "sensitive areas" subject to eutrophication as identified below in II. A (1) shall in addition meet the requirements shown in Table 2.

5. More stringent requirements than those shown in Table 1 and/or Table 2 shall be applied where required to ensure that the receiving waters satisfy any other relevant Community Directives.

6. The points of discharge of urban waste water shall be chosen, as far as possible, so as to minimize the effects on receiving waters.

7. The load expressed in population equivalents (p.e.) shall be calculated on the basis of the maximum average weekly load entering the treatment plant during the year, excluding unusual situations such as heavy rain.

C. Industrial waste water

1. Industrial waste water entering collecting systems and urban waste water treatment plants shall be subject to such pre-treatment as is required in order to:

- protect the health of staff working in collecting systems and treatment plants,
- ensure that collecting systems, waste treatment plants and associated equipment are not damaged,
- ensure that the operation of the waste water treatment plant and the treatment of sludge are not impeded,
- ensure that discharges from the treatment plants do not adversely affect the environment, or prevent receiving waters from complying with other Community Directives,
- ensure that sludge can be disposed of safely in an environmentally acceptable manner.

2. Member States shall ensure that, before December 31, 1993, the discharge of industrial waste water into collecting systems and urban waste water treatment plants is subject to prior regulations and/or specific authorizations by the competent authority or appropriate body.

D. Requirements and reference methods for monitoring and evaluating results

1. Competent authorities shall monitor:

- discharges from urban waste water treatment plants to verify compliance with the requirements of I. (B) in accordance with the control procedures laid down here in I. (D);
- amounts and composition of sludge disposed of to surface waters;
- direct discharges from industrial plants in cases where the receiving environment may be significantly affected.

2. Member States shall ensure that monitoring involves the following: [1]

- Flow-proportional or time-based 24-hour samples collected at the same point in the outlet and if necessary in the inlet of the treatment plant;

1/ *Alternative methods may be used provided these provide equivalent results.*

- The minimum annual number of samples determined according to the size of the treatment plant and be collected at regular intervals during the year as defined below:

Population equivalent (p.e.)	Number of samples
2,000-9,999	12 samples the first year; 4 samples in subsequent years if the water during the first year complies with the provisions of the Directive; if 1 sample of the 4 fails, 12 samples must be taken the following year
10,000-49,999	12
50,000 or more	24

3. The treated waste water shall be considered to conform to the relevant parameters if, for each relevant parameter considered separately, samples of the water show that it complies with the relevant a parametric value as follows: [1]

(a) for the parameters specified in Table 1 and in V. for "primary treatment," the maximum number of samples which are allowed to fail the requirements is specified in the table below:

Series of samples taken in any year	Maximum permitted number of samples which fail to conform
4-7	1
8-16	2
17-28	3
29-40	4
41-53	5
54-67	6
68-81	7
82-95	8
96-110	9
111-125	10
126-140	11
141-155	12
156-171	13
172-187	14
188-203	15
204-219	16
220-235	17
236-251	18
252-268	19
269-284	20
285-300	21
301-317	22
318-334	23
335-350	24
351-365	25

(b) for the parameters of Table 1 expressed in concentrations, the failing samples taken under normal operating conditions must not deviate from the parametric values by more than 100%. For the parametric values in concentration relating to total suspended solids, deviations of up to 150% may be accepted;

(c) for the parameters specified in Table 2, the annual mean of the samples for each parameter shall conform to the relevant parametric values.

1/ Extreme values for the water quality in question shall not be taken into consideration when they are the result of unusual situations such as heavy rain.

Table 1: REQUIREMENTS FOR DISCHARGES FROM URBAN WASTE WATER TREATMENT PLANTS [1]

Parameters	Concentration	Minimum % of reduction [2]	Reference method of measurement
biochemical oxygen demand (BOD_5 at 20°C) without nitrification [3]	25 mg/l O_2	70-90 40 under IV. (A)	Homogenized, unfiltered, undecanted sample. Determination of dissolved oxygen before and after 5-day incubation at 20°C ± 1°C, in complete darkness. Addition of a nitrification inhibitor.
chemical oxygen demand (COD)	125 mg/l O_2	75	Homogenized, unfiltered, undecanted sample Potassium dichromate
total suspended solids	35 mg/l [4] 35 under IV. (A) (more than 10,000 p.e.) 60 under IV. (A) (2,000-10,000 p.e.)	90 [4] 90 under IV. (A) (more than 10,000 p.e.) 70 under IV. (A) (2,000-10,000 p.e.)	- Filtering of a representative sample through a 0.45 μm filter membrane. Drying at 105°C and weighing. - Centrifuging of a representative sample, (for at least five minutes with mean acceleration of 2,800 to 3,200 g.) drying at 105°C and weighing

1/ The values for concentration or for percentage of reduction shall apply.
2/ Reduction in relation to the load of the influent.
3/ The parameter can be replaced by another parameter: total organic carbon (TOC) or total oxygen demand (TOD) if a relationship can be established between BOD_5 and the substitute parameter.
4/ This parameter is optional.

Table 2: REQUIREMENTS FOR DISCHARGES FROM URBAN WASTE WATER TREATMENT PLANTS TO SENSITIVE AREAS SUBJECT TO EUTROPHICATION [1]

Parameters	Concentration	Minimum percentage of reduction [2]	Reference method of measurement
total phosphorous	2 mg/l P (10,000-100,000 p.e.) 1 mg/l P (more than 100,000 p.e.)	80	Molecular absorption spectrophotometry
total nitrogen [3]	15 mg/l P (10,000-100,000 p.e.) 10 mg/l P [4] (more than 100,000 p.e.)	70-80	Molecular absorption spectrophotometry

1/ One or both parameters may be applied depending on the local situation. The values for concentration or for percentage of reduction shall apply.
2/ Reduction in relation to the load of the influent.
3/ Total nitrogen means: the sum of total Kjeldahl-nitrogen (organic N + NH_3), nitrate (NO_3)-nitrogen and nitrate (NO_2)-nitrogen.
4/ Alternatively, the daily average must not exceed 20 mg/l N. This requirement refers to a water temperature of 12° C or more during the operation of the biological reactor of the waste water treatment plant. As a substitute for the condition concerning the temperature, it is possible to apply a limited time of operation, which takes into account the regional climatic conditions.

II. Criteria for identifying sensitive and less sensitive areas

A. Sensitive areas [1]

1. Natural freshwater lakes, other freshwater bodies, estuaries and coastal waters which are found to be eutrophic or which in the near future may become eutrophic if protective action is not taken.

   The following elements might be taken into account when considering which nutrient should be reduced by further treatment:

   (i) lakes and streams reaching lakes/reservoirs/closed bays which are found to have a poor water exchange, whereby accumulation may take place. In these areas, removing phosphorous should be included unless it can be demonstrated that the removal will have no effect on the level of eutrophication. Where discharges from large agglomerations are made, removing nitrogen should also be considered;

   (ii) estuaries, bays and other coastal waters which are found to have a poor water exchange, or which receive large quantities of nutrients. Discharges from small agglomerations are usually of minor importance in those areas, but for large agglomerations, removing phosphorous and/or nitrogen should be included unless it can be demonstrated that the removal will have no effect on the level of eutrophication.

2. Surface freshwaters intended for the abstraction of drinking water which could contain more than the concentration of nitrate laid down under the provisions of the European Communities Directive *concerning the quality of surface water intended for the abstraction of drinking water* in the Member States if action is not taken;

3. Areas where further treatment than that prescribed in this Directive is necessary to fulfill other Council Directives.

B. Less sensitive areas [1]

1. A marine water body or area where the discharge of waste water does not adversely affect the environment as a result of morphology, hydrology or specific hydraulic conditions which exist in that area.

2. Open bays, estuaries, and other coastal waters with a good water exchange and not subject to eutrophication or oxygen depletion or which are considered unlikely to become eutrophic or to develop oxygen depletion due to the discharge of urban waste water.

When identifying less sensitive areas, Member States shall take into account the risk that the discharged load may be transferred to adjacent areas where it can damage the environment. Member States shall recognize the presence of sensitive areas outside their national jurisdiction.

III. General Rules

A. Disposal

1. Treated water shall be reused whenever appropriate. Disposal routes shall minimize the adverse effects on the environment.

1/ Member States shall ensure that the identification of sensitive areas is reviewed at intervals no less than four years.

2. Competent authorities or appropriate bodies shall ensure that the disposal of urban waste water from urban waste treatment plants is subject to prior regulations and/or specific authorization.

3. Sludge arising from waste water treatment shall be re-used whenever appropriate. Disposal shall minimize the adverse effects on the environment.

   - The disposal of sludge from urban waste water treatment plants must be made subject to general rules or registration or authorization no later than December 31, 1998.

   - Member States must ensure that no later than December 31, 1998, the disposal of sludge to surface waters is eliminated. Until then, Member States must ensure that the total amount of toxic, persistent or bioaccumulable materials in sludge disposed of to surface waters is licensed for disposal and progressively reduced.

B. Industrial waste water

1. Biodegradable industrial waste water from plants in sectors listed below which does not enter urban waste water treatment plants before discharge to receiving waters must still comply with the regulations or conditions contained in specific authorizations by December 31, 2000 for plants representing 4,000 p.e. or more.

   - Milk-processing
   - Manufacture of fruit and vegetable products
   - Manufacture and bottling of soft drinks
   - Potato-processing
   - Meat industry
   - Breweries
   - Production of alcohol and alcoholic beverages
   - Manufacture of animal feed from plant products
   - Manufacture of gelatine and of glue from hides, skin, and bones
   - Malt-houses
   - Fish-processing industry

2. By December 31, 1993, the competent authority or appropriate body in each Member State shall set requirements appropriate to the nature of the industry concerned for the discharge of such waste water.

C. Important Deadlines

- December 31, 1993 to establish a program for the implementation of this Directive;
- June 30, 1994 to provide the Commission with information on the program.

IV. Exceptions

A. Urban waste water discharges to waters situated in high mountain regions (over 1,500 m above sea level) where it is difficult to apply an effective biological treatment due to low temperatures may be subjected to treatment less stringent than that prescribed in I. (B) above, provided that detailed studies indicate that such discharges do not adversely affect the environment.

B. Requirements for individual plants discharging in "sensitive areas" need not apply where the minimum percentage reduction of the overall load entering all urban waste water treatment plants in that area is at least 75% for total phosphorous and at least 75% for total nitrogen.

C. Urban waste water discharges from agglomerations of between 10,000 and 150,000 population equivalents to coastal waters and those from agglomerations of between 2,000 and 10,000 population equivalents to estuaries situated in "less sensitive areas" may be subject to treatment less stringent than that prescribed in I. (B) above, provided that:

- such discharges receive at least "primary treatment" (defined in section V below) in conformity with the control procedures laid down in I. (D);

- comprehensive studies indicate that such discharges will not adversely affect the environment.

D. In exceptional circumstances, when it can be demonstrated that more advanced treatment will not produce any environmental benefits, discharges into "less sensitive" areas of waste waters from agglomerations of more than 15,000 p.e. may be subject to the same treatment described above in IV. (C).

E. Member States may, in exceptional cases due to technical problems and for geographically defined population groups, submit a special request to the Commission for a longer period for complying with the deadlines specified in I. (B).

This request, for which grounds must be specified, shall set out the technical difficulties experienced and must propose an action program with an appropriate timetable to be undertaken to implement the objective of this Directive.

Only technical reasons will be accepted and the longer period referred to above may not extend beyond December 2005.

V. Definitions

- *urban waste water:* domestic waste water or a mixture of domestic waste water with industrial waste water and/or run-off rain water.

- *domestic waste water:* waste water from residential settlements and services which originates predominantly from the human metabolism and from household activities.

- *industrial waste water:* waste water which is discharged from premises used for carrying on any trade or industry, other than domestic waste water and run-off rain water.

- *agglomeration:* an area where the population and/or economic activities are sufficiently concentrated for urban waste water to be collected and conducted to an urban waste water treatment plant or to a final discharge point.

- *collecting system:* a system of conduits which collects and conducts urban waste water.

- *1 population equivalent (p.e.):* the organic biodegradable load having a five-day biochemical oxygen demand (BOD_5) of 60 g of oxygen a day.

- *primary treatment:* treatment of urban waste water by a physical and/or chemical process involving settlement of suspended solids, or other processes in which the BOD_5 of the incoming waste water is reduced by at least 20% before discharge and the total suspended solids of the incoming waste water are reduced by at least 50%.

- *secondary treatment:* treatment of urban waste water by a process generally involving biological treatment with a secondary settlement or other process in which the requirements established in Table I are respected.

- *appropriate treatment:* treatment of urban waste water by any process and/or disposal system which after discharge allows the receiving waters to meet the relevant quality objectives and the relevant provisions of this and other Community Directives.

- *sludge:* residual sludge, whether treated or untreated, from urban waste water treatment plants.
- *eutrophication:* the enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorous, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned.
- *estuary:* the transitional area at the mouth of a river between fresh water and coastal waters.
- *coastal waters:* waters outside the low water line or the outer limit of an estuary.

Source: European Communities Directive 91/271 (May 21, 1991).

SUMMARY OF PROPOSED ACTIONS

POLICY REFORM

- Raise energy prices, providing transitional assistance if necessary for households or industries disproportionately affected.
- Aim for larger reductions in emissions of particulates, air-borne lead and heavy metals than for sulfur dioxide or nitrogen oxides since it is much less expensive to control emissions of the former than the latter.
- Invest in measures to reduce emissions from low stacks in urban areas where home heating is a major contributor to high ambient concentrations of particulates and sulfur.
- Concentrate the remaining resources during the initial stages on improving the environmental performance of existing *large* sources. This strategy will yield most of the benefits derived from an attempt to achieve lower emissions for all sources, large or small, but at much lower cost.
- Give priority to environmental policies and investments which reduce emissions of all forms to reinforce the underlying trends associated with economic reform and restructuring.

Privatization and environmental liability

- Government must accept responsibility for all past environmental damage.
- Establish a monitoring system to make it possible to distinguish between damages caused by past pollution and current emissions; define the environmental standards that privatized firms will be required to meet and the adjustment period to be permitted.
- So as not to delay privatization, limit environmental audits to a small number of the largest firms. Set aside a portion of privatization proceeds to pay for any clean-up subsequently required.

Better environmental policies

- Require all non-ferrous metallurgy and parts of the chemical industry to reduce or eliminate their discharges of heavy metals -- particularly lead -- to air and water.
- Choose market-based instruments for pollution control wherever possible, building on existing frameworks of pollution charges. These can help achieve desired levels of environmental quality at much lower costs than traditional regulatory approaches. Regulatory instruments will still be needed to control emissions of some micro-pollutants such as heavy metals and toxic chemicals. In some regions, tradeable permits will be appropriate.

- Where regulatory policies are more appropriate, adopt the EC framework of environmental standards or an equivalent system, allowing sufficient time for their introduction.

- Adopt a realistic set of ambient standards which can be monitored and built into the implementation of policies and regulations.

- Do *not* set uniform emission standards at a country-wide level. Allow for substantial variation in emissions for different locations and sources with the most stringent requirements -- such as the adoption of Best-Available Control Technology -- for hot spots where economic transformation and capital replacement will not bring ambient exposures to criteria pollutants down to acceptable levels.

IMMEDIATE EXPENDITURE PRIORITIES TO ADDRESS SHORT- AND LONG-TERM CONCERNS

- Design and select public investments to accelerate the impact of industrial restructuring on the environment and to reinforce market incentives for economic change.

- Provide funding to cover the operational, maintenance and repair costs of existing public environmental services, especially the treatment of drinking water and sewage, the collection and disposal of municipal waste, and maintaining inventories -- and monitoring the disposal -- of hazardous, toxic and nuclear wastes.

- Invest in "win-win" projects which can be justified on economic grounds alone but which bring substantial environmental benefits. These include improvements in energy efficiency, water conservation, the adoption of low input and low waste technologies, and minor plant improvements which facilitate "good housekeeping".

- Provide funding for training, internship and exchange programs, for the development of environmental education curricula, and for other activities which raise local capacity for effective decentralized decision making.

- Publicize the importance of improvements in management and operating practices in order to achieve environmental improvements with existing plant and equipment and provide resources to demonstrate how such improvements may be made and sustained.

Immediate public investment priorities

- Install dust collection systems and filters to non-ferrous metal smelters -- particularly lead, zinc, and aluminum plants -- which are located 5 km upwind of significant centers of population.

- Install equipment to reduce emissions of dust, smoke, and soot, and carbon monoxide from iron and steel plants, especially those relying on open hearth furnaces.

- Make investments to replace coal with gas or to permit the burning of smokeless solid fuels in district heating plants, commercial enterprises and households in towns and cities where the average ambient concentrations of particulates exceeds 150 micrograms per cubic meter.

- Invest in facilities to pre-treat the wastewater discharged by small and medium-sized industrial plants where contamination of groundwater and rivers by heavy metals is a significant problem -- for example in towns and cities with a concentration of tanning, electro-plating and other metalworking plants.

- Facilitate the installation of domestic septic tanks and the appropriate disposal of manure from intensive livestock operations in rural areas where levels of nitrates in drinking water drawn from shallow wells typically exceed 10 mg of nitrate-N per liter.[1]

- Ensure that the disposal of domestic, toxic, nuclear and other hazardous wastes is carefully monitored and that leachates from disposal sites do not contaminate ground or surface waters, especially sources used for the abstraction of drinking water supplies.

Country-specific investments

- Install municipal wastewater treatment plants in towns and cities close to important tourist or wildlife areas, especially on the Adriatic, Baltic and Black Sea coasts, Lake Balaton, the Mazurian Lakes and the Carpathian and Rhodope Mountains.

- Complete partially constructed wastewater treatment plants either in the upstream sections of seriously polluted rivers or where the bacteriological quality of water downstream of major towns and cities is particularly poor.

- Implement sustainable rural development projects in defined areas of high biodiversity and great ecological importance that are under threat. Such projects should combine better management of protected areas with ecologically benign agricultural/forestry, tourism and other activities.

Enterprise investments

- Invest in mitigating discharges of saline water from mines in countries such as the Czech and Slovak Republics, and Poland, provided that the costs of such investments are recovered over the long run from the mines responsible for salt water emissions.

- Provide industrial wastewater treatment facilities in plants -- for example in the textile and pulp and paper industries -- which discharge heavy loads of BOD and other pollutants into receiving waters that are relatively clean and that lie upstream of major centers of population.

1/ The proposed threshold is based on the standard WHO guideline, which is identical to US guidelines for the quality of public drinking water. The threshold allows a considerable margin of safety so that a less strict threshold of 20 mg/l of nitrate-N would prevent almost all cases of methemoglobinemia. The EC drinking water standard specifies that nitrates should not exceed 50 mg/l of NO_3 which is equivalent to 11 mg/l of nitrate-N.

- Install equipment to reduce leakages of heavy metals, toxic gases and discharges of toxic wastes -- to the air, in wastewater or in solid wastes -- from petrochemical and other chemical plants, especially those located close to substantial towns and cities.

Measures to address longer-term environmental problems

- Establish vehicle testing stations combined with facilities for better vehicle maintenance in order to enforce reasonably strict emission standards for the commercial diesel vehicles -- buses and trucks -- which are the major mobile source of particulate emission.

- Develop a program to phase out leaded gasoline and to require that new vehicles (automobiles, buses and trucks) should, from some appropriate future date, meet the emission standards laid down by the EC. Most of the cost of these measures will be borne by refineries, automobile manufacturers and their customers, but resources for technical assistance and to deal with special transitional problems would speed up the implementation of these programs.

- Fund applied research into a number of environmental problems for which solutions may be very costly (e.g., treatment of nitrate pollution) or where implementation of remedies has been difficult. Such research could focus on ecologically acceptable agriculture and forestry practices -- especially their economic costs and benefits. Support could also be channelled to specialized research institutions engaged in crucial conservation (e.g., botanical gardens); and to undertake well-defined studies on the ecological damage caused by large-scale development projects such as dams, canals, and major tourism developments.

- Strengthen the collection and dissemination of data on the state of the environment and natural resources. Pay particular attention to the forms of environmental damage and related issues which define the main priorities in this Action Programme.

TRANSBOUNDARY ISSUES

Acid air pollution

- Combine local and transboundary concerns. Implementing good economic and environmental policies in response to local concerns will do much to reduce transboundary emissions.

- Choose market-based instruments -- such as pollution charges or tradeable permits -- to minimize the costs of meeting international agreements.

- Provide a framework which allows groups of countries who might each benefit from cooperation to share the burden of achieving larger reductions in emissions than would be warranted on purely domestic grounds. In particular, donor countries might consider arrangements by which they contribute to the incremental costs of meeting stricter or earlier targets for emissions reductions in Central and East European countries.

Transboundary water pollution

- Install treatment technologies in coastal centers which remove more nitrogen and, perhaps, phosphorus than those which would be appropriate on the basis of local considerations alone when transboundary effects are important. International assistance would be appropriate for those countries in Central and Eastern Europe which border on international seas threatened by transboundary pollution.

- Concentrate on downstream sources during the initial stages of tackling the problem. This implies a two-pronged strategy of focusing domestic resources on improving upstream water quality while external resources are directed towards downstream sources which have the most direct impact on the sea concerned.

- Develop the framework of cooperation needed to take stronger action in the future if justified, including:
  (i) gathering information on water pollution affecting shared water resources to determine the most cost-effective control measures for controlling pollution;
  (ii) developing systems to collect and exchange information about trends in water quality and emissions;
  (iii) coordinating across countries water policies and regulations affecting shared water basins -- including, if appropriate, a joint water basin management agency responsible for implementing cooperative programs.

Wetland management

- Support current measures to protect the Danube and Volga deltas.

- Complete inventories of wetlands and assess the status of resources which they offer and the potential threats to their future health.

- Ensure that wetland management is integrated into the broad framework of policies for water management and nature conservation with due account being taken of the scope for multiple use management.

Phaseout of ozone depleting substances

- In the short-term, focus on the aerosol and flexible foam sectors where ODS use can be eliminated at very low cost.

- To facilitate access to new technologies in the technology-intensive sectors (mainly refrigeration), encourage companies in CEE to establish technology alliances with multinational companies.

- Prepare national recovery/reclamation/recycling strategies to ensure a sufficient supply of refrigerant to maintain the existing stock of capital goods relying on ODS (mainly cooling, air conditioning and refrigeration equipments).

Reduction of greenhouse gases

- Collect the gas associated with oil production rather than flaring it, minimize natural gas losses from transmission and distribution systems, and install more efficient compressors on gas pipelines to reduce emissions of carbon dioxide and other greenhouse gases, (especially methane), beyond what will occur as a result of economic reform. These investments will typically generate high rates of return without taking any account of their environmental benefits.

- Use market-based instruments -- such as carbon taxes -- wherever possible to reduce emissions of greenhouse gases. Encourage the development of an arrangement which allows countries to trade national emission reduction targets.

- In the European context, West European countries could make the best possible use of their resources devoted to greenhouse warming by allocating a substantial fraction to reducing energy use and carbon emissions from the CEE countries.

Conserving bio-diversity

- Complete inventories of biological resources.

- Build up the institutional and human resources required to assess and manage biological resources.

- Revise national legislation to conform with the provisions of the Convention on Biological Diversity.

- Prepare national strategies for the conservation of biological resources and implementation of the Convention.

Managing toxic chemicals and hazardous wastes

- Assess the state of industrial plants and activities that generate hazardous wastes as well as the related disposal and transport facilities.

- Improve safety measures, including through institutional, technological, managerial systems and equipment.

- Strengthen the institutional and technical capacity to comply with the provisions of the Basel Convention.

INSTITUTIONAL PREREQUISITES

Sustainable environmental management: setting goals

- Expressing a clear government commitment and setting environmental objectives in the context of a broad participatory approach is a fundamental prerequisite for longer-term successful environmental policy.

- Environmental objectives must be based on realistic assumptions about the availability of financial and human resources.

Constraints to Policy and Project Implementation

- Environmental reviews and consultant studies must be carried out in close cooperation with the "clients", i.e., must involve substantial local participation. Terms of reference should be carefully agreed among all parties, and the work carried out in continuous and close collaboration.

- Much more emphasis must be placed on the front-end of the project cycle -- establishing objectives; identifying efficient solutions among a range of institutional, policy and technological options; analyzing in detail the necessary implementation arrangements and relationship to the policy framework.

- Donor countries and institutions may wish to provide special support for project identification and for the necessary local expenditure requirements to launch such work with substantial local participation.

Reshaping the Environmental Agenda in Central and Eastern Europe: Legislative and Institutional Reform

- Adopt caution in developing comprehensive environmental laws, because the rapid political and economic changes may undermine their implementability.

- Integrate environmental concerns in the economic reform laws wherever possible.

Decentralization and its implications for environmental management

- Strengthen the integration of sectoral and environmental institutions responsible for industrial development and energy on the one hand, and agriculture and forestry, land privatization, tourism, and transport on the other hand. Permit environmental agencies to focus their attention on a limited set of policy objectives that have the potential for having a significant impact on the policies implemented by the sectoral ministries.

Institutional adjustments

- Shift responsibilities for environmental management from central to local authorities, and provide local authorities with the necessary means to carry out their functions (e.g., develop necessary local taxation systems).

- Improve the functional capacity of the environmental ministries; and

- Increase the inter-ministerial coordination on environmental issues.

Shift in responsibility for environmental management from central to local authorities

- Create or strengthen *river basin* management institutions and provide them with appropriate autonomy. Attend to the linkages with central, regional and municipal authorities, and develop financing mechanisms and channels. Establish responsibility for standard-setting.

- Define the functions and responsibilities of the three main levels of environmental management -- the central environmental agencies, their regional offices and the environmental divisions of the local authorities (regional and municipal).

- Require that ministries of environment develop procedures which explicitly transfer and delegate decision-making power to lower managerial levels.

- Design a consultancy unit to serve the reforming local authorities on environmental management issues, operating on a "travel-to-client" basis.

- Increase the training support for local governments (especially through donor-supported environmental management and training centers), focusing especially on financial issues.

- Improve the horizontal links between the environmental divisions of the local authorities sharing a particular environmental system (e.g. a watershed or an "airshed").

Strengthening environmental ministries

- Ministries of environment should emphasize policy and coordination, rather than implementation (which is better left to regional and local institutions). Establish a close working relationship with ministries of health, many of which traditionally have been responsible for ambient environmental monitoring, to establish the vital link between health objectives and environmental policies and investments.

- Consider an integrated approach to industrial pollution prevention and control (IPPC) designed to implement a strategy which accounts for the effects on all media (air, water wastes, etc.) and which causes least damage to the environment as a whole.

- Concurrently, a one-stop permitting system can be developed which allows potential investors and enterprises to obtain authorization covering environmental and financial issues at the same location.

- Create a First Deputy Minister (or equivalent senior) position for Environmental Policy and Regulations to shift attention from technical to economic policy issues, and from day-to-day control to strategy development and policy implementation.

- Design task-oriented (rather than sector-oriented) teams under the new Deputy, to connect existing Departments and to provide inter-ministerial links.

- Create financial analyst and economist position(s) to develop new concepts for environmental financing without ministerial participation.

- Develop programs for mid-level officials and business executives from Western institutions to work in the central ministry and in the regional offices.

Improving inter-ministerial cooperation

- Establish cabinet-level committees for environment and development, bringing together the ministries of environment and all economic and sectoral ministries.

- Establish temporary task forces of high-level officials to prepare the work for these cabinet-level committees, and provide for career and other professional incentives to encourage participation in such task forces.

- Designate staff from the ministry of environment to participate in strategy development in all sectoral ministries, and invite staff from these ministries to participate in Working Groups in the ministry of environment on relevant issues.

- Within the ministry of environment, create capacity and better analytic tools for sectoral policy evaluation (especially for industry, agriculture and infrastructure) with long-term targets for key environmental indicators.

Management capacity, training and education

- Develop nation-wide programs addressing the public in order to overcome the lack of experience in active public involvement in making and implementing environmental policies.

- Provide training in administrative, financial, and economic management, and in implementation of multi-sectoral environmental strategies and programs. Such training is not only called for in environment ministries, but also in public and private industry (e.g., water supply and sewerage utilities, district heating enterprises, and industrial plants) at national, regional and local levels.

- Strengthen local capacity for implementation and environmental management of local functions (e.g., in water supply, sewage treatment, and solid waste disposal -- also in protected areas and coastal zones) as much as possible; without this, money targeted for environmental investments may fail to achieve the desired improvements in environmental quality.

- Promote efficient environmental education and training, by
  (i) surveying existing institutions, involved in environmental education and training and identifying actions needed to optimize their performance;
  (ii) reviewing and redesigning the teaching programs at all levels;
  (iii) developing teaching techniques, tailored to the particular audience; and
  (iv) evaluating financial needs, available sources, and funds management.

- Develop an educational training program for high level decision-makers at national and local levels in two formats: -- for top-level ministerial and business staff (ministers and deputy ministers, and managers of big enterprises) in a workshop format, and for middle level staff (ministerial, municipal and business experts) in formal training sessions. Particular emphasis should be placed on providing training for enterprise managers in business planning, marketing and management skills. Enterprise managers should, at a minimum, be well equipped to understand and tackle "win-win" options involving energy and water conservation.

- Promote a network of national institutions proficient in environmental training.

- Incorporate environmental training components in all technical and financial assistance projects with environmental impact. Integrate elements of environmental education in training programs in a variety of subjects, such as in economics and management; local government and administration; public finance and taxation; privatization programs; and economic restructuring.

- Involve NGOs and the media in efforts to raise public awareness. Central and Eastern European NGOs could be assisted in developing core teams for providing leadership, fundraising capacity and logistic support.

Environmental monitoring and information systems

- Collect, analyze, and disseminate environmental information for the following priorities:
  (i) monitoring and enforcing compliance with regulations and environmental policies;
  (ii) promoting policy integration; and
  (iii) communicating with, and informing decision-makers, the public, the private sector, NGOs and interest groups.

- Redesign existing information systems, upgrading the quality of existing arrangements where necessary, dropping or re-assigning elements which do not meet users' needs or which are not cost-effective, and progressively filling in the most important gaps.

- Give priority to strengthening the availability of quality information in those areas with the greatest risks to human health and of irreversible environmental change. Strike a balance between monitoring ambient environmental levels and emissions, as well as "peak" concentrations involving exposure to sensitive populations, such as with air pollution in some cities.

- Expand gradually environmental information systems in accordance with priorities and resource availability. In particular consider expanding coverage of:
  (i) some parameters for measuring water quality (e.g. biological indicators, phosphorus and heavy metal levels);
  (ii) discharges polluting the marine environment;
  (iii) pesticide use on arable and crop land;
  (iv) ambient air quality emissions of carbon monoxide and hydrocarbons, lead and CFC usage;
  (v) population exposure to noise from traffic, airports and other sources;
  (vi) wastewater treatment, especially the numbers of population connected to sewage schemes, capacity of treatment systems and degree of treatment prior to disposal; and
  (vii) volumes and sources of solid waste and hazardous waste.

- Make reliable environmental information available for foreign and domestic investors.

Technical design of information systems

- Extend monitoring networks, ensuring compatibility, comparability and reliability of the data collected. Replace costly census methods with sample surveys.

- Strengthen links between CEE countries' environmental information systems and international arrangements.

Institutional arrangements

- Provide training for managing monitoring systems and the resultant data (including quality control), and information flows. Consider horizontal integration of environmental concerns between different sectors (through the creation, e.g., of policy teams to address air emissions, biodiversity concerns, etc.) and the holding of regular round tables at national, regional and local level with the private sector (commercial and NGOs).

- Whatever institutional arrangements are established in a particular country, at minimum, a national environment ministry should focus with regard to environmental monitoring and information systems on:
  (i) trans-frontier or global environmental issues, together with issues concerned with international environmental policies;
  (ii) ensuring that local monitoring networks are established and operated in a compatible manner so that their objectives and outputs are well adapted to the environmental issues involved and to national policies;
  (iii) ensuring full use of the outputs of local monitoring networks to contribute to the assessment of national environmental policy implementation and to make sure that all potential users make optimal use of data and the results of local monitoring schemes; and
  (iv) recognizing, establishing, and in some cases implementing monitoring schemes related to new or emerging environmental issues.

Pollution monitoring

- Promote self-monitoring of continuing compliance by enterprises, with random spot-checks by the authorities. Consider making the future frequency of monitoring or spot-checks depend on the past record of compliance (e.g., sources found in violation twice in a row could be put on a watch list for frequent audits). With appropriate penalties for violations, it has been demonstrated that high rates of compliance are possible even with tight budgets.

- Give priority to monitoring areas with the highest ambient levels of pollutants which damage human health, even if it means transferring air and/or water pollution monitoring stations from other parts of a country. It is better to have fewer but well-operating monitoring stations than many poorly operating ones.

Environmental science, technology and research

- Encourage research in the areas of energy efficient technologies and renewable energy resources. Improve, where appropriate, factory laboratories attached to enterprises.

Institute a new research program oriented towards the development and implementation of clean technologies and clean products.

Strengthening environmental and nature conservation organizations

- Encourage authorities and business to recognize the role and importance of environmental NGOs as full participants in the public debate about sustainable development and the formulation and implementation of practical policies. Invite NGOs to the relevant advisory boards, delegations, negotiations, etc. Western governments, multinational institutions and western business should recognize CEE NGOs as regular discussion partners for their activities in and related to the region.

- Provide NGOs with access to environmental information and permit their participation in environmental impact assessments. It has been proposed to follow U.S. legislation and practice concerning access to information, and Dutch legislation and practice concerning environmental impact assessment.

- Consider providing financial support to such NGOs in order to assist them to play the necessary roles described above (as is being done by some western governments in their own countries, as well as by the European Community).

IMPLEMENTATION

- CEE countries should facilitate the secondment of western experts by bilateral donors to work in Central and Eastern European Environment Ministries (and CEE country experts in western institutions). Such secondments would be especially useful for cross-sectoral issues, and for designing effective legislation and implementation procedures and to provide assistance in upgrading economic analysis and other techniques to support decision-making.

- CEE countries should make better use of multilateral channels to share experience and know-how such as the Regional Environment Center.

Strengthening institutional capacity

- To build a local environmental management capacity and establishing appropriate coordination mechanisms, CEE countries should
  (i) clarify roles and responsibilities for environmental management among national, regional and local levels;
  (ii) strengthen inter-municipal cooperation to address environmental problems and overcome administrative fragmentation;
  (iii) increase efficiency of municipal environmental services with significant environment impact such as water, district heating, solid waste management and urban transport;
  (iv) strengthen environmental planning, project preparation and financial management capacity at the local level.

- Donors should support these efforts and, in particular, strengthen decentralized cooperation mechanisms (e.g. programming meetings involving decision-makers at all levels), and provide assistance in integrated environmental management and project implementation.

Education and training

- CEE countries should design and implement educational training programs for high-level decision-makers at national and local levels, in close collaboration with local institutions. Training programs should be supported by voluntary contributions from donors, with CEE countries providing the on-site organization and support.

- CEE countries should establish a network of national institutions most directly involved in environment training. The purpose of the network would be to promote exchange of information between those institutions and their counterparts in other countries, and with external financial partners.

- All bilateral and multilateral assistance projects having a direct impact on the environment should include environmental training elements.

- Western governments should support education and training programs developed by the informal sectors for their counterparts in CEE.

Assistance prior to investment

- Donors should from the outset, consult and agree with the local partner on the objectives of the study. Policy reforms or structural changes that affect the viability of the proposed project should be clearly specified.

- CEE countries should clearly specify commitments to policy reform and structural change that affect the viability of a project.

- CEE countries should better design feasibility studies. In the terms of reference for such studies, address not only the technical case for investment, but also the often neglected financial and institutional requirements for implementing the project over time. Donors: involve international financial institutions when preparing terms of reference.

- Donors should make greater use of local expertise. Not only would this help to develop local skills, it can also provide a better understanding of local circumstances and be more cost-effective then using experts from donor countries. Donors should address the problem of tied aid.

Project preparation facility

- The Project Preparation Facility to be established in preparation for the Lucerne Conference should concentrate on three tasks:
  (i) selecting projects from those put forward by CEE countries according to the criteria laid down in the EAP;
  (ii) instituting feasibility studies (or upgrade existing studies);

(iii) to put together assistance and investment packages for urgent projects with significant environmental benefits which are less financially viable.

Financing investment

- Wherever possible, finance environmental infrastructure with user charges.

- For those environmental projects which cannot be supported by cost recovery mechanisms, there is an urgent need to develop innovative financing mechanisms. The project preparation facility currently under discussion could provide one mechanism for developing co-financing arrangements. Clearly one or more mechanisms are needed which would facilitate the preparation of financing packages by CEEs and donors involving different combinations of grants, loans, equity investment from the private or public sector and local counterpart funds. "Debt for Environment" swaps provide another possible source of finance.

Program management

- Donors should provide support to enable local institutions to undertake project and program management effectively.

- Recipients should make every effort to ensure stability and continuity for institutional arrangements and personnel.

- CEE countries should undertake programs in an integrated manner in support of long term country and regional strategies, not as an aggregation of individual projects and should establish effective program and project management procedures.

Strengthened Coordination

- The key functions of coordination should be:
  (i) to monitor whether priority issues are being addressed in investment and technical assistance programs;
  (ii) to stimulate corrective actions when priority needs are not being addressed;
  (iii) to put CEE countries with a particular need for assistance in touch with potential providers of assistance;
  (iv) to help avoid duplication of effort by collecting and effectively disseminating information on assistance activities;
  (v) to review and share experience gained, both by donors and recipients.

- CEE countries should consider what coordination arrangements would be most appropriate in connection with the Environmental Action Programme.

Informal Sectors

- Provide clear "rules-of-the-game" for the private sector in order to attract foreign investment and remove uncertainty for business. In developing national strategies, give priority to clarifying environmental liability issues and establishing appropriate EIA procedures. Western donors: support the development of the local environmental services sector.

- Encourage companies to use *The Budapest Guiding Principles on Environment, Industry and Investment Decisions in Central and Eastern Europe* for guidance with regard to the environmental dimension of investment. This may facilitate the transfer of technology and know-how.

- Encourage enterprises to assign responsibility for environmental affairs to one individual together with an environmental auditing and reporting obligation.

- Encourage NGO participation in discussions of the EAP, for example, through roundtables involving government, community and business organizations.

- Promote public participation in facilitating the key objectives of the EAP.

Review of Implementation

- All countries concerned should report periodically on implementation of the EAP. NGOs can be encouraged to contribute to this effort.

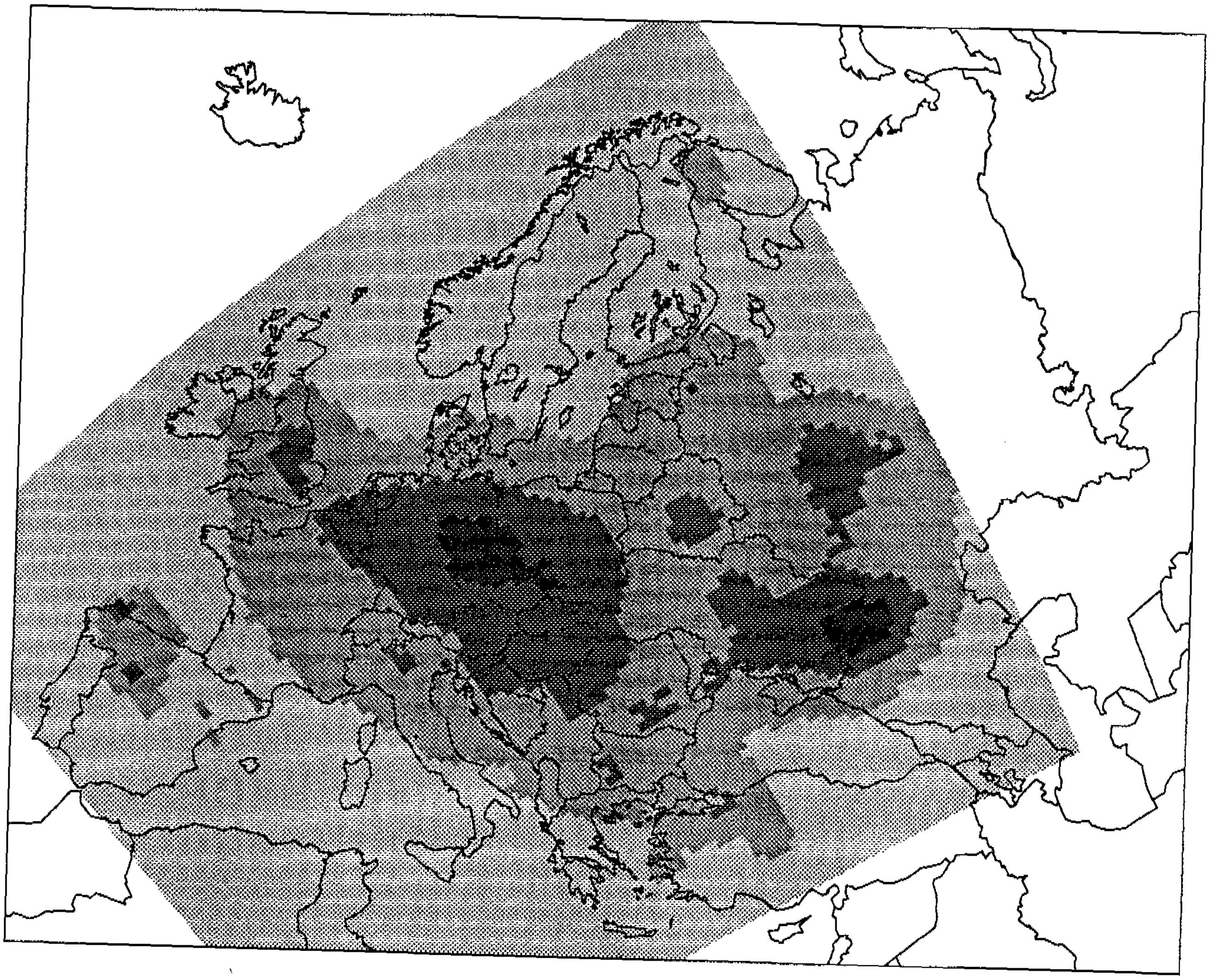
- In monitoring the State of the Environment in Europe, the future European Environment Agency should take account of environmental trends in "hot spots" or critical regions identified in the EAP and national strategies.

- The results achieved by a Project Preparation Facility will require joint review.

- Establish a mechanism to enable the EAP to function as a "living document", elaborating key elements of the strategy and providing feedback on the original strategy.

Concentration of total dust

average concentration in 1990



microgram per cubic metre

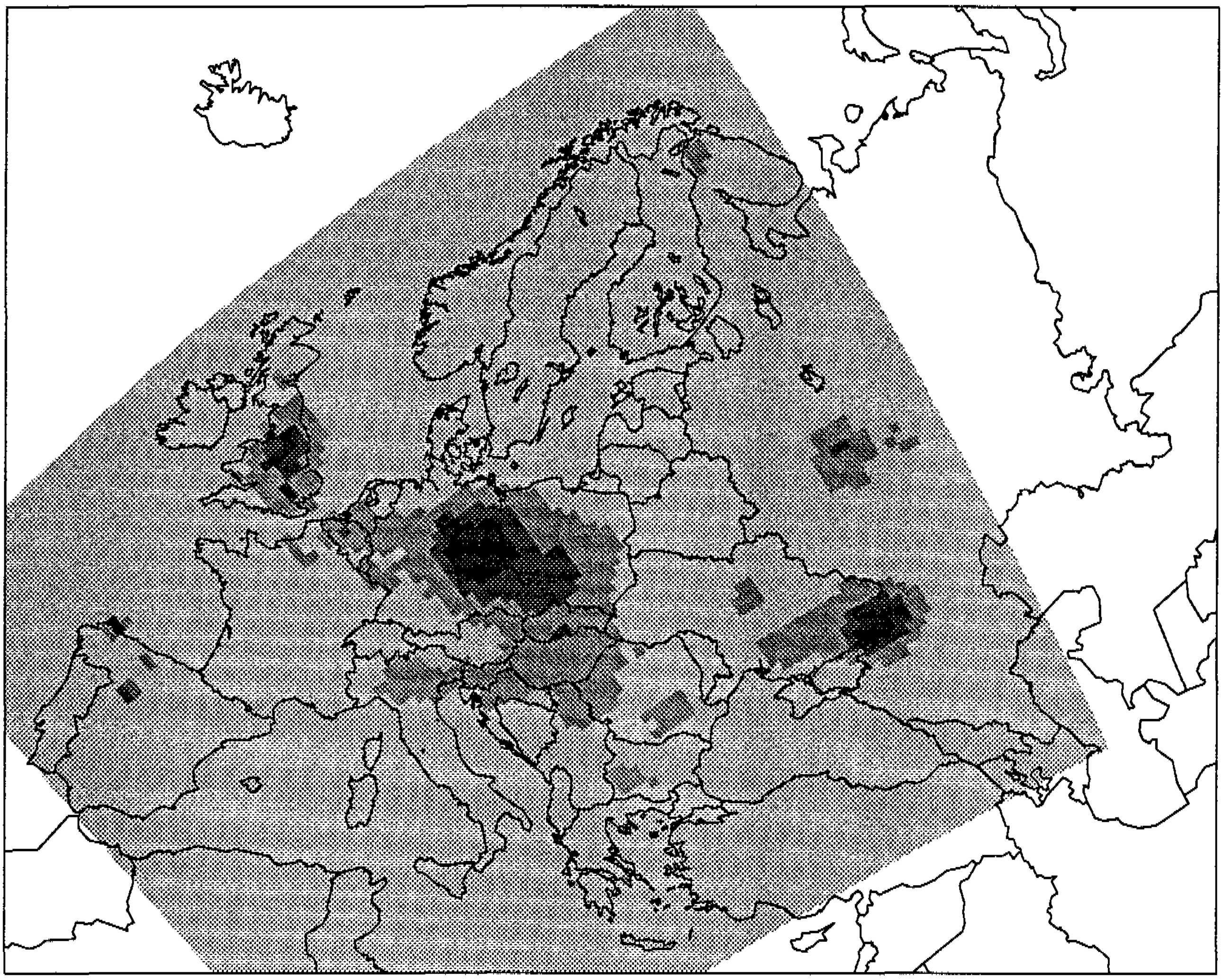
	< 10
	10 - 20
	20 - 40
	> 40

Computations: RIVM

riVM

Concentration of Sulphur-Dioxide

average concentration in 1990



microgram per cubic metre

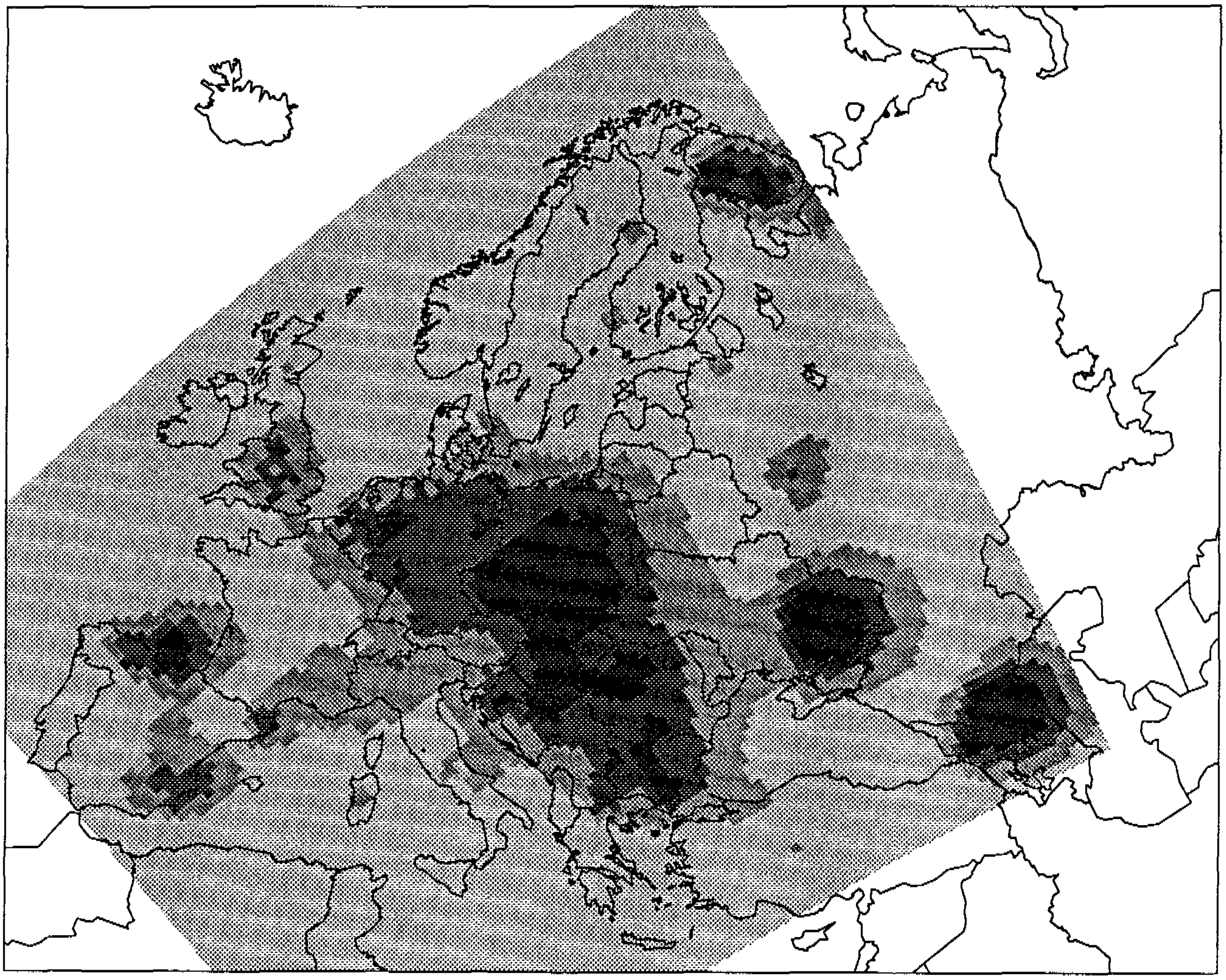
	< 10
	10 - 20
	20 - 40
	> 40

Computations: RIVM

rivm

Total deposition flux of Cadmium

1990



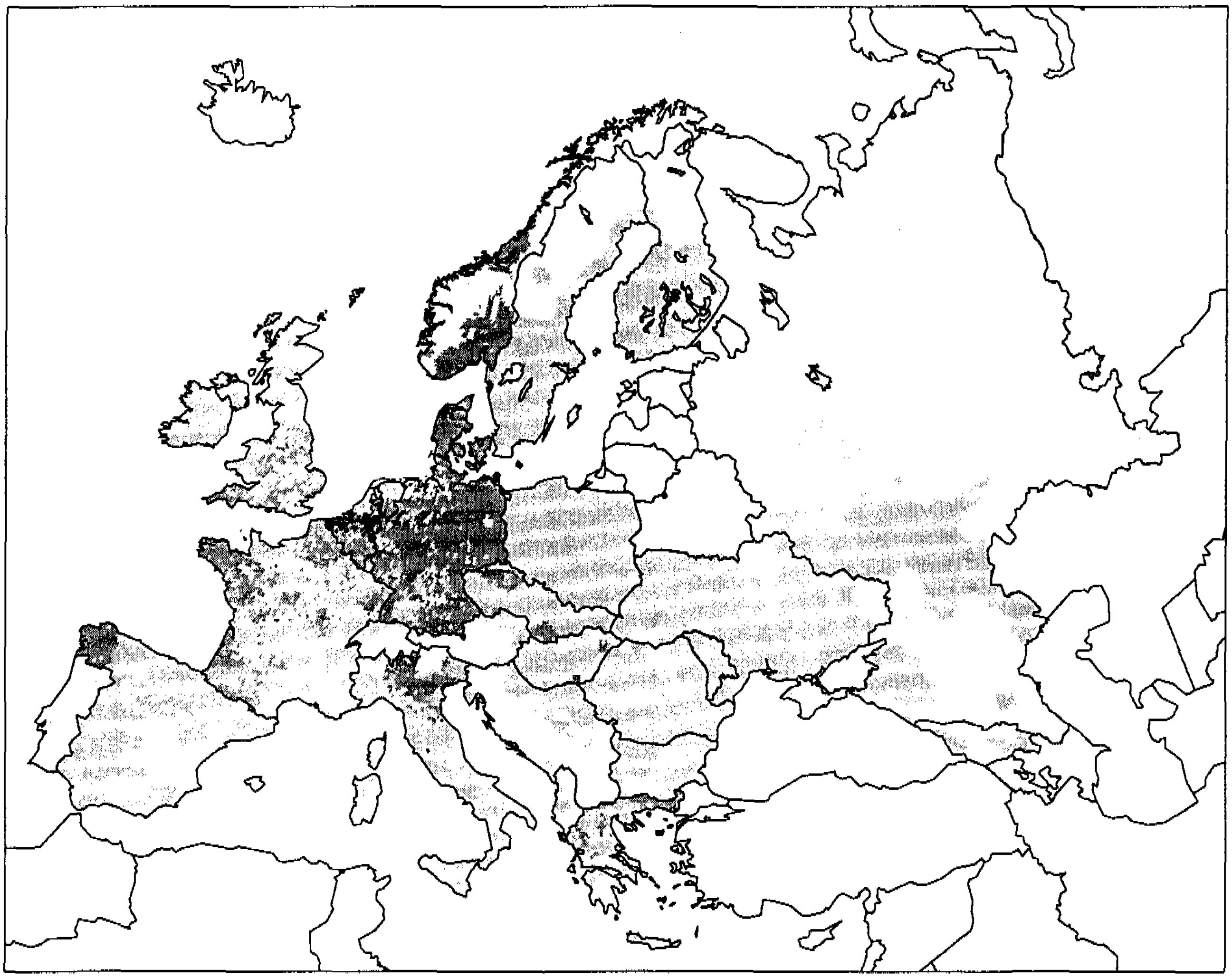
gr/ha.yr

	< 0.5
	0.5 - 1.0
	1.0 - 2.0
	> 2.0

Computations: RIVM

rivm

Leaching of nitrate in agricultural soils



Computed leaching
in the topsoil
in mg/l

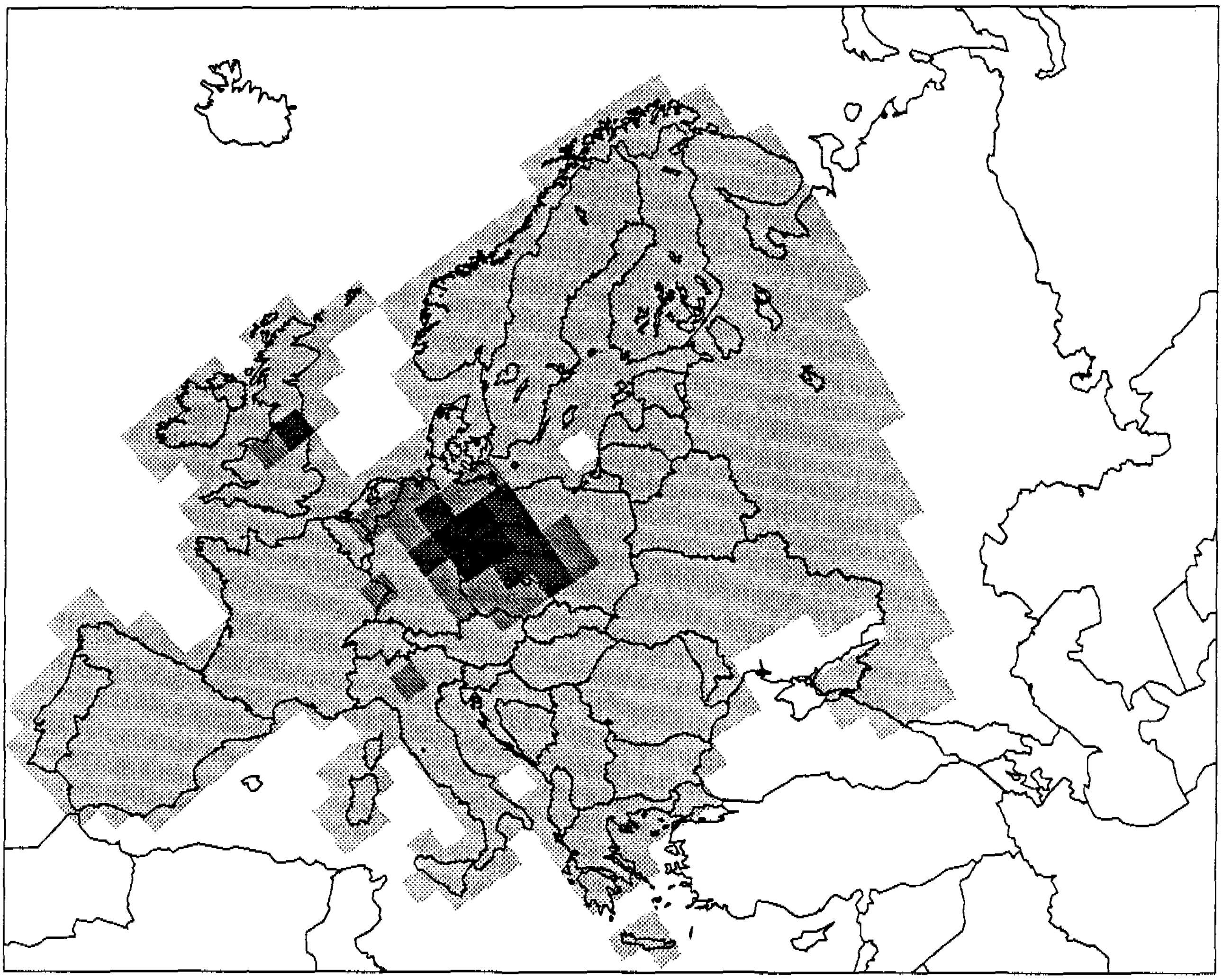
- no data
- < 25
- < 50
- < 100
- > 100

Source: Eurostat, FAO
Computations: RIVM

research for man and environment

Exceedance of Critical Loads for acidity

2010, scenario 1



eq/ha.yr

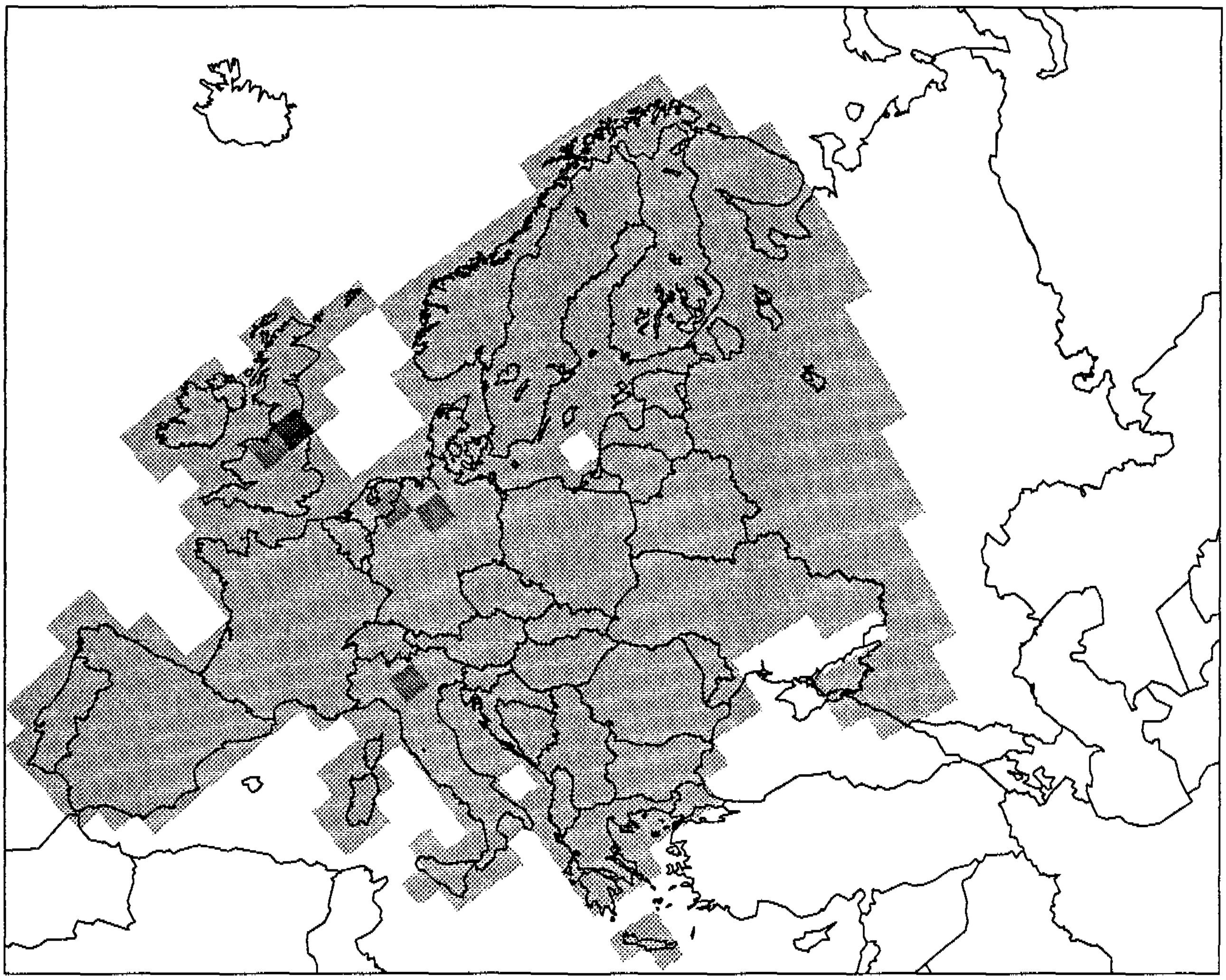
░	< 500
▒	500 - 1000
▓	1000 - 2000
█	> 2000

Computations: RIVM

rivm

Exceedance of Critical Loads for acidity

2010, scenario 2

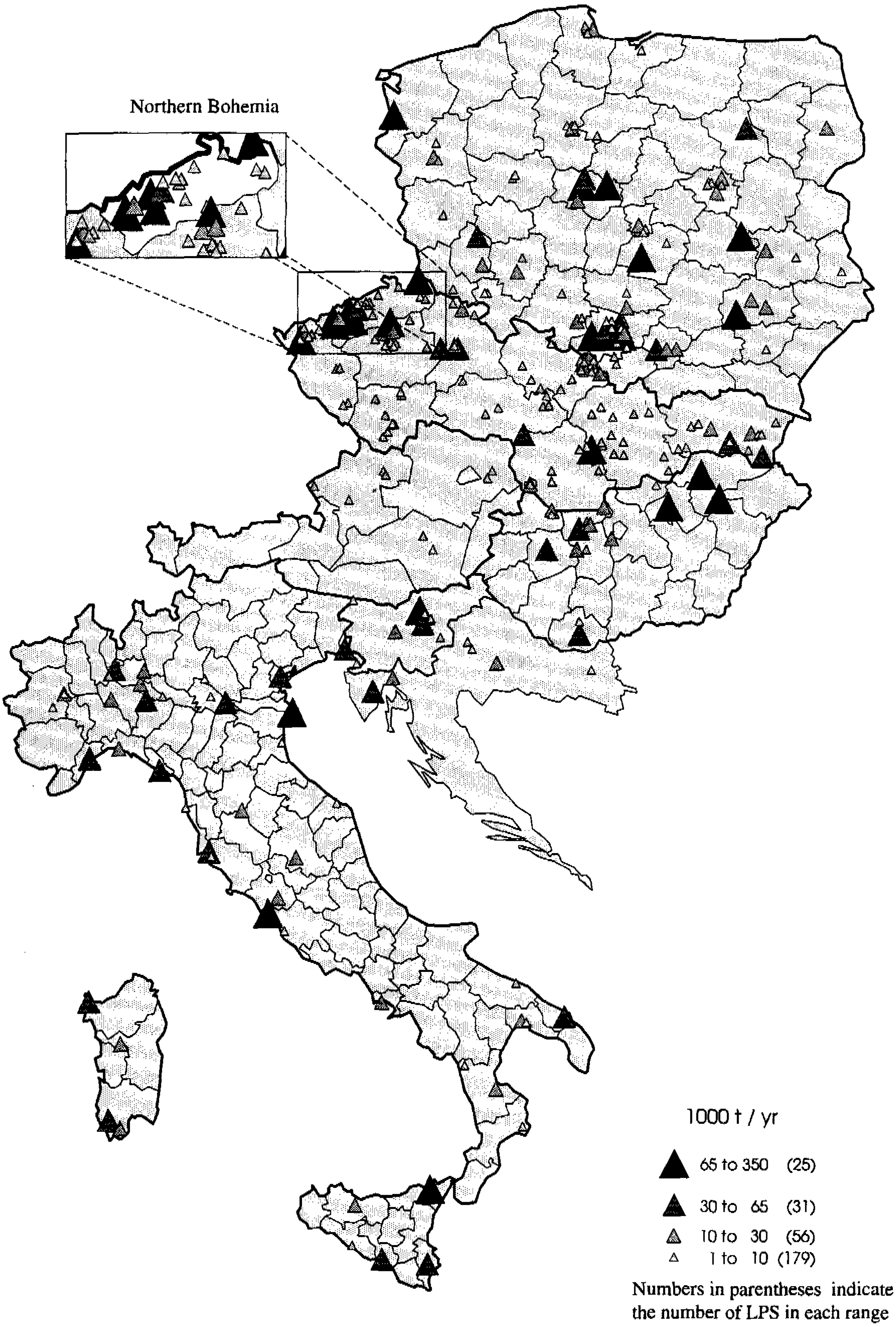


eq/ha.yr

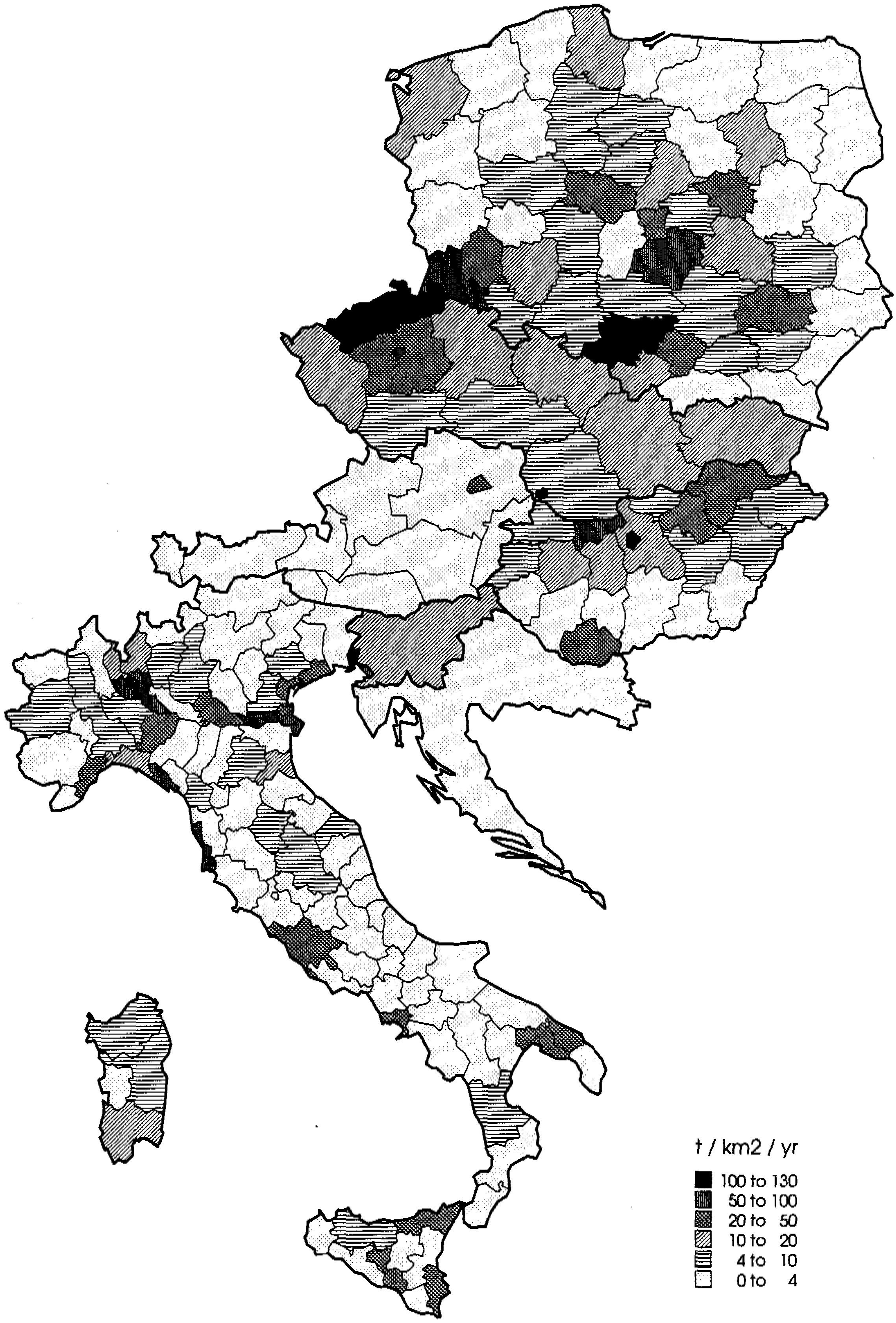
- < 500
- 500 - 1000
- 1000 - 2000
- > 2000

Computations: RIVM

rivm



Locations of large point sources of SO_2 emissions in the CEI region



Regional SO_2 emissions from all sources in the CEI region

environmental impacts from "cradle to grave".

For more information on TC 207 and its work, contact the ISO, Case postale 56, CH-1211 Geneva 20, Switzerland. ◆

Europe East and West charts environmental cooperation

Environment ministers from 45 countries of the UN Economic Commission for Europe (ECE) region have agreed an important series of measures to protect Europe's environment. The accord came out of the second pan-European Environment for Europe conference, held from 28-30 April 1993 in Lucerne, Switzerland. The key results of the conference were adoption of an environmental programme for central and eastern Europe (CEE), agreement to designate 1995 as the European Year of Nature Conservation, and endorsement of a framework policy for a long-term environmental programme in Europe. The meeting followed an earlier conference held in 1991 in Dobris, former Czechoslovakia. Bulgaria has offered to host the next conference in the series, in 1995.

Recognizing that many CEE countries do not have sufficient resources to deal with the severe environmental problems they face, the ministers endorsed an Environmental Action Programme for Central and Eastern Europe (EAP). Such a programme had been requested at the 1991 Dobris conference, and was drafted between the two meetings jointly by the World Bank and the Organisation for Economic Co-operation and Development (OECD). The EAP foresees less immediate financial aid to CEE countries than some had hoped for, but it does set a framework for policy making. This is based on three main principles: integration of environmental considerations into the economic reconstruction process, legal and administrative capacity building, and immediate assistance to regions where human health or natural ecosystems are severely jeopardized by environmental hazards. As part of the Environment for Europe process, the EAP is intended to be a living document, to be updated periodically and adapted to specific country circumstances. Over time its focus is expected to shift from remedial actions towards measures that support sustainable development.

The EAP sets out a number of expenditure priorities for immediate action. Where air quality is poor, these priorities are better dust controls for non-ferrous smelters and steel plants and the substitution of gas for coal in district heating plants and households. In the water sector, the priorities are treatment of industrial wastewater containing toxic chemicals and heavy metals, and reduction of nitrate levels in rural drinking water supplies. Leachate control is the priority for waste disposal sites. Help for enterprises to accelerate their environmental investments is another priority. In particular, the EAP envisages assistance for companies investing in reduction of saline water discharges from mines, improvement of wastewater treatment in pulp, textile and chemical plants, and reduction of toxic discharges from chemical plants.

Acid rain has taken its toll on Eastern Europe's forests

The issue of biodiversity conservation received special emphasis, and ministers welcomed the initiative for a European Year of Nature Conservation in 1995. With relatively low population densities and industrial intensity, many CEE countries still possess extensive areas rich in wildlife. But, as the EAP workplan notes, "The transition to market economies, together with high levels of pollution in some vulnerable areas, are beginning to have a negative impact." The ministerial declaration calls for increased cooperation to improve policies for protected natural areas, and promotion of methods for the sustainable use of natural resources. Among immediate actions recommended are complete inventories of biological resources, revision of national legislation to conform with the Convention on Biological Diversity, and the preparation of national strategies for the conservation of biological resources.

The European Commission is preparing a European State of the Environment Report, which is expected to be completed at the end of 1993 and will serve as a basis for further development of the environmental programmes discussed at the conference.

Looking to the longer term future of environmental policy in Europe, ministers endorsed a report submitted to the conference by the Senior Advisers to ECE Governments on Environmental and Water Problems (SAEWP). This is titled "Elements for a Long-Term Environmental Programme for Europe". It focuses on the policy tools needed to take European environmental policy making into the 21st Century. One of these is a pan-European Environment Agency. Ministers called for such an agency to be developed as an instrument for coordinated data collection and analysis as soon as possible after it has been formally established by the European Community.

Ministers also called for further development and use of innovative environmental policy tools, especially economic and fiscal instruments such as environmental taxes. They welcomed the "emerging consensus on the importance of coordinating the use" of such instruments, including those aimed at reducing carbon dioxide emissions and increasing energy efficiency. Recognizing the financial difficulties facing many CEE countries, the ministers called for consideration of burden sharing to help countries execute projects under the EAP and commitments under protocols to the Convention on Long-Range Transboundary Air Pollution.

Turning to implementation of environmental laws, the ministers recommended intensified cooperation to strengthen tools and mechanisms of monitoring, compliance and enforcement of laws and policies. To give concrete effect to this, they welcomed the planned enlargement of the OECD's Country Environmental Performance Review Programme, which is to be extended gradually to CEE countries, starting with pilot reviews in Poland, Bulgaria and Belarus.

These and other recommendations made at Lucerne set out an enormous environmental agenda for Europe. The job of coordinating progress on it was given to a new ad-hoc working group of senior officials, to be established by the ECE's SAEWP. The European Commission, UNEP and other organizations are to be invited to participate in its work. The new committee will prepare for the next ministerial conference in 1995. A special task force chaired by the European Commission and a CEE country on a rotating basis is to begin implementing the EAP. Meanwhile, the Council of Europe, in cooperation with the International Union for the Conservation of Nature and other organizations, will pursue implementation of recommendations made in the field of nature conservation. The job of the 1995 ministerial conference will be to review progress on the many ideas for action mapped out at Lucerne.

For more information, contact UNEP Regional Office for Europe, 15 chemin des Anémones, 1219 Châtelaine, Geneva, Switzerland. ◆

Action for Central and Eastern Europe

At UNCED, UN member-states recognised that environmental problems of global significance needed to be tackled by the international community. The question of whether assistance should be provided to eastern European states in addition to the huge sums promised for financing economic transformation, is therefore of vital importance.

The environmental problems evident in Central and Eastern Europe will be the main focus of this year's European Environment Ministers Conference, to be held in Lucerne, Switzerland, from 29-30 April. In certain regions in eastern Europe, nature has been damaged to such an extent that it may be beyond remedy, say the Conference's organisers. In view of the very serious and urgent problems of eastern Europe, it is hoped that the Environment Ministers meeting in Lucerne will give priority to working out an immediate action programme aimed at providing the necessary short-term solutions to the worst problems of these countries.

One part of the discussions will be the transformation of eastern Europe and how its development will be affected by environmental considerations. To ensure that these concerns take their rightful place in the new economic structures, efforts would have to be made to integrate social and ecological costs, for example in the form of taxation linked to emissions and/or higher energy prices. The Environmental Action Programme for Central and Eastern Europe (EAP), which will be up for discussion in Lucerne, will try to provide concrete proposals for how to deal with these central problems.

In deciding their priorities, the European Environment ministers will be considering four different topics. To prepare for this, intergovernmental working groups have been set up to work on the areas of discussion, which are:

- Environmental Action Programme for Central and East Europe - mandated to prepare an immediate action programme for improvement of the most urgent environmental problems;
- State of the Environment Report for Europe - mandated to develop a report with all relevant data and figures; to consider the origins of environmental pollution and identify those environmental problems which have a pan-European character;
- Environmental Programme for All Europe - mandated to work out a basis for cooperation, for example in harmonising the collection and evaluation of environmental data, and to build on what already exists;
- Nature Protection - mandated to prepare a nature protection component with emphasis on central and eastern Europe, including tourist development, information and education of the public.

Alongside the official preparations for the conference, a number of NGOs have been holding parallel discussions to ensure the non-governmental community has a significant input. Their third preparatory meeting will be from 14-15 March where they will decide whether plans to hold a two-day NGO conference on 27-28 April, just before the Ministers conference, will go ahead. These plans are currently subject to appropriate funding.

Theresa Herzog, who is coordinating the NGO input, is keen that NGOs outside of Europe should also get involved in the preparations. In particular, NGOs from North America are asked to get in contact with her. The best way to reach Ms. Herzog by telephone is to call between 09.00-12.00, from Monday to Thursday.

Contact: Theresa Herzog, Europe Coordination, Toggenburgerstr. 12, 9500 Wil, Switzerland; Tel/Fax: (41 73) 22 48 53.

For further information on the Environment Ministers Conference, contact: Christa Dettwiler, Press Officer, Environment for Europe Secretariat, Hallwylstrasse 4, 3003 Berne, Switzerland; Tel: (41 31) 61 70 49; Fax: 61 70 54.

ABBREVIATIONS

BACT	Best Available Control Technology
BAT	Best Available Technology
BATNEEC	Best Available Technology Not Entailing Excessive Cost
BOD	Biological Oxygen Demand
CAC	Command and Control
Cd	Cadmium
CEE	Central and Eastern Europe
CIS	Commonwealth of Independent States
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
COMECON	Council for Mutual Economic Aid
CPE	Centrally Planned Economy
CSFR	Czech and Slovak Federal Republic
DO	Dissolved Oxygen
EAP	Environmental Action Programme for Central and Eastern Europe
EBRD	European Bank for Reconstruction and Development
EC	European Communities
ECE	Economic Commission for Europe (U.N.)
ECU	European Currency Unit
EIB	European Investment Bank
FGD	Flue Gas Desulfurization
FSU	Former Soviet Union (also referred to as Newly Independent States)
GDP	Gross Domestic Product
GNP	Gross National Product
IBRD	International Bank for Reconstruction and Development (World Bank)
IIASA	International Institute for Applied Systems Analysis (Laxenburg, Austria)
IMF	International Monetary Fund
LCP	Large Combustion Plant
LRTAP	Long-range Transboundary Air Pollution
MBI	Market-Based Instrument(s)
N	Nitrogen
NGO	Non-Governmental Organization
NIS	Newly Independent States (Former Soviet Union)
NO_x	Nitrogen Oxide
NSPS	New Source Performance Standard(s)
O_3	Ozone
OECD	Organisation for Economic Cooperation and Development (Paris)
P	Phosphorus
Pb	Lead
PM	Particulate Matter (PM10 = Particulate Matter smaller than 10 μm)
SO_2	Sulfur Dioxide
Rb	Ruble (Russian Currency)
TN	Total Nitrogen
TP	Total Phosphorus
TSP	Total Suspended Particulates (in air)
TSS	Total Suspended Solids (in water)
UN	United Nations
UNECE	United Nations Economic Commission for Europe (ECE)
UNEP	United Nations Environment Programme
US$	United States Dollar(s)
VOC	Volatile Organic Compounds
WHO	World Health Organization