COMPLIANCE COSTING FOR APPROXIMATION OF EU ENVIRONMENTAL LEGISLATION IN THE CEEC

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EXECUTIVE SUMMARY

This report reviews and compares 15 recent studies that estimate the cost of approximation of EU environmental legislation, in order to identify major issues and best estimates.

Although the studies provide a lot of information, their relevance for the approximation process is limited because estimates are not directly linked to approximation and because different assumptions and cost indicators make the results hard to compare. Four major concerns need to be taken into account when using the numbers.

First, it is often impossible to single out the impact of EU legislation. The estimates relate to the total cost for the CEECs for upgrading their environmental legislation to ‘western European standards, technologies and approaches’, irrespective whether this is required for EU legislation, local legislation or to meet other international obligations. Although total costs are a better indicator of the real financial effort the CEEC are facing to improve the environment, they overestimate the additional costs required to meet EU obligations. Second, the costs depend on a number of assumptions (economic growth, policies selected) so that no single number indicating ‘the’ costs of approximation’ can be defined. The best estimates given vary depending on the assumptions used. Third, The cost figures overestimate the true economic costs to society because they do not take the economic benefits of related environmental improvements into account. Fourth, not all economic sectors and environmental issues are adequately covered by the studies reviewed. The area of municipal waste water and air pollution is best covered. For water supply, industrial pollution control, waste and nature protection less information is available.

The results of the review are reported for each of the major environmental sectors (water supply and waste water, air and waste management) and a best estimate for investments, capital and operating costs for all CEEC is provided in chapter 8.

The best estimate for total investment costs amounts to more then ECU 100 billion or ECU 1000 per capita. This figure covers water supply, sewerage, waste water treatment, air pollution from combustion plants and waste management. These investment needs are larger than those projected for the four Cohesion countries, as well in absolute terms, as in investments per capita or as a percentage of GDP. Total annual costs are estimated to range from ECU 8 to 12 billion. (ECU 80-120 per capita) This figure covers capital and operation costs for municipal waste water, air pollution and operational costs for waste management. Although this amount is only two thirds of the average per capita annual environmental expenditure for the EU-15, it corresponds to a much larger share of GDP for the CEEC. These costs and their impacts will depend on the timing of the investments and the selection of the most cost-efficient policy measures. These are important considerations for the CEEC and EU to define a cost-efficient and affordable pathway to approximation.

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ACRONYMS

BAT	Best Available Technology, Best Available Techniques
BATNEEC	Best Available Technology Not Entailing Excessive Costs
CEEC	Central and Eastern European country
CM	Combustion modification
DG XI	Directorate General for Environment, Nuclear Safety and Civil Protection, European Commission
DISAE	The Phare-funded facility to support approximation of environmental law in central and eastern European countries which have signed Europe Agreements with the European Union
EMAS	Environmental Management and Assessment System
FGD	Flue gas desulphurisation
GDP	Gross Domestic Product
HGV	Heavy goods vehicles
IPPC	Integrated Pollution Prevention and Control
kWh	Kilowatt hours
LCP	Large Combustion Plant
LPG	Liquid Petroleum Gas
MECU	million ECU
MW	Megawatt
MWh	Megawatt hours
MOSES	Model on Sustainable Environmental economic Scenarios
n.a.	not available
NEAP	National Environmental Action Programme
PAC	Pollution prevention and control (PAC expenditure)
OECD	Organisation for Economic Co-operation and Development
RAINS	Regional Air-pollution Information and Simulation
SCR	Selective catalytic reduction
TME	Institute for Applied Environmental Economics (The Netherlands)
IIASA	International Institute of Applied Systems Analysis (Austria)
WRc	Water Research Centre (United Kingdom)

1. THE ASSIGNMENT

1.1 Background

The Terms of Reference given to EDC/EPE state that the Commission is required to prepare a first annual report on the approximation of environmental legislation in central and eastern European countries (CEECs) which have ratified Europe Agreements and intend to join the European Union. The report is to be submitted in September, in translation, so it is important that the initial draft be completed in March. The scope is all EU environmental legislation, with the exception of nuclear safety and radiation protection.

A first draft was given to DG XI on 5thMarch. This is the final document, including corrections and comments made by DG XI staff and the consulting authors.

The need for this report is, first, because the potential costs of the approximation of EU environmental legislation by the CEECs have been seen as an important barrier to implementation. Second, significant benefits have been assumed to arise from a cost-effective implementation of the EU legislation. Third, as the role of economic analysis in environmental policy making in the EU has increased and is becoming more explicit, the cost implications of approximation need to be identified.

1.2 Objective

The objective is to prepare a background document for DG XI on recent studies of compliance costs in CEECs, in view of a section on compliance costing for the first annual report.

Therefore, this background document should inform the European Commission about the state of the art of compliance costing in the CEECs. It should further identify and clarify the role compliance costing can play to structure the debate on economic impacts, clarify the issues involved and how it can contribute to an effective and efficient approximation. A framework should be elaborated in which the dispersed and partial information available can be placed in a proper context.

A second important objective of the assignment has been to use this information to produce country-specific estimates of cost by piece or category of legislation, as far as possible[1].

[1] Note of 15.1.97 from DG XI A.5

Thus the background report needs to:

- Identify and review the major compliance costs studies in the CEECs undertaken so far
- Determine the best estimates of compliance costs for environmental legislation for each CEEC, based on these studies and in so far as they provide reliable information
- Draw lessons for the interpretation of the compliance costs studies in general (criteria for review) which will be of value to future work in this area
- Clarify the role of compliance costing for policy making in general and for the implementation of EU legislation in the context of approximation in particular.

2. INTRODUCTION

2.1 Structure of the report

Although more than a dozen studies undertaken during the past five years have been identified, there has been no systematic overview of the methodologies used or the resulting data. This report is the first. The studies have been by sector (water, air, waste, and 'other') with conclusions and best estimates for the CEEC compliance costs of each sector (Sections 4-6). In the conclusions, an overall estimation of the costs of approximation is given, both in terms of investment costs and annual costs (Chapter 7).

A comparable exercise was undertaken for the four Cohesion countries (Greece, Ireland, Portugal and Spain) were facing a similar challenge in 1991, Chapter 3 reviews the data and lessons learned from a series of DG XVI-supported estimates of the costs of approximation for these countries, and also compliance cost estimates for the states of the former GDR.

Throughout the report, the results for the CEECs are compared with environmental expenditures in EU-15.

2.2 Methodological issues

The calculation of 'compliance costs of approximation' can be made in a number of ways: the differences in approach can have significant effects on the results, their interpretation and use. The studies reviewed in this report illustrate this problem, and their comparison requires a close definition of the terms 'costs' and 'approximation'.

2.2.1 Estimating the costs of environmental policies: general issues

The first issue is the exact definition of the environmental policies of which the costs are to be estimated. This is always a rather complex exercise when it comes to policy programmes covering multiple sectors, pollutants, etc. but in the case of approximation a number of specific issues arise.

Definition of an 'approximation scenario' in contrast to a reference case

Approximation is the process of adapting or adopting national laws, regulations and procedures to give effect to EU legislation.

It imposes costs on countries which approximate, because EU legislation requires them to meet performance obligations which involve administrative, investment and operating expenditure which may be higher than they would otherwise have incurred, because:

- the timetable for EU accession requires faster investment than the country would have made on its own (and the faster the implementation, the higher the cost is likely to be)
- imposes higher standards which require additional investment, or
- imposes more detailed obligations on government and the affected sectors of society.

Measuring the costs of approximation is thus measuring the costs of an approximation scenario compared to a reference case in which no approximation of environmental legislation takes place. It thus requires the definition of a reference case and of an approximation case.

In general, the estimation of the costs of environmental measures basically requires three different elements:

- The total amount of pollution (e.g. SO_2 emissions)
- The amount of pollution to be reduced (following the policy objectives), and
- The cost to reduce one specified unit of pollution for different pollution reduction technologies/techniques.

In practise, this simple three-line calculation can become quite complex, and estimating the cost of approximation makes it even more complex.

The most important issues are:

- *Baseline estimate*: This is the definition of the current situation - an estimate of the current burden on the environment (e.g. total amount of pollution or waste produced, taking into account the capacity and efficiency of existing environmental control technologies and infrastructure).
- *Definition of the reference case*: This is the future development of the burden on the environment, taking into account changes in economy and society which are not related to environmental policies (e.g. economic growth, economic structures, consumption patterns and behaviour) as well as the baseline environmental policies. Because assumptions can differ between studies their results may be hard to compare. In other cases, studies build several scenarios, in which case a choice between them must be made. In principle, it would be necessary to analyse how estimates of the cost of approximation are sensitive to changes in assumptions.
- *Definition of the approximation scenario*: The definition of the 'new environmental policy scenario' - in this case the approximation scenario - also involves some definition of policy measures and technologies to implement them. Costs are taken into account in these choices, and most such studies and plans aim to use the most cost-efficient solutions to reduce pollution. So, most studies use a model to rank different policy options and technologies and to select measures and technologies according to cost.

Hence, different studies may select different policy options and technologies. The Moses model described in annex to this report gives an example of one such approach.

Second, the EU legislation must be interpreted in order to be implemented, and the stricter the environmental requirements the bigger the required effort will be to reduce pollution, and thus the higher the costs of compliance will be. Therefore, a number of studies will report costs for different levels of pollution abatement, technology or approximation, depending on the authors' interpretation of the legal requirements. Again, studies often report several 'approximation' scenarios.

Third, an overall limit on total cost may have been involved in the definition of the scenario used in the study. This is especially important for environmental action plans (e.g. the Romanian plan takes as an explicit starting point that environmental expenditures account for 0.6% of GDP). This prevents such policy plans from being used to estimate the cost of approximation.

- *The unit costs of environmental measures*: Cost studies estimate the costs of environmental technologies and measures by using unit costs (e.g. the cost of reducing 1 ton of SO_2 with FGD for a new power plant of a specific size). The studies always include some educated guess of what the real costs will be. The costs in the models are normally based on a variety of different sources and cost estimates for a certain situation (e.g. a plant of a certain size), and may need to be transferred to another or a more general situation.

In conclusion, it is clear that 'approximation' is a process, not a single, well defined activity or event, and the estimated cost of accomplishing approximation will vary according to the assumptions made as well as the conditions in a specific country. As a result, the estimates of the cost of approximation arrived at in the studies under review in this report do differ and are difficult to compare without a detailed analysis of underlying assumptions, data, etc.

From 'additional costs' to 'total' costs

The objective is to measure the 'additional costs' associated with approximation for the CEECs. However, it will never be possible to separate out these additional costs of approximating clearly, because the level of information available will never be detailed enough. Also:

- It is hard to differentiate between general trends and the change imposed by accession.
- It is difficult to distinguish between 'autonomous' industrial improvement related to the need to be competitive and additional improvement related to new obligations under EU legislation.
- Isolating the 'additional' costs from the overall effort required to improve the environment may overlook the importance of the investments the

CEEC are facing. E.g. the additional costs for in the water sector would only be a small part of the total costs. (see Chapter 4)

Therefore, most studies and this overview will focus on the total costs of bringing the environmental regulations in the CEECs in line with the EU environmental *acquis* (and Western European standards in general).

Costs indicators

There are different indicators to measure costs, for example:

- Total investment costs of providing the necessary infrastructure. These cost can be expressed as the total investment required (investment costs) or as a yearly investment effort over a certain period of time.
- Annual capital cost. The yearly depreciation of these total investment costs and the interest related to that investment. Annual capital costs depend on both total investment, the number of years over which these are depreciated, and interest costs.
- Operating costs. these are related to the operation of the investments (in which case they are related to the investment costs (e.g. energy costs for water treatment plants), but they also may be influenced by measures which do not necessarily require investments or are less linked to investment costs (e.g. monitoring, waste collection, fuel substitution).
- Administrative costs. The costs of implementing, monitoring and enforcing legislation should never be underestimated. The lack of appropriate administrative structures and procedures may be a main source on noncompliance with EU legislation.
- Total annual costs[2] : includes capital costs + operating costs

These types of costs are normally inseparable, since there is little point in providing infrastructure that is not properly operated and maintained. Some directives impose costs mainly on government bodies responsible for implementation, monitoring and enforcement, while others also imply substantial investment costs by the sector of the economy being regulated.

In principle, all these cost indicators are needed to have a complete picture. However, in practise, studies often report only some cost indicators (e.g. annual costs or investment costs). This makes the comparison of results very difficult. Because our information for the best estimates for investment costs and annual reports comes from different sources, this report uses types of cost indicators. However, they cannot be

[2] The assessments of approximation costs in this study include investment and annual costs plus operating costs. This differs from the OECD evaluation of EU-15 environmental expenditures on pollution prevention and control, which only considers annual expenditure.

completely comparable because they are based on different assumptions and approximation scenarios.

The costs described are those borne by economic entities including governments, industries or households. They need to be distinguished from impacts at a macro level, because the costs for individual economic actors are net costs of actual environmental expenditure and do not consider effects on GDP and inflation nor the economic benefits of environmental improvements.

There is a natural tendency to focus on financial constraints since money supply is always assumed to be finite, whilst administrative and technical capacity are assumed to be flexible and expandable. However, the budgetary stringency required of all CEECs makes it difficult for them to finance public investments as well as to expand their administrative institutions.

2.2.2 Economic benefits from environmental improvements

It is important to note that the gross costs reported in the studies and this in report actually **overestimate the true economic costs of environmental legislation because they do not take into account the economic benefits of environmental improvements**. These benefits include savings on health costs, cost of maintenance for buildings, increased yields in agriculture, etc..

Methodologies to evaluate environmental damages in economic terms are improving, although a large number of damages remain hard to quantify and evaluate. One methodology covers three types of damage:

- Cost to human capital and productivity (health costs): increased illness and mortality due to expose to too high level of pollutants
- Losses to physical and natural capital (productivity costs): e.g. reduced yields in agriculture, damages to fisheries; increased maintenance costs for buildings
- Loss of environmental quality (amenity costs): people attach a value and are willing to pay for beautiful views and recreation areas, a quiet neighbourhood, the protection of endangered species.

Earlier, very rough, estimates indicated that total environmental damage in central and eastern Europe ranged from 2 to 10% of GDP. A somewhat more detailed analysis for Poland by the World Bank estimated damage up to 3-4% of GDP, most of it involving human health. [3] This is understandable, because methodologies to estimate the costs to human health from pollution are the most advanced. In fact, this estimate is certainly low. Health damage in the CEECs is estimated to be 2-3 times higher then in the original group of OECD countries.

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[3] World Bank, Environmental Action Programme for Central and Eastern Europe, Document for the Ministrial Conference, Lucerne, Switserland, 1993, p. II-4.

Bad environmental conditions will hamper economic growth. As an example, it is reported that for Poland the amount of surface water unsuitable for even industrial purposes had increased to 40% in 1989.[4] In South Poland, the average life expectancy has declined over the last 15 years while the number of days of illness increased.

It is not the purpose of this report to consider studies aimed at quantifying environmental damage.

Although the reduction of environmental damage is not quantified in the studies reviewed, when considering compliance costs, it must be realised that the cheaper environmental measures are likely to lead to net economic gains for the society as a whole in the CEECs.

2.3 CEEC and EU considerations

2.3.1 CEEC considerations

Notwithstanding the difficulties inherent in measuring 'additional costs' of approximation, the notion of additional costs remains useful because this is what the accession countries and the Commission will refer to when deciding the approximation measures and timetables - i.e., what the countries will be required to do by the date of accession that they would otherwise not have done, would have done differently, or would have done more slowly.

The process involved in a preliminary determination of the costs of approximation[5] include:

- Determining total environmental expenditure, to establish a general framework
- Determining the difference schedules according to which the necessary improvements can be achieved, based on different assumptions about implementation
- Identifying investments with an economic rate of return to determine the proportion of investment which could be made on a commercial basis and the proportion which will remain a central government cost
- Setting environmental sector needs in the context of overall accession needs for each CEEC; this goes well beyond the scope of the present study but should be borne in mind to keep a sense of proportion.

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[4] Jantzen & de Bruyn, *Cost-assessment of medium term Polish Environmental Policy Goals*, TME (Institute for Applied Environmental Economics) for the polish and Dutch Ministry of Environment, The Hague, April 1994, p. 5

[5] For example, in defining different approximation scenarios with different sets of priorities, or in establishing an initial negotiating position.

Several variables need to be considered whilst going through this process:

- The current level of environmental protection and state of the environment (baseline conditions)
- National environmental policy goals, plans and programmes, and the record of political will to improve environmental conditions
- The extent of private sector improvements based on current and projected economic changes, which may increase the pressure on the environment on the one hand (more energy demand, polluting emissions, etc.) but on the other hand which may hasten the renewal of industrial stock, allowing the introduction of better pollution abatement technologies (often justified by their more efficient natural resource use)
- The extent of public sector investment possible, based on the same economic projects and the record of political will
- The administrative costs of implementing the new laws and regulations by bother government and the regulated sector of society.

In practice, it will be difficult for some countries to go through this process, because of their lack of experience in programme preparation and implementation. But, external expertise brought in to support this type of exercise creates risks which must be borne in mind:

- Countries (and ministries and individuals) must take responsibility for their actions and not rely on outside expertise to provide answers: It is vital to break from the systematic shifting away of responsibility so characteristic of the Soviet period
- They must feel ownership of their programmes in order to be able to negotiate them with the EU as part of the accession process, and thus be directly and deeply involved in their preparation
- They must gain their own experience of environmental protection practice so as to participate effectively in the development of future EU policies and laws.

Finally, the debate on the sharing of costs is particularly important because it raises fundamental questions about the allocation of responsibility within countries, which will become more acute as implementation of legislation and its related investment proceeds:

- Just as there is a tendency to focus on capital costs as a proxy for all costs, so also there is a tendency to concentrate on central government’s role in providing funds or supervising implementation as a proxy for regional and local government responsibilities

- The devolution of responsibilities to local levels of government has not gone far enough: they still lack important powers to take decisions and raise and spend revenues.
- The nature and extent of privatisation in each country has important implications for the allocation of costs among institutions and sectors.

2.3.2 EU implications

The compliance cost studies analysed in this report give rise to a number of observations about the nature of EU legislation and its implementation.

It is important to remember that compliance with environmental directives is the obligation of governments. Some representative types of obligations include:

- A specific single obligation to be imposed on industry (such as fuel oil sulphur limits) through a law or binding regulation
- Application of a general technical standard (BATNEEC) to an individual facility (for which an EU-level guidance document may be provided) by a permitting authority
- Drawing up and implementing pollution reduction plans for areas not meeting EU environmental quality standards
- Preparation of national or regional plans to eventually meet non-binding policy goals set out in the legislation (such as water quality guide values).

Although costs are easier to determine for the first type of obligation, and studies therefore tend to have focused on them, some studies have also attempted to cost the realisation of environmental quality objectives such as ambient air quality improvements or reductions in acidification. More attention thus needs to be paid to defining effective compliance strategies for legislation with policy goals[6].

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[6] Over the years, the EU has not yet succeeded in harmonising the terminology of environmental regulation, at least not in English. Thus, a number of different terms can mean the same thing and it is important to verify in each case whether the term applies to the general environmental quality or to a particular source or pollution, and whether it is binding or nonbinding.

There are *emissions* to air, and *discharges* to water and land; both are emitted (or discharged) from a single identifiable (point) source and therefore able to be regulated through a permitting system setting numerical limits on the quantity emitted (or discharged) from each source. There are water quality *limits*, *standards* or *objectives* (binding and nonbinding) and nonbinding *guide values*. Then there are binding ambient air quality *standards* and *limit values*, and nonbinding ambient air quality *objectives* or *targets* (depending on the document). There may also be *emission*, *discharge* or *effluent limit values*, depending on whether the directive concerns air, water, or land.

Although EU policy documents support the idea of less regulation and more market based incentives, even the most recent EU legislation tends to take a strongly regulatory approach which leaves limited room for market instruments. The Best Available Techniques (BAT) concept in the IPPC Directive is an example. BAT implies that all currently available technology to control emissions should be applied, possibly not leaving room for emissions trading regimes.

The use of economic instruments should lead to the achievement of policy goals at the lowest societal costs, whereas application of regulatory mechanisms will in general lead to higher costs: some initial estimates by TME show that if tradable emissions could have been used to meet the Netherlands objectives on acidification the ‘compliance costs’ could have been 50% lower than the mandatory regulatory regimes which were actually applied.

Affordability is of course a key issue. The nature of environmental legislation makes some implementation more expensive than it could be, and the level of effort needed to implement the body of EU directives is high. It may be advisable to define cost thresholds[7] when setting timetables, and by extension to consider providing support mechanisms when either thresholds or timetables exceed negotiable levels - the CEEC equivalent of the Cohesion Fund.

This type of argument is reinforced when considering the goal of the requirements and standards in EU legislation, which is to achieve a ‘high standard of protection’, in the words of the Treaty and the 5th Environmental Action Programme (5EAP). But this goal has been set for generally high-income economies with nearly a generation of environmental investment underway. It is the core reason for the establishment of the environment part of the Cohesion Fund for four Member States which are relatively wealthy by CEEC standards.

Implementation is not only a question of affordability. It is also one of institutional capacity, and with this of an optimum division of responsibilities (and financial opportunities) between central and local governments and between public and private sectors. A cost-effective programme is one in which all actors take part, arguing for a strong institutional support programme to accompany any investment activity, especially when the latter involves a devolution of responsibilities.

Phare (and DG XI) need ensure that the support mechanisms they devise empower the countries assisted and does not replace or weaken the internal decision-making process.

2.3.3 Implications for the review the studies

The main goal of this exercise has been to determine the cost to the CEECs of compliance with EU environmental legislation. In an ideal situation, four main indicators should be defined which bring together the various strands discussed above:

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[7] In terms of the percentage of GDP per capita needed, for example.

- Gross investment needs, as a general reference measure
- The cost-effective additional investment to be achieved within the period envisaged, derived from a sound evaluation taking into account the matters raised in Chapter 1 above
- Affordable annual additional costs for households, industries, local authorities and governments
- The implementation timetable of the affordable programme.

The Commission, for its part, should examine how to use the results to calculate measures of affordability, in order to ensure that it can determine whether additional support might be needed, and at what level.

Since affordabilty was not assessed in the studies, the first objective of this review has been to offer a transparent description of scope, methodology and basic assumptions of the studies reviewed. Their most important results are reported, compared, and checked for consistency with other information. For each environmental sector, we try to identify the best information available. Finally, the results are compared on a per capita basis and as a percentage of GDP with environmental expenditure in the EU and cohesion countries.

2.4 The CEEC compliance cost studies

This report should enable the reader to evaluate the 15 studies reviewed against a background of currently available information.

In the past five years, a number of major studies related to compliance costing in the CEECs have been undertaken. The 15 studies reviewed are listed in Table 2.1, indicating the area and country they cover. The full title of each study is given at the end of this section following the same numbering.

Only one, the ifo Institut study (1993) covers all environmental sectors and countries. It also contains an overview of results of studies undertaken before 1992.

All others focus either on a specific environmental sector or country.

Of these, only the *Slovak National Environmental Action Program, the National Environmental Action Programme of Romania* and *Strategic guidelines on waste management for the republic of Slovenia* are policy programmes, the other are technical-economic studies which estimate the cost of upgrading environmental policies in the CEECs to or in the direction of western European standards and technologies.

Of course this list is unlikely to be complete and new studies are starting up. However, because most studies and underlying models are based on similar techniques and data, it is unlikely that the studies not included would offer completely new insights or data. It is, however, likely that new studies using different assumptions and better data inputs will come up with better estimates.

It has to be noted that some important studies are under preparation. The CEECs are also included in the 'economic assessment of priorities for a European environmental policy plan', described in the annex to this report.

2.4.1 Country studies

The 1994 study by the ifo Institut for EBRD covers air, water and waste sectors for all CEECs, but its base information is relatively old and very rough. Nevertheless, it offers an interesting starting point, containing a full matrix of figures for investment costs.

Poland is the best documented country. It is included in most of the sector-oriented studies as well as a few country specific studies. A study by TME for the Polish government covers most industrial sectors. It is complemented by a study by ERM, that focuses on compliance with EU directives affecting industry. A draft working document by the World Bank offers complementary information for comparison.

An earlier study on water investment needs in the Czech Republic has been criticised by the Czech Ministry of Environment, which will soon be launching a series of new studies on compliance costs. Detailed work has been undertaken in relation to the ongoing investment programme aimed at compliance with the UN/ECE Agreement on SO_2 and NO_x.

Water investment needs are the subject of a Phare '95 project in Hungary, but this is just getting underway.

Table 2.1 Overview of studies reviewed

	Studies	water	air	waste	other	Hungary	Poland	Czech Rep.	Slovak	Romania	Bulgaria	Baltic States	Cohesion
Covering all sectors and countries													
1	IFO, EBRD-EU	X	X	X		X	X	X	X	X	X	X	
Water													
2	Wrc, EBRD-EU	X				X			X	X	X		
3	Somlyodi, World Bank	X				X	X	X	X		X		
4	Wrc, Water, Romania	X								X			
5	EBRD-note	x								x		x	
Air													
6	IIASA, EU DG 11		X			X	X	X	X	X	X	X	
7	TME, Transport		X		transp.	X	X						
Single country studies													
8	TME, Poland	X	X	X	industry		X						
9	ERM, EU, Poland	x	x	x	industry		X						
10	World Bank paper Poland	x	x	x	x		X						
11	Slovak NEAP	X	X	X	X				X				
12	Romania NEAP	X	X	X	X					X			
13	Waste plan Slovenia			X									
Cohesion countries													
14	BCS, EU, DG XVI	X	X	X	X								X
15	Blackwell, EU, DG XVI	X	X	X	X								X

2.4.2 Sector studies

The water sector is comprehensively covered by a WRc study for the EBRD, which was also used as the basis for the ifo Institut-study. It is complemented by a World Bank study covering five countries More detailed information on Polish industrial compliance is available from TME, the World Bank draft paper on compliance costs for Poland, and the Slovak NEAP. The information is completed by some brief information about EBRD investment projects in the region.

Air is also relatively well covered. An interim report from an ongoing study by IIASA for DG XI offers a complete overview of measures related to SO_2 and NO_x for all sectors in all CEECs, but it only reports annual costs and costs are not detailed per sector. This information is completed and compared with other studies that include ifo Institut-study, TME for Poland, the Slovak NEAP, World Bank report for Poland and a specific study for transport related emissions in three CEEC cities.

Waste is not well covered. This issue is included in the ifo Institut study. Additional information is available for Slovakia, Slovenia and Poland.

Other (nature protection, horizontal directives, chemicals, industrial risk) regulatory sectors are hardly covered in the studies reviewed; they are discussed briefly in Chapter 7.

2.5 The studies

The studies reviewed and used for this report are listed below, following the same numbering as in Table 2.1.

All countries and sectors

1. Adler et al, *Environmental Standards and Legislation in Western and Eastern Europe Towards Harmonisation: Economic costs and benefits of harmonisation*, IFO, Munich, 1994.

Water

2. EBRD and EU (1993), Environmental Standards and legislation in Western and Eastern Europe, Towards Harmonisation, Water Sector Case study by Zabel, Buckland, Glennie, Warren of WRc, final report of task Vii.
3. Somlyody Lazlo (1995) Municipal wastewater treatment in central and Eastern Europe, Present situation and cost-effective development strategies, report for the environmental action programme for central and eastern Europe, World Bank.
4. Regione Emilia-Romagna (1992), Problemi di organizzazione dei servizi idrici in Emilia-Romagna, Report N° CO 3109 by Wrc
5. EBRD, Costs of Projects funded in the wastewater sector personal information, Feb. 1997

Air

6. Amann et al, Cost-Effective Control of Acidification and Ground-Level Ozone (second interim report), IIASA:, for the EU, DG XI, December 1996

7. Jantzen, 1995, Urban Transport and Air-pollution: Trends and Policy Options, Case studies for Moscow, Budapest and Warsaw (draft final report) for the World Bank, The Hague, 1995

Studies or policy plans related to one country

8. Jantzen & de Bruyn, Cost-assessment of medium term Polish Environmental Policy Goals, TME (Institute for Applied Environmental Economics) for the polish and Dutch Ministry of Environment, The Hague, April 1994.

9. Polish Ministry of Environmental Protection, Natural Resources and Forestry (1994) Designing a Programme of Compliance Schedules for Polluters, final report by ERM

10. World Bank, The Environmental Impliciatons of EU Accession, Draft working paper, World Bank, Poland Country Economic Memorandum, Feb. 1997, 27 p.

11. MoE SR (Ministry of the Environment of the Slovak Republic): National Environmental Action Programme, Bratislava, 1996

12. Ministry of Waters, Forest and Environmental Protection, National Environmental Action Programme of Romania, Bucharest, 1995

13. Minstry of Environment and Physical Planning, Strategic guidelines on waste management for the republic of Slovenia,Ljubljana, August 1996

Cohesion Countries

14. Business Consulting Services, (1992) Costs of Compliance with Environment directives in Greece, report for DG XVI, Thessaloniki - Athens., Nov.92

15. Blackwell, Jonathan and Associates, 1992. Study on the Environment and Regional Development in Ireland, Report prepared for the EU, DG XVI for Regional Policies.

16. EBRD, Costs of Projects funded in the wastewater sector personal information, Feb. 1997

Background information

17. OECD (1996) Pollution abatement and control expenditure in OECD countries

18. IIASA (1996) ‘Water Quality in Central and Eastern Europe, Good to the last drop’, IIASA Options journal

19. RIVM (1996), Scenarios for Economy and Environment in Central and Eastern Europe, report N° 48 1505002

20. ECN-SRC International Prague, Environmental Costs of transport and policies’, Case studies for Poland, Bulgaria, Czech Republic, for EU, DG XII, July 1996

3. THE COHESION COUNTRIES AND THE FORMER GDR[8]

3.1 Available information

Compliance costs of meeting EU directives in Greece, Ireland and Portugal were estimated in 1992 by the Greek firm SIS, on behalf of DG XVI; the work was subcontracted to in-country consultants. ERL carried out a parallel study on Spain.

The SIS studies had the following terms of reference:

- a background report to be provided on the major environmental issues in the context of regional development
- identify and quantify the cost implications - public and private - of EU environmental directives
- identify and assess existing environmental priorities
- identify and describe schemes to support introduction of clean technologies, and companies producing same
- review needs for improved information, planning management and institutions
- methodology - the work will be based on existing data and reports and consultations with key actors in the public and private sectors. No empirical work is anticipated.

The Amber Report *Environmental Investment Needs in Objective 1 Region*[9] summarises some aspects of these reports. It focuses on three key environmental sectors: urban wastewater management, municipal solid waste management, and industrial hazard management.

Amber concludes that the ERL report is less reliable than the SIS estimates because: it overestimates the current fixed capacity of existing plants, assumes that existing capacity is adequate (which it is not), and did not use appropriate unit cost factors for the sewerage networks.

[8] Prepared by Dr Frank Convery, University College, Dublin.

[9] *s,* Final Report, July 1993, prepared for Envireg.

3.2 Methods used

The methods used in the report on Ireland (Blackwell, 1992) are representative of the three SIS studies:

1. An analysis of environmental performance and challenges - first report.

2. Analysis of each directive and its cost implications: Each environmental directive was taken in turn, and an attempt was made to determine actions already taken or in process, and then to estimate what further actions would be required and to cost these. Personnel and documentation at central and local government were the key sources of information. There were no independent sources of information other than government from which to make estimates.

The directives covered included:

- Water and Water Quality: surface water abstraction (75/440); dangerous substances in water (76/464); bathing water (76/160); salmonid waters (78/659); surface water (79/869 - measurement); shellfish (79/923); water abstracted for human consumption (80/778); urban wastewater (91/271)

- Waste etc.: groundwater (80/68); asbestos (82/217); waste (75/442); toxic and hazardous waste (78/319); incineration (existing-89/429); incineration (new-89/369); waste (75/442 as amended by 91/156); landfill proposal; packaging proposal.

- Air and air quality: industrial plant (84/360); large combustion plants (84/609); car emissions (91/441); lorry emissions (91/542); ozone layer (91/594); chemical directives (various); SO_2, gasoils (87/219); black smoke, SO_2 (87/779); lead (82/884); NO_x (85/203).

- Other: proposed IPPC directive; birds (79/409); habitats (92/43); EIA (85/337); access to environmental information; proposed eco-label regulation.

These compliance costs are set out in the following table.

Table 3.1. Costs of Compliance - Ireland[10]

1. Water	
Urban wastewater	IR£750 million of which about 250 million done already
Freshwater fish	depends on designation stance taken
Shellfish	depends on designation
Bathing water	included in Urban Wastewater directive
Drinking water	about IR£90 million, but difficult to disentangle EU-specific requirement from a total water supply budget of IR300 million
Groundwater	no major problems
Total water	total cost of IR£1.1 billion, of which EU driven IR£445 to 565 million.
2. Air Quality	
Large combustion plant	superseded by the Helsinki and Sofia Protocols on Long Range Transfrontier pollution which set more demanding standards. - No cost estimates
Vehicle emissions	borne by final consumer - no estimate
Ozone monitoring	no estimate
Chemicals	no costs
Air quality (Smoke and SO_2)	transfers of IR£5.8 million annually to compensate households
Asbestos	no estimates
SO_2 content in gas oils	additional costs, but not estimated
3. Waste	
Landfill	total of IR£75 million
Toxic and hazardous waste	IR£35 million
4. Integrated Pollution Control	
Electricity	IR£486 million, if retrofitting electricity generation plant to achieve BAT
Pharmaceutical and chemicals	IR£100 million
Food	IR£100 million
Monitoring	IR£5 million

[10] Note: a questionnaire completed by local authorities was the basis of much of the data. The questionnaire focused on refurbishment needs and new capital requirements.

5. Habitats	
Habitats Directive	assuming acquisition of 56,000 hectares of raised bog, blanket bog, sand dune systems etc. £99.5 million.
Monitoring	£5 million capital, £2 million operating
6. Information	
EPA networks	£15 million capital, £3.5 million operating
EIA	£5 million annually
It can be seen that the highest documented costs are related to:	**Amount (£million)**
Urban wastewater	500
Drinking water	90+
Landfill	75
Integrated pollution control	200+ (excluding electricity generation)
Habitat protection	100

The analysis of the costs in Greece (Business Consulting Services, 1992) followed the same methodology, and also concluded that compliance with the Urban Wastewater Directive was the dominating influence on cost (DR 580 billion). Modernisation of diesel powered vehicles (91/441) would be second largest at 190 billion DR, and landfill upgrading third (80 billion DR.).

3.3 Relative importance of different EU legislation

It is clear that the Urban Wastewater directive is a dominant force in the Cohesion countries. This is not surprising, because they are all maritime states which have made extensive use of the very large assimilative capacities of the surrounding oceans and seas to dispose of organic wastes with little of no treatment. The Wastewater directive in effect requires them to treat these wastes and they were starting from a comparatively low base.

The requirement to comply with EU drinking water standards is also a major force driving investment in the Cohesion countries, although there is uncertainty as to what extent EU law *per se* is the motivation. The Amber report summarises some key expenditure estimates as follows:

Table 3.2 Estimates of average annual investment required for new capital infrastructure in Objective 1 regions (MECU)[11]

Category	Greece	Ireland	Portugal	Spain	Total	%
Urban Wastewater	240	95	113	458	906	53
Municipal Solid Waste	35	20	35	19	109	6
Industrial Hazardous Waste	2	7	14	10	33	2
Water Supply	95	30	149	372	646	38
Total	372	152	311	859	1694	100

Note: These are annual data. It was assumed that investments would be carried out by a ten year programme, so total capital requirements would be these numbers multiplied by ten.

Total costs over a ten-year period were estimated to be:

Table 3.3. Capital costs and per capita cost estimates urban wastewater, municipal waste, industrial hazardous waste, and water supply in the Cohesion Countries[12]

Country	Total Cost (MECU)	Population (millions)	per capita Cost (ECU)
Greece	3720	10.37	359
Ireland	1520	3.56	427
Portugal	3110	9.89	315
Spain	8590	39.08	220

3.4 Results of the experience per country

The experience in the Cohesion countries seems to yield the following lessons:

First, the costs per capita for wastewater treatment show considerable variation across countries; costs in Spain and Portugal are low relative to Greece and Ireland (Table 3.2).

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[11] *Amber* (1993).

[12] *Amber* (1993).

Table 3.4 Capital costs of wastewater treatment estimates over ten years

Category	Greece	Ireland	Portugal	Spain	Total
Urban wastewater (MECU)	2400	950	1130	4580	9060
Population (million)	10.37	3.56	9.89	39.08	62.90
Costs (per capita per year)	231	267	114	117	144

Second, the higher estimates for Greece and Ireland are consistent with the numbers emerging to achieve comparable treatment in CEE countries (See Table 3.5). These estimates, developed by WRc (1993), were derived by applying coefficients for cost/metre, number of metres, etc., to the gap between existing and future capacity needed to meet EU standards.

Table 3.5. Additional costs to achieve compliance with the EU Urban Wastewater Directive[13]

Country	Cost per capita (ECU)
Hungary	319
Bulgaria	328
Romania	314
Slovakia	231

Third, in the Cohesion country analyses, there is little presentation, data or discussion of operating and maintenance costs. **This is a surprising gap in the terms of reference for these studies, which should not be repeated in the CEEC compliance cost studies**.

Capital costs are often subsidised - as in the case of the Cohesion countries where the Cohesion Fund provides up to 80-85% of capital costs - and all operating and maintenance costs must be borne by the Member State. Where the operating and maintenance costs increase sharply as a result of investment in new plant, this can pose financial stress and operational challenges.

Fourth, Cohesion country analyses do not discuss cost recovery, nor the polluter pays or precautionary principles, nor pricing to encourage innovation and efficient use of resources or of infrastructure.

There is considerable price elasticity in demand for water, and - on the part of industry in particular - for waste treatment. This means that the capacity requirements

[13] Source: WRc (1993, pp. 102-104).

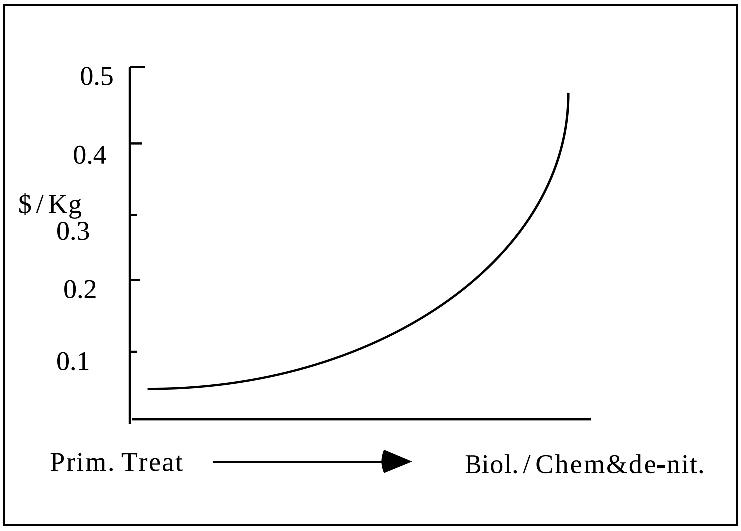
cannot be estimated independently from the pricing and cost recovery regime to be used. Since full cost recovery is a central theme in the proposed EU Framework Directive on Water, **it makes sense to incorporate a consideration of price effects in the investment estimation process**.

Fifth, the marginal costs of treatment rise sharply with increasing degree of treatment, as shown in the following table:

Table 3.6 Marginal costs of wastewater treatment ($ per Kg, BOD removal)[14]

Treatment level	Total cost	Marginal cost
Primary treatment	0.55	0.04
Chem. enhanced primary treatment	0.59	0.14
Primary precipitation plant	0.73	0.27
Prim. and biol. treatment (low load)	1.00	0.0
Biol. and chem. treatment	1.00	0.45
Biol./chem. treatment with denitration	1.45	

Schematically, the marginal cost curve is as follows:



Sixth, the determination of investment requirements to comply with EU environmental directives should not be limited to a mechanistic kind of compliance calculation, but should consider what it would take to achieve satisfactory receiving water quality. This

[14] Source: Somlyody (1995), p.46.

involves calibrating the requirements in terms of the receiving waters. It will demonstrate that it is possible to stop investment in many cases which are further to the left of the marginal cost curve if mechanistic compliance calculations are applied. The approach adopted by Somlyody (1995) reflects this philosophy, and is to be commended.

Seventh, a more fundamental examination of marginal benefits associated with the marginal costs could prove instructive.

Eighth, in the SIS studies, little or no attention is paid to the costs incurred by the private sector, especially households.

In the Irish study, the potential compliance costs of meeting BATNEEC standards under the projected implementation of the IPPC Directive are large; this gap need to be addressed in CEEC studies regarding the directive as finally adopted.

Ninth, compliance with the Habitats Directive is relatively expensive in Ireland, but as the CEECs have comparatively large natural regions compared to many EU Member States, the impact of this directive could be much lower and needs to be investigated.

3.5 Eastern Germany (The former GDR)

In 1991, ifo Institut estimated the costs of coping with the main environmental problems for eastern Germany at ECU 48 to 190 billion. (Table 3.8) These estimates cover the investment in upgrading infrastructure to regulation benchmarks and environmental cleanup plans issued by the Federal Government. In addition to bringing the new states into compliance with EU standards, they reflect the objective of the Unification Agreement to promote uniformly high standards of environmental protection in the new Länder.

The per capita investment needs, especially for water (even the minimum estimate) are much higher than the estimates for the Cohesion countries. The minimum estimate falls within the upper range of the WRc estimate for investments in EU Member States (ECU 500-1500/capita, see below, Chapter 4.4). The huge difference between the Cohesion countries and the CEECs, which is described in Chapter 4 cannot be explained at this stage, without more intensive review of the data. (ifo Institut does not explain the differences between their estimates.)

Second, the cleanup of contaminated land and other cleanup measures are important categories which were not estimated for the Cohesion countries. Cleanup of nuclear related pollution and waste can be very important, but they have been excluded here because they do not fall within the scope of this overview.

Table 3.8 Cleanup cost estimates for eastern Germany, ifo-institute, 1991 (billion ECU)

	Total (billion ECU)		per capita ECU	
Sector	**minimum**	**maximum**	**min.**	**max.**
Air	5	7	269	349
Water	25	75	1344	4032
Waste	8	19	403	995
Contaminated land	5		269	
Total	48	105+	2554	5645 +
Other cleanup (including. nuclear sites and reactors)	85		4570	
Total (including nuclear)	133	190+	7124	10215 +

In 1993, following a debate in parliament, the German Government estimated the costs of environmental investments in the new *Länder* which more or less confirm the high estimates of ifo. (Table 3.9) For air and waste, the Government's figures for medium term planning (up to 2000) are even higher than the ifo estimate. Also for water, the government estimate is high and at least confirms the ifo Institut's minimum estimate.

Table 3.9 Estimates of the cleanup cost for eastern Gernmany, 1993 (billion ECU)

	Total billion ECU		per capita ECU	
Sector	**1993-2000**	**maximum**	**1993-2000**	**maximum**
Waste	19.6		1054	
Wastewater	17.5	50	941	2688
Water supply	17		914	
Air power stations	n.a.		na	
district heating	7.5		403	
Cleanup contaminated land	3.75		202	
Total	65.35+	115.35+	3513 +	6202 +
Uranium mining sites	6.5		349	
Total (including nuclear)	71.85+	121.85+	3863 +	6551 +

4. WATER[15]

Many of the water directives date from the 1970s and represent the level of understanding of environmental management of the period. These usually set water quality standards for designated water bodies and uses, such as: shellfish, *salmonidae*, drinking water, and bathing water. A few dangerous substances were regulated under a directive which combined effluent discharge limits with best available technology (BAT) and water quality objectives.

The Community has also participated actively in the development and application of international conventions to protect its seas and international rivers.

EU water policy reached a turning point with the 1996 of the Commission strategy paper *European Community Water Policy*.[16] Developing the water policy of the *5th Environmental Action Programme*, this strategy paper sets out the Commission's proposals for legislation and other measures to achieve a sustainable water policy which would meet four objectives:

- Provides a secure, sufficient, reliable and safe supply of drinking water
- Ensure that water resources are of sufficient quality and quantity to meet other economic requirements
- Ensure that the quality and quantity of water resources and their physical environment are sufficient to protect aquatic and related habitats and waters of exceptional quality or interest
- Prevent or reduce the adverse impacts of floods and droughts.

Thus, the current 'patchwork' of narrowly-focused water directiveswill be drawn together under the umbrella of a new 'framework' directive on water resources, which will integrate the legal and other measures aimed at achieving these four objectives.[17]

4.1 EU legislation

The early water directives set mandatory water quality objectives for certain uses or types of water, and required the Member States to designate water areas within the

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[15] Prepared by Dr Anil Markandya, University of Bath, Metroeconomica Ltd.

[16] *European Community Water Policy*, Communication from the Commission to the Council and the European Parliament, COM(96) 59 final.

[17] The Commission approved the proposal for the Framework Directive on Water Resources in February 1997.

scope of the directives, meet the water quality objectives, to establish clean up programmes, monitor-exchange information and report to the Commission. directives controlling the discharge of dangerous substances to water require the Member States to establish permitting systems and incorporate emission limits into the permits of industrial activities.

Directive 80/778/EEC on drinking water[18] sets quality standards for drinking water and has been a driving force for the improvement of drinking water in the Community. Most importantly, it provided governments and water suppliers with a stable and predictable base for their investment programmes.

The 1976 Bathing Water Directive[19] has forced the Member States to protect areas used for water recreation, mainly by controlling discharges from sewage treatment plants. Specific effluent standards were set by Directive 91/271/EEC on Urban Waste Water Treatment, which established a timetable for the provision of wastewater collection systems and treatment plants, and defines the level of treatment required in different population areas and receiving bodies of water. Directive 91/676/EEC on diffuse pollution from agricultural nitrates complements these directives by requiring the Member States to monitor and control nitrate loss to surface and groundwater from agricultural activities. Like Directive 91/271/EEC, it requires stricter measures to protect sensitive waters.

Directive 80/68/EEC on groundwater[20] requires the Member States to list and control direct and indirect discharges of certain substances into groundwater through a permit system linked to monitoring and control of compliance and groundwater quality.

The framework Directive 76/464/EEC on dangerous substances discharged to surface water established a short ‘black list’ of substances which must be subject to a permitting system, and a longer ‘grey list’ for which the Member States must establish pollution reduction programmes. This directive, and the six ‘daughter’ directives adopted during the 1980s, combine the use of effluent discharge limit values and water quality standards.

4.2 Problems and key issues

The EU effluent and water quality standards have forced the Member States to make substantial investments in water treatment and supply technology over the past decade.

Some Member States are still having ‘major difficulties in satisfactorily applying’ the directives.[21] Problems have arisen in part from the very focused and partial nature of

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[18] Council Directive 80/778/EEC relating to the quality of water intended for human consumption.

[19] Directive 76/160/EEC.

[20] Council Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances.

[21] *European Community Water Policy*, p. 26.

many of the directives, as well as from the broad planning and management programmes which must be developed. An overall framework integrating the range of water protection and restoration policies and activities is still lacking. For example, the Commission has launched infraction proceedings against many Member States for non-notification of the pollution reduction programmes for List 2 substances, and the Nitrates Directive is far from being fully implemented; Member States have been late to designate vulnerable zones, to adopt codes of good agricultural practice, to establish proper surveillance programmes, and to submit reports to the Commission.

We do not yet know whether the Urban Waste Water directive and the Nitrates directive will be sufficient to control nutrient pollution in the EU, as implementation has not yet been completed.

Sometimes the language of the directives has given rise to considerable variety in implementation, as in Directive 76/160/EEC on bathing waters. The Commission has received complaints concerning drinking water quality, which often relate to a lack of technical infrastructure in the Member States. Differences in water quality monitoring methodologies have also raised problems.

The Groundwater directive does not cover the two most important sources of groundwater pollution today - diffuse pollution (from agriculture, etc.) and unsustainable levels of water abstraction.

The key issues for EU water policy in the future are to accomplish the revision and restructuring of the legislative framework to achieve integrated and sustainable water management, and to implement the individual directives so that further deterioration is avoided and sustainable water quality and supplies are guaranteed.

4.3 Studies reviewed

Ideally, one would like to have an investment and operations plan for each country's water sector in the absence of any EU legislation and with EU legislation taken into account. The difference would then represent the costs of the directives. We do not have this data for any CEE country[22]. Hence, in taking the full costs of upgrading the water sector (which is what most writers have done) and not allowing for improvements which CEE countries would make anyway, we are overestimating the costs of compliance.

Another caveat to this review is that the studies are too engineering oriented. For example, the cost estimates take little account of reducing water consumption through better pricing and water management. The present use of water in many CEE countries is excessive because of poor maintenance and virtually no pricing. As these deficiencies are corrected, the level of consumption should fall and the costs of providing water and collecting and treating wastewater should also fall. Again, we have no estimates of how big these reductions will be.

[22] In fact, only the Irish study makes some reference to this concept and attempts to measure the difference in costs.

In spite of these problems, the data below do provide an order of magnitude estimate of the total costs of upgrading water quality requirements to EU standards and are consistent with estimates from the cohesion countries. Hence they are a useful first step.

The best estimates given in Chapter 8 and at the end of this section are based on the ifo Institut study on total investment, because this is the most complete overview and covers all countries, water supply and wastewater and urgent and long term measures.

The annual costs estimate is based on the WRc study because it is the only one estimating operating - as well as investment - costs. However, operating costs are only provided for urgent measures related to wastewater.

4.3.1 Sector Case Study, WRc, Report CO 3291/2, 1993

This is a very useful study. It does not cover all aspects of the question we are addressing but the data it has appears to be sound and the analysis generally correct.

The study looks at the costs of complying with EU water legislation in the countries of the Danube Basin: Bulgaria, Hungary, Romania and Slovakia. The main problems for these countries will arise in:

- Developing adequate monitoring and enforcement systems
- Increasing the level of sewerage collection and sewerage treatment, which previously do not comply with EU directives
- Increasing the treatment of industrial discharges prior to release in the sewerage network, and
- Improving the quality of the drinking water.

The report also discusses issues of institutional reform and the use of economic instruments.

Developing adequate monitoring and enforcement systems

The present system of monitoring is budget inadequate, spot checks cannot be carried out, staff resources are overstretched and laboratory facilities overloaded. The present system collects data on too many parameters, with little analysis of the data and little further action. The report estimates the annual costs of compliance as follows:

Bulgaria:	MECU 10
Hungary:	MECU 12
Romania:	MECU 28
Slovakia:	MECU 6.

All values are in 1990 prices and are based on a per capita cost of ECU 1.16, which is calculated from the costs of the monitoring and licensing system in England and

Wales. Below, these figures are used to derive estimates of monitoring costs for all CEE countries in 1996 prices.

Increasing the level of sewerage and sewage treatment to compliance with EU directives

WRc calculates the investments required to comply with the Urban Waste Water Directive (Table 4.1):

- Provide sewerage services to all towns with population of over 5,000
- Increase treatment capacity to deal with the additional collection (in some cases this will require new facilities, in other existing facilities will have to upgraded).

Table 4.1. Additional investment costs of complying with the Urban Waste Water Directive, 1990 prices[23] (MECU)

	Bulgaria	Romania	Hungary	Slovakia
Sewerage	845	1600	602	144
Storm control	845	1600	602	144
Wastewater treatment[1]	1197	4081	2050	937
Wastewater treatment[2]	669	2259	1073	553
Total[1]	2887	7281	3254	1225
Total[2]	1759	5459	2277	841

[1]costs with nutrient removal in wastewater treatment
[2]costs without nutrient removal in wastewater treatment

Operating and annual costs

WRc also estimates total operating costs, capital costs and annual costs for the urgent investments in wastewater. This gives an idea of the relative importance of different cost components.

The major lesson from Table 4.2 relates to the importance of operating costs. Even if total investments are depreciated over 15 years with a real interest rate of 3%, additional annual operating costs make up 40% of total annual costs. These figures are extrapolated to all countries in Chapter 4.4.

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[23] These estimates have been updated to 1996 prices in Chapter 4.4.

Table 4.2 Additional annual costs of meeting the terms of the Urban Waste Water Directive (capital and operating). (ECU/capita)

	Bulgaria	Romania	Hungary	Slovakia
Total capital costs	21	20	20	15
Operating costs	15	15	15	15
Total with nutrient removal	36	35	35	30
Total without nutrient removal	34	32	32	27

These figures are very close and could provide the basis of an estimate of costs in other countries of the CEE. This is done in below, in Chapter 4.4, where the costs have been updated to 1996 prices. WRc estimated the costs to households with different income levels to investigate the affordability of the increases in prices that will be required to finance the increased provision of facilities.

Increasing the treatment of industrial discharges prior to release to the sewerage network

The analysis is divided into the food and the non-food sectors. The costs in each sector depend on how much of the present industrial capacity remains in place during and after the transition. Clearly not all plants will remain operational as many of them are outdated and unable to compete. Assuming a 50% survival rate the investment costs are given below in Table 4.3. For the food sector the assumption is made that all plants will remain in operation.

Table 4.3 Additional investment costs of improving wastewater treatment in industrial facilities (MECU)

	Bulgaria	Romania	Hungary	Slovakia
Non-food industry	330	163	200	150
Food industry	22	75	10	18

Again, these costs have been updated in Chapter 4.4.

Water supply

WRc does not estimate the costs of improving drinking water.

Timing of investments, institutional dimension and economic incentives

The report concludes with a note that these changes cannot be expected to be implemented in a short period, even if the resources were available. In East Germany, experts believe that a period of 20 years will be needed to fully meet EU requirements. This is an important observation.

On institutional reform, the report notes that many of the ingredients for successful implementation are missing in many CEE countries (integrated, consistent administrative and legal framework, openness to change, etc.). In particular, staff need to be trained in financial management and the authorities need to be come politically more independent. Salaries need to be raised to retain highly qualified staf.

On economic instruments, the report does not have much that is innovative to say. It notes that the present system of fines and charges is not working, to a small extent because of the state ownership of enterprises which do not respond to incentives, but mainly because the fines and charges are too low to have any incentive effect. In many cases even low fines are not imposed if it is throught that employment could be threatened.

4.3.2 Economic Costs and Legislation in Western and Eastern Europe, Adler et al, ifo Institut, 1994

The study looks at the costs and benefits of environmental clean-up in the CEECs. The objective is to achieve harmonisation[24] with the 'environmental standards of Western Europe', a more general goal than compliance with the EU directives. The countries covered include: Bulgaria, the Baltic States, the Czech Republic, Slovakia, Hungary, Poland, Romania and the former Yugoslavia. Not all countries, however, are covered for all the issues discussed. As in the WRc study, it recognises that harmonisation is a long term process, with a time frame of 'at least 10-20 years'. The study assumes that investment with technologies already in use in CEE countries can be made in the next ten years, and that new technologies will take 15 years. This summary focuses only on the assessment of water.

The report begins by noting that the CEE countries are well below the levels for water treatment and water source protection than their EU counterparts. Many people in these countries do not receive potable water. On average 80% of the CEEC population is connected to water supply whereas this figure for the EU is above 90%.

Because much of the wastewater is not treated, bathing waters frequently do not meet EU standards, nor do they meet internal standards, which can be as strict as the EU ones. On average only 40% of the municipal wastewater is treated, ranging from 35% in Poland to 60% for the Baltic states, and 63% is connected to a sewage system, varying from around 40% in Bulgaria to 70% in Hungary. This means that they are far behind compared to the non-cohesion EU member states - except Belgium- (connection to wastewater treatment ranging from 60% for Italy to 98% for

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[24] 'Harmonisation' is a flexible term with several closely related meanings, depending on the context and the speaker. Originally, it referred to the process of bringing standards and procedures *close together* through a binding OECD Council decision or a recommendation. It is (and probably will continue to be) popularly used as a *synonym for 'approximation'* with EU legislation, although approximation involves an element of compulsion that is lacking in the OECD. It has also become popular to refer to the entirely voluntary process of taking EU or western legislation *as a modelor guide* for the reform of legislation in the CIS or other countries as harmonisation; thus, a regional grouping of countries (e.g. Black Sea littoral states) may agree to harmonise their standards and laws.

Denmark). The required effort is however comparable with that of the cohesion countries for which connection rates range from 10% for Greece to around 50% for Spain.

Costs of various treatment and protection facilities were made by local experts and used to arrive at overall estimates in a ‘sequential fashion’, so that the lowest cost alternatives were undertaken first. There are substantial differences in costs between countries.

The estimates of water supply and treatment were made for: water supply, repair and extension of the sewage network and upgrading and extension of waste-water treatment facilities. The costs are divided into three levels: urgent measures in urban areas, low-cost medium term standard measures, and Best Available Technology (BAT) measures, which are in turn divided into biological and advanced treatment. The first category of urgent measures is based on an extension of the WRc analysis to the other CEE countries. We first discuss drinking water, then wastewater and finally timing of the investments.

The estimates for each country come from studies covering several countries. Care needs to be taken because the ifo Institut study - from which the investments estimates are taken - has made extrapolations from specific country studies in each sector (Poland for air, Hungary for water and Czech Republic for waste) to the other countries. Because these extrapolations are rather rough, figures for individual countries will be less accurate then the overall figure for the CEE region. For example, the ifo Institut’s estimated cost of industrial wastewater treatment in Poland is not confirmed by the more specific and detailed study by TME.

Water supply

Ifo Institute estimates the total cost of infrastructure investment to upgrade and extent the water supply in the CEECs at ECU 17 billion. This amount is equally divided between repair and extension. There is no discussion of the costs of higher treatment, and the point is made that better sewerage treatment will reduce drinking water treatment costs.

This total corresponds to ECU 167 per capita, ranging from less then ECU 50 for the Baltic states to more then ECU 300 for Hungary. The explanation for this extreme difference is the huge difference in km of water pipes to be installed or repaired. Their is no direct relationship to the% of population connected to water supply in 1990. Thus, CEEC costs are about twice as high as in the Cohesion countries, where estimated costs per capita ranged from ECU 84-150.

Note, that drinking water costs are included in the best estimates for investments but not for annual costs.

Table 4.4 Total investments in water supply (billion ECU)

	Repair	Extension	Total	*Cost* per capita (ECU)	Level of service* in 1990 (%)
Poland	2.65	1.77	4.41	116	91
Hungary	1.56	1.98	3.54	337	90
CR/SR	1.94	1.24	3.18	203	80
Bulgaria	1.05	1.16	2.21	246	81
Romania	0.75	3.04	3.79	162	58
Estonia	0.04	0.09	0.13	78	
Latvia	0.06	0.05	0.11	41	87
Lithuania	0.08	0.03	0.11	29	
Total	8.12	9.34	17.47	167	80

*Level of service:% of population connected to water supply in 1990

Sewerage and wastewater treatment

The total investments for sewage and wastewater treatment amount to ECU 25 billion (Tables 4.5 and 4.6). On average, 40% goes to sewerage and 58% to wastewater treatment. About 60% of total investments in wastewater treatment are attributed to municipalities, the rest to industry.

The investment figures for industry are very rough estimates. For the Baltic States, Bulgaria and Romania, these figures only include the upgrading of existing installations. On the other hand, the estimate for Poland is much higher then the much more detailed TME study.

The total cost for wastewater treatment corresponds to the so called local standard, BAT biological cleaning. (See column 4 in Table 4.6).

Table 4.5 Total investments for sewerage (MECU)

	Repair	Extension	Total	Level of service* in 1990 (%)
Poland	775	2385	3160	54
Hungary	340	835	1175	70
CR/SR	825	1135	1960	65
Bulgaria	230	1125	1355	42
Romania	450	1730	2180	50
Estonia	35	130	165	57
Latvia	40	95	135	57
Lithuania	55	175	230	57
Total	2750	7610	10360	63
%	31%	42%	100%	

*Level of service:% of population connected to sewerage in 1990

Table 4.6 Total investments for sewerage and wastewater treatment (MECU)

	Waste water treatment					
	Treated[1] 1990 (%)	Municipal	Industry	Total[2]	Total cost sewerage + treatment	Cost per capita (ECU)
Poland	35	2870	2405	5275	8435	222
Hungary	40	940	945	1885	3060	291
CR/SR	50	1095	450	1545	3505	223
Bulgaria	42	400	220	620	1975	219
Romania	47	745	1370	2115	4295	184
Estonia	60	485	205	690	855	534
Latvia	60	815	55	870	1005	372
Lithuania	60	1165	50	1215	1445	380
Total	39	8515	5700	14215	24575	235
%		35%	23%	58%	100%	

[1]% of public wastewater treated in 1990.

[2] municipal + industrial wastewater treatment.

Timing of the investments

The figures in Table 4.7 show how investment needs are related to the envisaged level of technology and to urgency. These figures include the estimates the ifo Institut made on the basis of the WRc report, but note that they do not match the figures in Table 4.1 above. This is because ifo Institut took only the minimum requirements for urgent treatment under the WRc study possibly adding some other urgent costs for drinking water.

The medium-level estimates are based on further improvements to drinking water supply and to wastewater treatment, and finally the BAT levels of investment will take these countries to complete fulfilment of current EU standards. All these costs are presented in Table 4.7 in 1990 ECU prices.

Remember that the higher estimates include the lower ones, so the costs should not be added together. Table 4.7 defines each option in terms of the most advanced technology.

Table 4.7 Costs of water supply and treatment (MECU)

Country	Urgent Measures - Low Technology	Medium Term Technology	BAT Biological Cleaning (local standard)	BAT Advanced Cleaning (EU standards)
Bulgaria	699	3010	4300	4644
Romania	3464	5677	8110	8759
Hungary	2652	5350	6600	7200
Slovakia	367	5950	6675	6900
Czech Republic	n.a.			
Poland	5700	7600	12840	14550
Baltic States	1200	1650	3500	4500
Total	14082	29237	42025	46553

In Chapter 4.4, the ifo Institut's estimates are compared with those of WRc. The important idea here is that these costs can be incurred in stages, with ECU 14 billion needed in the first stage for capital investments and eventually another ECU 32 billion needed to reach full compliance with EU standards.

If for example the goal is to achieve the full compliance with EU standards in 20 years, the annual cost (on a simple average) would be ECU 2.3 billion per year. However, if one goal is to carry out the urgent measures in the first five years, the annual requirement will be about ECU 2.8 billion. The timing of the investments is clearly important, as is the set of priorities to be fulfilled.

The third column (BAT - Biological cleaning) is considered the 'local standard', which is how ifo Institut interprets current legal requirements in these countries. So the difference between meeting the 'local' standard and the EU standard is very small - ECU 5.5 billion.

This difference is only 10% of the effort the CEECs as a whole need to make to improve water supply and wastewater treatment. For some countries this difference is much bigger, esp. the Baltic states (+ 28%)

These figures illustrate that there may be a big difference between 'additional costs' for approximation and total costs. While the additional cost may be a very misleading indicator to assess the total effort required by the CEEC, it is also clear that the total cost cannot be attributed to the approximation process alone.

4.3.3 Municipal Wastewater Treatment in Central and Eastern Europe, L. Somlyody, World Bank, 1994

This study begins by remarking that overall the water supply is 'quite good', in contrast with the other two reports cited above. Somlyody notes that the CEECs have high water consumption due to large water losses in the system.

This study provides useful estimates of the costs of improving wastewater treatment in the CEECs and is used by the ifo Institut report as providing the 'medium cost' option.

In contrast to the studies mentioned above, it states that sewerage is adequately developed but that the level of sewage treatment is poor.

As in the ifo Institut report, Somlyody stresses the need for cost-effective measures to achieve improvements in water treatment, starting with lower cost options and moving to the higher cost ones. This makes good sense. However, Somlyody does not provide national level estimates in the same way as the earlier two reports.

Some overall estimates are provided, however. Investment costs amounting to ECU 6.4 billion and annual operating costs of MECU 960 would be needed to achieve the EU standards for effluent concentrations for all sensitive regions and communities larger than 100,000 persons equivalent,. The investment figure amounts to ECU 184 per capita cost. Intermediate targets can be met at lower cost, partly by using less sophisticated technology and partly by providing less treatment (e.g. primary versus secondary or tertiary treatment). These cost estimates should be reduced by around MECU 500, which represents investments that are already in the pipeline at the time of writing (1994). Allowing for current investment programmes is an important issue which other authors have not picked up on.

Overall, Somlyody's paper is more useful in providing estimates of the different technologies and cost-effective strategies than in deriving the costs associated with meeting EU requirements (which was not its purpose). It has been used by ifo Institut to derive medium-level estimates, so has been an input in the debate on approximation.

4.3.4 Cost Assessment of Medium Term Polish Environmental Policy Goals, Jantzen and De Bruyn, TME, 1994

This study contains cost estimates for industrial plants, but no link is provided of how the goals of the Polish *Environmental Policy Plan* relate to the EU directives and how they intend to introduce those directives into Polish law. Nevertheless the following figures are of some importance:

It estimates the annual cost of reducing COD, phosphorous and its compounds for the non-food industries at MECU 71.7 more than 1991 costs. How much of this is driven by EU regulations and how much by domestic needs is not clear.

Needed investments in wastewater treatment for the non-food industrial sector in the Polish Plan are put at MECU 577. (Table 4.9)

Table 4.3 lists comparable investment costs for the same sector in Bulgaria, Romania, Hungary and Slovakia. The two sets of figures are broadly in line, allowing for the larger Polish economy and the fact that the Polish Plan may not fulfil all the requirements of the EU legislation.

However, these TME figures do not match the ifo Institut's estimates of industrial investments costs (ECU 2.5 billion). Because of different units, reference years and scope of the two studies, it is hard to compare their emissions or control costs.

Table 4.8 Annual costs reduction of COD and Phosphorous compounds, *Environmental Policy Plan* 2000, additional costs in comparison with 1991. High-growth market-based policy scenario, TME (MECU)

Sector	COD	Phosphorous compounds	Total
Paper	5.19		5.19
Refineries	4.34		4.34
Org chemical	7.99		7.99
Fertilizer	3.49	9.78	13.26
Other chemical	31.20		31.20
Iron&steel	4.42		4.42
Non-ferrous	2.04		2.04
Power	3.32		3.32
Total	61.97	9.78	71.74

Table 4.9 Investments for wastewater treatment under the Polish Environmental Policy Plan 2000, additional costs in comparison with 1991. High-growth market-based policy scenario, TME (MECU)

Sector	COD	Phosphorous compounds	Total
paper	304.05		304.05
refineries	14.96		14.96
org chemical	28.56		28.56
fertiliser	12.41	33.58	45.99
other chemical	145.69		145.69
iron & steel	17.34		17.34
non-ferrous	7.99		7.99
power	12.58		12.58
total	543.58	33.58	577.15

4.3.5 National Environmental Action Programme, Ministry of Environment, Slovakia, 1994

This report provides a cursory estimate of the costs of different water treatments in Slovakia. It is estimated that MECU 429 will be needed to deal with sewerage and treatment (MECU 358) and industrial wastewater (MECU 71). This is lower than the estimates from WRc (see Table 4.1), probably because they do not include all the expenditures proposed in the EU directives. At the same time it is remarkably close to the 'urgent measures' estimate from the ifo Institut study (MECU 367).

Table 4.10 Investments for sewerage and wastewater treatment management in Slovakia (MECU)

Environmental problem	Total	Chem	Metal	Other	Public
Sewerage & wastewater treatment	358				358
Industrial wastewater	71	22	19	28	
General water policy	1				1
Total	429	22	19	28	358

4.3.6 The Environmental Implications of EU accession, Poland Country Economic Memorandum, fraft working paper, World Bank, Feb. 1997

This draft working paper discusses a number of investment cost estimates for Poland, which are based on several sources. These are summarised in Table 4.11.

The range indicated for drinking water is comparable with the ifo study (ECU 4.1 billion). The estimate for wastewater investments in Table 4.13 corresponds to the minimum estimate by the World Bank.

Table 4.11 Water-related investments in Poland (MECU)

	Minimum	Maximum	%
Sewerage	9.35	11.05	28%
Waste water treatment	9.35	16.15	40%
Drinking water treatment	2.55	6.8	17%
Total	21.25	34	

4.3.7 EBRD wastewater treatment projects

Projects to improve wastewater treatment or sewerage offer interesting points of reference to check the estimates in the technical-economic studies. Table 4.12 lists a number of projects funded by the EBRD during recent years. It shows an enormous wide variation of costs per capita which in fact are often far below the average costs indicated by other studies.

This does not, however, mean that the technical-economic studies have overestimated wastewater treatment costs, because the projects provided to EPE by EBRD may be relatively cheap ones. Without a more detailed assessment we cannot really draw any lesson from these figures.

Table 4.12 Costs of wastewater treatment projects co-financed by EBRD (ECU per capita)

Country	Extent to which EU standards are achieved (%)	Costs (ECU/capita)	Size of project (1000 inhabitants)
Romania	70	5	358
Romania	80	3	335
Romania	80	8	335
Romania	75	15	324
Latvia	100	38	800
Romania	75	85	200
Slovenia	100	150	280
Lithuania	100	176	297
Slovenia	100	400	130

4.4 Comparison of the study results and costs

This comparison can only be a guide to the kinds of costs that will be incurred, because none of the studies is specific about the costs that would be incurred without the incentive of EU accession, and none provides a concrete guide to the phasing of the costs.

Nevertheless, Table 4.13 summarises investment costs for water supply and wastewater from all the CEE studies. Insofar as it possible, the costs are given in 1996 ECU prices. Table 4.14 summarises annual costs related to sewage and wastewater treatment.

The main findings are the following:

1. The only two studies with estimates that cover a wide range of water investments are WRc and ifo. They are not directly comparable because ifo has a much wider scope, including water supply and industry. Also the definition of the approximation scenario differs: ifo has three levels of response and WRc has only one, with a marginal consideration for delaying nutrient removal investments. Nevertheless, both have broadly comparable definitions of the full costs for wastewater treatment, and their estimates are not too different. In Table 4.13 we have taken the average of the two to derive the 'best Full Compliance Cost Estimate'.

2. The figures are less comparable for industrial wastewater treatment. The WRc and TME estimates are consistent and are relatively low compared to sewerage and municipal wastewater treatment investments. These figures are hard to extrapolate to the other CEECs within this review. Ifo's figures cover all CEEC but are only partial and seem very high compared to WRc and TMEs'.

3. Ifo Institute's estimates of short-term costs (cfr. Table 4.7, column 2) are useful guides to what investments will be essential in the next five years or so. The amount is about ECU 17.5 billion for all the CEECs. (1996 ECU)

4. The full costs of compliance for water supply, sewerage and wastewater treatment are around ECU 50 billion. This corresponds to a per capita cost in the range of ECU 330 to ECU 704. The lowest cost is for the Czech Republic and Slovakia (combined) and the highest is for the Baltic States.

5. One-third of this total investment, i.e. ECU 16 billion, is required for upgrading and extension of water pipes for water supply, not including additional treatment. However, the relative importance of water supply varies a lot between countries; from less then 10% for the Baltic states, to 33% for Poland and around 50% for the other countries. The per capita costs for water supply vary considerably. (from ECU 30-337).

6. Two-third of total water investments are related to sewerage and wastewater treatment (ECU 24.5 billion). For wastewater, the costs per capita vary less then for drinking water and range from ECU 180-380.

7. As far as timing is concerned, we can distinguish two periods. If programmes covering urgent measures are undertaken over a period of five years, the annual investment programmes total around ECU 3.5 billion. To reach full compliance over 20 years, a second 15-year period would be required with an annual investment of ECU 2.2 billion. Note, that the higher short-term costs arise because of the shorter period over which the investments have to be made.

8. When these CEEC costs estimates with the EU Cohesion country costs to achieve similar goals are compared, we find some interesting differences and some similarities. The Amber report came up with per capita investment costs for the Cohesion countries of ECU 212-318. The CEEC range of ECU 330-704 is higher, but many of these countries are starting from a much poorer base; hence the two figures are not inconsistent. On the other hand, the WRc estimated costs of ECU 500-1500 per capita over ten years in other (non-Cohesion) EU Member States is way out of line with the other estimates.

9. For wastewater, operating costs are also very important even if there are much less data available. The WRc study is the main source, providing estimates for meeting the Urban Waste Water Directive ranging from ECU 30-36 per capita and per annum. These estimates include the amortisation of the capital cost of 20 years at 3% interest, and are not seriously challenged in any other study. Somlyody comes up with an estimate of ECU 960 million for all of the CEE countries, and ECU 28 for the operational cost and about ECU 9 for the capital cost. Together these arrive at a figure of ECU 37, compared to the 30-36 given by WRc. It is interesting to note that the studies of the Cohesion countries provide no estimate of the annual costs of the different directives.

10. Finally there are the costs of monitoring and compliance. These are given for the Danube basin countries above, taken from the WRc report. The estimates are very similar in per capita terms (ECU 1.16 per annum) and therefore estimates can be prepared for the other CEE countries

11. Information is lacking on operating and annual costs for water supply.

Tables 4.13 and 4.14, below, summarise the compliance costs in the sector (both capital and annual) as best as can be done from existing data. The many gaps to be filled are pointed out in the conclusions, but the figures do have some coherence which can help us to determine at least the ‘orders of magnitude’ of the costs to the CEECs.

The following conclusions can be drawn from Tables 4.13 and 4.14.

1. Total investment costs in the short-term will be around ECU 3.5 billion a year for the next five years. Total short-term investment costs will be around ECU 17.5 billion.

2. In the longer term, full compliance is assumed to be achieved over 20 years with the total costs of around ECU 50 billion. This includes total short-term investment costs (ECU 17.5 billion), and comes to about ECU 500 per capita.

3. The annual costs of the municipal wastewater treatment improvements are ECU 3.2-3.7 billion, which includes operating costs, monitoring costs and amortisation of capital at 3% over 15 years. Individual country costs are at around ECU 30 per capita.

4.5 Conclusions

The data available do not precisely answer the question we would like to have answered, namely, by what amount will the costs of providing water and collecting and treating wastewater increase as a result of meeting the requirements in the EU water directives. This would require comparison of a series of national investment and operation plans with and without the EU directives, which we do not have. In fact, we do not know how much these countries would have to upgrade their water services in the absence of of the accession obligations.

The ifo Institut figures (Table 4.6) indicate that the additional costs of compliance with EU standards compared to local standards will be relatively low. However, the main conclusion of this review is that the CEECs are facing huge investments in both water supply and wastewater management.

The estimates provided in these conclusions are based on the assumption that all investments in water improvement are attributable to compliance with the EU directives. The figures were checked for consistency with the costs that the Cohesion countries faced in meeting the same legislation and, although the figures are higher for the CEE region, they are broadly consistent.

One issue that has a great influence on the annual financial cost of meeting the directives is the time period over which the countries must attain full compliance. It is assumed that 20 years will be needed, given the experience of East Germany (WRc report and others).

One factor affecting the eventual real costs of meeting these directives (which was not taken into account in the studies reviewed) is that some results are not determined by engineering considerations alone. Loss of water and use of water is a function of economic incentives, but none of the studies allowed for any improvement through better water management. High water consumption in the CEECs has been noted. This is partly the result of poor maintenance in the supply system but equipment and consumption issues can only be addressed by providing better incentives for water conservation through some form of pricing.

Finally, it has not been possible to look at the affordability of investment programmes in the countries concerned. This will depend on public funds and subsidies, and on how much protection is offered to low income households. These issues still need to be examined.

Table 4.13 Summary of best estimates for investment costs for water supply and wastewater treatment (million/billion ECU in 1996 prices)

	Total investment costs		Investment/capita	of which			Annual investment requirement	
	short term (billion ECU)	full compliance (billion ECU)	(ECU/cap.)	water supply (%)	sewage (%)	wastewater treatment (%)	5 year short term[2] (MECU)	next 15 year long term [3] (MECU)
Poland	7.09	18.10	476	25%	18%	57%	1418	734
Hungary	3.30	6.63	632	42%	14%	44%	660	222
Czech Rep.	0.29	3.26	317	36%	22%	42%	58	198
Slovak Rep.	0.17	1.89	351	36%	22%	42%	34	115
Bulgaria	0.87	4.90	545	36%	24%	40%	174	269
Romania	4.31	10.13	435	35%	20%	45%	862	388
Estonia	0.40	1.50	939	9%	12%	80%	80	73
Latvia	0.46	1.71	633	7%	9%	84%	91	84
Lithuania	0.64	2.38	628	5%	10%	85%	127	117
Total	17.52	50.52	483	31%	18%	51%	3504	2200

[1] Column two (full cost compliance/inhabitants).

[2] Annual investment requirement = short term investments needs (column 1) spread over 5 years.

[3] Full compliance investment (column two) minus short term investment (column 1) spread over 15 years, to reach full compliance over 20 years.

Table 4.14 Summary of best estimate for annual costs for sewerage and municipal wastewater treatment (MECU in 1996 prices)

	Investment		Annual costs				
	Total capital investment[1]		Annual capital costs[2]		operating costs	monitoring costs	total annual costs
	without nutrient removal	nutrient removal	without nutrient removal	nutrient removal			
Poland	10072	1918	638	122	570	55	1385
Hungary	2733	521	185	25	158	15	383
Czech Rep.	3226	807	124	31	155	15	324
Slovak Rep.	980	245	65	16	81	7	169
Bulgaria	2541	346	166	23	135	12	336
Romania	6116	1165	391	75	350	35	851
Estonia	420	80	27	5	24	3	59
Latvia	709	135	45	9	41	3	98
Lithuania	997	190	64	12	57	5	138
Total	27794	5407	1705	317	1569	150	3742
% of total annual cost			46%	8%	42%	4%	100%

[1] Total capital investments: only including sewerage and wastewater treatment for nutrient removal.

[2] Total investments for sewerage and wastewater treatment, depreciated over 15 years with 3% real interest rate.

5. AIR[25]

Air quality has been protected by national legislation since more than a century, with the result that national institutions and regulatory systems in many Member States are well-developed and have longstanding practices and procedures. This made it difficult for the European Community to become active in the sector, and pre-1984 directives were often generated by particular urgent health problems (e.g. the impact of lead on children, NO_x) or wider agreements of the UN/ECE (control of emissions from motor vehicles), OECD or UNEP (ozone-depleting substances). Later directives still tended to focus on obvious and serious air pollution problems to health or the environment (acidification, ozone layer depletion).

The focus of EU air legislation during the past 15 years has been on controlling pollutants in three areas:

- Ozone-depleting substances
- Emissions from motor vehicles and related industry (petrol stations)
- Strengthening and implementation of the UN/ECE convention on long-range transboundary air pollution.

The 1996 directive described below brings the EU's air activities together in a common framework for controlling the most serious air polluting substances and ensuring that the Commission and the Member States monitor and assess air quality in a consistent way.

5.1 EU legislation

Directive 84/360/EEC on the combating of air pollution from industrial plants was the first 'framework' directive in the air sector - it requires the Member States to set up a permitting system for air emissions from certain industrial activities, establishes a procedure for the Council to adopt emission limits, and requires the Member States to take steps to identify and improve air quality in particularly polluted areas or those which need special protection. It's provisions also cover monitoring, exchange of information, public information, and gradual tightening of controls on industrial plants to bring the level of protection up from BATNEEC to BAT. This directive will be replaced by the Integrated Pollution Prevention and Control Directive (see Chapter 6.5).

[25] This chapter was prepared by Jochem Jantzen, Institute for applied for Applied Environmental Economics, The Hague, NL, currently on assignment in Slovak Republic.

The EU has set ambient air quality limit values for only five pollutants: SO_2 and 'smoke' (suspended particulates) (80/779), NO_2 (85/223), lead (82/884), and ground-level zone (O_3, 92/72), but they do not draw an explicit relationship between these environmental quality standards and the emission limits imposed under other directives. Nor is the ozone standard binding.

Directive 88/609/EEC on the limitation of emissions of certain pollutants into the air from large combustion plants establishes emission limit values and sets interim and final national targets for the reduction of SO_2 and NO_x from these facilities ranging from allowed increases in Greece, Spain and Portugal to substantial reductions in the other Member States. The overall target of of 45% SO_2 reduction by 1998 had already been met by almost all Member States in 1995.

The new framework Directive 96/62/EC on ambient air quality assessment and management provides the framework for the European Union's strategy to control monitor and control air pollution. The Commission will propose binding limit values for 14 pollutants during the period 1997-99. These include the pollutants already regulated, and other key organic compounds and metals. The directive's other provisions aim to ensure that national monitoring is comprehensive and comparable, that ambient air quality is assessed in a comparable way, to inform the public and to maintain or improve ambient air quality through plans and programmes. The Member States must implement the directive by mid-March, 1998.

5.2 Problems and key issues

A number of institutional and procedural problems in air quality protection were identified and should be dealt with by the new ambient air quality assessment and management directive. These include the integration of emission limit values and ambient air quality, the harmonisation of monitoring and assessment strategies and methodologies, improvement in communication and information exchange, improvement in the speed of compliance with limit values, strengthening of long term air quality objectives. In particular, the harmonisation of information should make it much easier for the Commission to identify and evaluate air quality problems and propose effective countermeasures.

There are large differences among the national air pollution policies of the Member States. Those which have achieved the most have used a combination of product standards (sulphur content of fuels, motor vehicle fuels and engines), emission limits, and ambient air quality limits. In general, there are many more emission limits imposed than ambient air quality standards, which is consistent with some countries' policy of prevention through emissions reduction based on best available technology. Member States which had relied more on ambient air quality standards in the past are introducing more direct controls on emissions, an approach which is consistent with the precautionary principle of the EU Treaty.[26]

[26] '(Community policy) … shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source … .' Article 130r(2).

Directive 88/609/EEC has been the focus of attention in the air sector when approximation issues are raised, because it imposes the most substantial costs on a single industrial sector - energy production. This directive has been the EU's main tool for implementing the UN/ECE convention on long-range transboundary air pollution. However, substantial differences between the limits of some Member States reflect the need for some southern European countries to catch up with the economic development of their northern neighbours.

The costs of meeting a particular emission limits or ambient air quality limit values are usually borne by a narrowly defined group of industrial enterprises and the consumers of these enterprises. Often they can be identified by name in each country; hence it should be possible to identify the range of options for meeting the limit values and agree an appropriate emissions reduction strategy.

Still, the 1996 Progress Report on the implementation of the 5EAP described the NO_x situation as 'very worrying' and noted that critical loads for SO_2 are still exceeded in a large number of regions in the EU.[27] The Commission is preparing a new strategy on acidification which will ask the Member States to reduce their emissions of acidifying substances still further.

On average, air pollution abatement accounts for around 15% of total EU environmental expenditure, ranging from 10% in France to 25% in Germany. Almost all these costs are incurred in the private sector, especially energy sector and primary industries (iron and steel, oil, chemicals) However, the costs of controlling air pollution from transport is increasing.

5.3 Studies reviewed

Five studies have been identified in which some data concerning compliance costs for air-pollution are summarised for some CEECs; one of these has been prepared by a national government. They are:

1. IIASA: *Cost-Effective Control of Acidification and Ground-Level Ozone* (second interim report) (Amann et al, 1996). Commissioned by DG XI, it covers all European countries and reviews scenarios for compliance with ambient levels, it uses the RAINS-model. The interim results analysed results cover larger stationary and mobile sources of SO_2 and NO_x. There is no direct link with compliance costs for approximation, though national policies are taken on board.

2. ifo Institut: *Environmental Standards and Legislation in Western and Eastern Europe Towards Harmonisation: the Economic Costs and Benefits of Harmonisation*, (Adler et al, 1994), DG XI and the EBRD is linked directly with approximation, and gives (rough) estimates for the investments needed to comply with European guidelines. It covers most CEECs.

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[27] *Progress Report from the Commission on the Implementation of the European Community Programme of Policy and Action in relation to the environment and sustainable development 'Towards Sustainability*', COM(95) 624 final, p. 56.

3. TME: *Cost-assessment of medium term Polish Environmental Policy Goals*, (Jantzen et al, 1994). It was carried out for the Dutch and Polish Ministries of Environment and aims at estimating compliance costs/investments with Polish legislation and policy objectives. It uses the MOSES model and covers the eight main polluting sectors of the Polish economy.

4. TME: *Urban Transport and Air-pollution: Trends and Policy Options, Case studies for Moscow, Budapest and Warsaw* (draft final report) (Jantzen, 1995); for the World Bank, and aimed at finding cost-effective solutions to this problem. The study is limited to Moscow, Budapest and Warsaw. It used a simulation model developed for the purpose of the study and covers six pollutants (NO_x, SO_2 , VOC, particles, CO, Pb). A link is made with approximation to EU standards for vehicles.

5. Ministry of the Environment of the Slovak Republic: *National Environmental Action Programme* (1996) provides a list of projects needed to fulfil national objectives of environmental policy which has a certain link to approximation, though it is not primarily aimed at identifying costs.

6. Ministry of Waters, Forest and Environmental Protection, *National Environmental Action Programme of Romania*. This plan makes an assessment of the investment needs for the execution of environmental policy. It assumes that that environmental investments count for about 0.6% of GDP and lists more than 100 concrete projects.

7. The results of these studies are also compared to the figures discussed in a working draft of a World Bank document on compliance costs for Poland (Country Economic Memorandum, *The Environmental Implications of EU accession*, Draft working paper, 1997)

The studies all have different starting points, scope, methodology, data input and assumptions, and present results in a different way, it is difficult to select the study that gives the best information on compliance costs for air pollution. Nevertheless, for the purposes of this study, the IIASA study offers the best reference point because:

- It has the broadest sectoral coverage (power generation, industry and transport)
- It covers all the CEECs
- Although less detailed, it offers the most complete set of costs of environmental measures.

On the other hand, because the objective of the study is to explore the impacts of cost-effective measures to reduce air pollution, the selection of the 'approximation scenario' was difficult. Second, results are only reported as total annual costs for the year 2010 by each country. Related investment costs, or costs for each sector, can also be generated by the RAINS model but are not available at this stage. Therefore, we have used the ifo Institut's figures as the 'best estimate'.

5.3.1 Cost-Effective Control of Acidification and Ground-Level Ozone, (second interim report), Amann et al, IIASA, 1997

The study covers emissions of SO_2 and NO_x for as well stationary as mobile sources. It also covers NH_3 emissions from agriculture. It reviews six scenarios, each with different assumptions concerning control of emissions. The one that probably comes closest to approximation is termed the 'Reference scenario'. This combines or uses two other scenarios 'Current Reduction Plans' and 'Current Legislation'. For each country, the scenario which give the largest emission-reduction is used.

It defines an approximation scenario which includes total annual costs (depreciation, interest and operational costs) calculated for all European countries and depending on:

- Costs of technical emission control options
- Scenario assumptions concerning control of emissions.

There is an overview of types of technologies assumed to be used in the Member States for compliance. Unfortunately this is not repeated for the CEECs, so it is not possible to determine the extent to which approximation needs are taken on board (mainly large combustion plants and vehicle emission standards). For mobile sources, the results for NO_x show that not all CEECs have adapted legislation to EU standards. So costs for approximation will be underestimated for mobile sources in some countries.

In the RAINS model, emission control is optimised spatially. Ambient standards or 'critical loads' are defined for each 'grid' on the map of Europe. However, in the Reference Scenario such optimisation can hardly play a role since:

- In the 'Current Legislation' scenario, emission standards are the control mechanism
- In the 'Current Reduction Plan' scenario, emission reduction depends on national emission ceilings (which only allows larger countries for some 'emission trading' between sources within a country).

The cost data used in the RAINS model are averages for three main types of installations. For coal-fired power plants (retrofit and new) and industrial boilers (SO_2) three add-on technologies are mentioned:

- Limestone injection (ECU 30/kWh; ECU 22/kWh; ECU 35/kWh)
- Wet flue gas desulphurisation (FGD) (ECU 69/kWh; ECU 49/kWh; ECU 72/kWh)
- Regenerative FGD ((ECU 165/kWh; ECU 119/kWh; ECU 203/kWh).

No attention is paid to scale, costs are averages. The only cost difference is between new and retrofitted power plants.

Four types of low sulphur fuels are considered:

- Hard coal and coke 0.6% S (ECU 397/tSO_2)
- Heavy fuel oil, 0.6% S (ECU 905/t SO_2)
- Gas oil, 0.2% S (ECU 1444/t SO_2)
- Gas oil, 0.05% S (ECU 4333/t SO_2).

For industrial process emissions, three stages (respectively 50, 70 and 80% SO_2-reduction) are considered (respectively ECU 305, 407 and 513/t SO_2).

For NO_x, a distinction is also made between new and retrofit power plants and for industrial boilers. Basically, four technologies are assumed for four types of fuel (brown coal, hard coal, heavy fuel oil and gas):

- Combustion modification and primary measures (CM) (retrofit power plants and industrial boilers, domestic and services) (ECU 3.9-6.8; 5.0-5.7 and 5.6-16.3 per kWh)
- CM and selective catalytic reduction (SCR) (retrofit power plants and industrial boilers) (ECU 19.6-24.8; 17.4-21.9/kWh)
- CM and non-catalytic reduction (industrial boilers only) (ECU 9.1-11/kWh)
- SCR (new power plants, CM is default) (ECU 8.8-11.8/kWh).

NO_x process emissions are analysed in the same way as $SO_{2\ \text{emissions;}}$ three stages (in this case with 40, 60 and 80% reduction) are assumed to be applicable (ECU 1-5/kg NO_x).

The RAINS simulations also consider options to control vehicle related emissions of NO_x:

- For gasoline passenger cars and 'low duty vehicles', three types of catalysts (1992, 1996 and 2000 standards), are considered (at ECU 250, 300 and 715 per vehicle)
- The same applies for diesel passenger cars and HGVs (at ECU 150, 275 and 780 per vehicle)
- For 'heavy duty vehicles', there are also three options (EURO I, II and III) are available (ECU 600, 1800 and 4047 per vehicle).

Costs are either expressed as investment per MWh plus a percentage for operation and maintenance, or as costs per ton reduced emissions. Costs are annualised over the lifetime considering the technical lifetime of the equipment and interest (4%).

These cost estimates are claimed to be upper level estimates. No consideration is given to the possibility of changing fuels (other than exogenous input in energy balances).

The interim results of the output of the RAINS simulations are expressed as annualised costs for 2010. Investments must also be available but are not presented in the study. Ideally, the estimates for 2010 should be reduced by the amount of current expenditure to give an estimate of the costs of approximation. Since no cost estimates are given for 1990 or any other start year for approximation, this is impossible. On the other hand, it may be assumed that the measures to reduce SO_2- and NO_x emissions in 1990 were of minor importance in CEECs.

Table 5.1 gives an overview of the outcomes of the Reference scenario, being the best estimate for costs of approximation concerning SO_2 and NO_x. Unfortunately, it is impossible to separate estimates for stationary and mobile sources. Nor is it not possible to separate out the costs for the different economic sectors (industry, power)

Table 5.1 Annual compliance costs estimation for CEEC, SO_2 and NO_x, stationary sources and vehicles, (IIASA for 2010) (MECU/year)

Country	SO_2	NO_x	Total
Bulgaria	155	4	159
Croatia	62	94	156
Czech Rep.	423	318	741
Estonia	0	0	0
Hungary	187	269	456
Latvia	0	19	19
Lithuania	0	0	0
Poland	875	682	1557
Romania	198	0	198
Slovakia	120	185	305
Slovenia	57	69	126
Total	2077	1640	3717
%	56%	44%	

In conclusion, a good understanding of these figures requires more detailed information by economic sector, and environmental theme as well as a split between investment costs and annual costs. This would allow a better comparison with other studies.

The costs are attributed about half to SO_2 and half to NO_x. Other pollutants have not been taken into account. Cost to limit emissions of particulates may be very important: they contribute to about half of the total costs in the TME study and even more in the Word Bank work on Poland, for example. On the other hand, SO_2 and NOx account for 94% of the total investment costs in the ifo Institut-study, does not consider particulates to make an important contribution to overall costs. In the Slovak NEAP, 85% of the costs are related to NO_x and SO_2. This also considered VOC, toxic substances and CFCs, which account for about 10% of total costs.

On average, these annual costs correspond to ECU 34 per capita (Table 5.2), ranging from nine in Romania to 72 in the Czech Republic. This comes close to the average figure for current expenditure on air pollution for the EU-15 (OECD estimates), where the range given is from a negligible amount in Spain and Portugal to ECU 40-60 in the Netherlands, Finland, Germany UK and France to 100 for Austria. The estimates for Slovakia, Hungary, Poland, and Slovenia fall within the same range as those of the northern EU countries. However, without detailed analysis, it is hard to judge whether the two data sets are accidentally within the same range or whether they are really consistent. Expressed as a percentage of GDP, these costs are much higher for the CEECs at 1.4% than for the EU at 0.2%.

There is off course a large variation on these costs between different CEE countries; both on a per capita basis (0-63 ECU/capita) as in terms of% of GDP (0-2.4% of GDP). These differences could not be explained within the context of this review because the study itself does not provide enough information to understand all the policy measures and emission reductions considered.

Table 5.2 Annual compliance cost estimates for CEEC for SO_2 and NO_x, stationary sources and vehicles (MECU/year)

Country	Total costs, (MECU 2010)	Cost per capita (ECU/capita/year)	Cost% of 1994 GDP
Baltic	19	3	0
Bulgaria	159	19	1.53%
Croatia	156	33	1.09%
Czech Rep.	741	72	2.02%
Estonia	0	0	0.00%
Hungary	456	44	1.08%
Latvia	19	8	0.32%
Lithuania	0	0	0.00%
Poland	1557	40	1.65%
Romania	198	9	0.65%
Slovakia	305	58	2.42%
Slovenia	126	63	0.88%
Total	3717	34	1.37%

For the Reference scenario, IIASA estimates the EU-15 costs to be up to ECU 40 billion a year in 2010. This figures is 4 to 5 times higher than the current expenditure of 10 billion estimated by OECD. Without more detailed analysis this difference cannot be explained. It may indicate that for a number of EU countries a lot of expensive expenditure is scheduled for the near future. The above-mentioned 40 billion ECU correspond to around ECU 100 per capita, which is close to the air pollution control costs reported for Austria.

There still appears to be a significant difference between technologies used in the EU-15 and the CEECs. IIASA also investigated a scenario called ‘full implementation of current control technologies’, which includes a ‘realistic’ assessment of ‘maximum technically feasible reductions where costs for the CEECs increase more than four times up to ECU 16 billion/year, or almost ECU 200 per capita. In this scenario, the NO_x emission control costs are estimated to be much higher. However, even under this scenario, costs for the EU-15 would increase by only 75%.

The study estimates that with the current policies and plans, emissions of SO_2 and NO_x will decline by 58% and 20% in the CEECs, and by 66% and 48% in the EU-15. Although this will significantly improve air quality in Europe and help ecosystem protection, further reductions are required to ensure critical loads are respected.

5.3.2 Economic Costs and Legislation in Western and Eastern Europe Towards Harmonisation, Adler et al, ifo Institut, 1994

The cost-estimates in this study are not the result of model simulations as is the case in the IIASA study, but the result of estimates for one country and extrapolations to other countries.

In the field of air-protection, investment estimates for the power sector only are available. The study covers SO_2, NO_x and particulates. Data on investment costs are derived from a 'inquiry of experts from the German Energy Suppliers Association' which are based on case studies and adapted to CEECs circumstances.

For each of the countries reviewed (Poland, Hungary, Czech Republic, Slovakia, Romania, Slovenia and Croatia) estimates were made of the capacity of new equipment, equipment in operation (high level standard, EU level and mean level standard). In addition, a split was made between types of fuel (coal and oil only; natural gas is implicitly assumed to be clean, because no estimates for NOx are made).

By multiplying the relevant number of MWs by unit investment costs, ifo Institut ends up at an estimate for each country.

A comparison of the cost data on individual measures with those used by IIASA show some striking differences:

- for new FGD-installations ifo Institut estimates the costs per kW at 210 DM (ECU 105), whereas IIASA estimates the costs at ECU 49
- for retrofit FGD the difference is even larger: ifo Institut-estimates the costs at DM 590 (ECU 295) per kW, IIASA at ECU 69
- for deNOx (SCR) the same goes: ifo Institut-estimates are high at DM 90 per kW (ECU 45), IIASA at maximal ECU 25.

A possible explanation for the difference is that IIASA explicitly assumed the thermal capacity of power plants, whereas ifo Institut only refers to MWs without further explanation (although it suggests that electrical capacity is meant, since the heading of Table 23 mentions a '800 MW-unit', which is a typical capacity for German power plants, using as reference the electrical capacity). However, this does not explain the large difference in assumptions on retrofitting costs (IIASA additional 50%, ifo Institut almost 200%).

Table 5.3 Compliance costs of approximation, selected CEEC, total needed investments in the Power-sector, 2010, according to ifo Institut (MECU)

Country	SO_2	NOx	particulates	total
Baltic	n.a.	n.a.	n.a.	8446
Bulgaria	n.a.	n.a.	n.a.	5054
Croatia	536	117	15	668
Czech/Slovak R	7512	495	240	8247
Hungary	2198	449	82	2729
Poland	10736	2157	979	13872
Romania	7303	1556	286	9144
Slovenia	546	112	36	694
F.Yugoslavia	n.a	n.a	n.a	4412
Total	28830	4886	1637	53267
%	82%	14%	5%	

(Note: figures are recalculated due to errors in the original ifo Institut document, and have been converged to ECU)

It has to be noted that these estimates for investment costs - although they only cover the power sector - are much larger than the estimates by TME for Poland or in the Slovak NEAP. One reason is that these figures asume a high economic growth and energy demand (see below for more detailed analysis). On the other hand, the relative share for particulates is lower than in other studies.

5.3.3 Cost Assessment of Medium Term Polish Environmental Policy Goals, Jantzen and De Bruyn, TME, 1994

This is a study on the costs of the implementation of the Polish Environmental Action Programme. Estimates were made for the SO_2, NOx and particulates, as well as for water pollution (COD, P, N) and waste management (Hazardous waste, Industrial Waste and Domestic Waste).

The study covers eight industrial sectors: paper, refineries, chemical industry (organic, fertiliser, other), iron and steel, non ferrous metals and the power sector.

The study used the MOSES modelling framework which enables simulations of regulatory as well as market-based policies (mainly emission charges). Large sources are modelled separately whilst comparable medium and smaller sources are aggregated. For each of the sources, various emission reduction technologies (in order of emission reduction potential) are selected from a standardised database, allowing the construction of marginal abatement cost functions for sources, sectors, for all sources. Costs and investments are calculated by multiplying (marginal) unit costs expressed in costs per kg reduction with targeted emission reductions.

Six scenarios were simulated, for three types of policies: ‘current (1991) standards’, ‘policy objectives (acid rain protocol) with more stringent regulation/standards’ and ‘policy objectives with application of economic tools (charges)’ and two types of economic developments (‘low’ and ‘high’). The time horizon of the study was 2000.

Of the six scenarios probably the scenario ‘market based incentives’ and ‘high’ growth come closest to ‘approximation’.

The modelling databases includes many technologies described in terms of by scale, operation time, fuel and type of energy conversion. Cost and other data are estimated on bases of literature (mainly Dutch). Some typical unit-cost figures are (NL£/kg):

- SO_2: power retrofit 1.00-1.80 (85%); 2.50-6.00 (85-95%); power new respectively, 0.90-1.50 and 2.10-4.50
- SO_2: industry (limestone washing/fluidised bed): 1.10-1.70
- SO_2 process: Degussa: 3.40-12.20; limestone: 10.00-25.00; lye stripping: 3.00-9.00
- NO_x: fireplace adjustment: 0.40-3.20 (gas)/0.40-3.80 (coal)
- Low-NO_x burner: industry 0.80-4.20; small boilers 6.60-13.30; gas turbines:0.80-2.50
- Steam-injection gas turbines: 2.80-20.00
- NO_x-OUT (ureum): 0.70-2.50
- SCR: 7.00-55.00 (gas); 17.00-140.00 (coal)
- Flue Gas Recirculation (NO_x): 1.70-13.00 (industry); 25.00-55.00 (small boilers)
- gas cyclone (particulates): 0.04-0.12 (coal); 0.05-0.15 (brown coal)
- 2-step electro filter: 0.00-0.46 (coal); 0.00-0.57 (brown coal)
- 3-step electro or cloth/fabric filter: 0.57-5.70 (coal); 0.64-10.00 (brown coal).

Note that some unit costs are marginal to others (2-step electro filter to gas-cyclone; SCR to low NO_x burner).

The unit costs in the MOSES databases are difficult to compare with the earlier studies of ifo Institut and IIASA, since they are defined in currency units per kg for controlled emissions, whereas IIASA and ifo Institut mainly use unit (investment) costs per capacity (MW).

The results of this scenario for the six sectors are presented in Tables 5.4 and 5.5.

Table 5.4 Annual costs for the Polish Environmental Policy Plan, 2000, additional costs in comparison with 1991. 'High-growth market-based policy' scenario (MECU)

Sector	SO_2	NOx	Particles	Total
Paper	5.78	0.94	10.63	17.34
Refineries	24.65	5.10	0.85	30.60
Org chemical	17.77	1.70	12.07	31.54
Fertiliser	6.55	0.34	5.36	12.24
Other chemical	43.35	3.15	65.28	111.78
Iron and steel	125.89	4.08	35.28	165.24
Non-non-ferrous metals	33.83	0.34	9.61	43.78
Power	263.25	95.63	349.44	708.31
Total	521.05	111.27	488.50	1120.81

Table 5.5 Investments for the Polish Environmental Policy Plan, 2000, additional investments needed in comparison with 1991-stock, 'High growth-market based policy'-scenario, according to TME (MECU)

Sector	SO_2	NO_x	Particles	Total
Paper	11.14	5.36	32.64	49.13
Refineries	15.30	19.47	2.98	37.74
Org chemical	11.82	8.33	41.23	61.37
Fertiliser	12.92	1.79	16.07	30.77
Other chemical	35.62	14.20	233.33	283.14
Iron and steel	108.97	19.30	89.08	217.35
Non-non-ferrous metals	67.41	2.04	29.67	99.11
Power	553.01	561.09	1179.72	2293.81
Total	816.17	631.55	1624.69	3072.41

The assumptions about economic development have a major influence on the outcomes. In the case of the 'low growth' scenario, costs for SO_2 would have been 35% lower, investments 44%, costs and investments for NO_x and particulates would be about 20% lower.

5.3.4 National Environmental Action Programme, Ministry of Environment, Slovakia, 1994

This NEAP includes a list of over one-thousand measures to be taken in the (near) future. A short description is given of each measure (environmental problem, type of measure, investor) and an estimate of the investment costs. It covers air, water (including drinking water) waste, and numerous other fields.

It is stated that the list is not complete, because some institutions or enterprises have not submitted data. Although it is clear that the submitted data were not checked, but it may be assumed that in many cases the submitted data are based on ‘plans on the shelf’ (given the rate of exactness of figures).

Though no direct link with approximation is described, it is stated in the introduction that the Slovak Environmental Policy aims at ‘compliance with the procedures ….in the European Union’

A summary of the investments for air protection is given on the following page.

Table 5.6 Investments for air protection in Slovakia (MECU)

Environmental problem	Total	%	Paper	Oil ind.	Chem	Metal	Other	Gas & Power	Public
particles	26	6%	4		2	16	3	1	
SO_2	326	73%	2	184		32		108	
NO_x	43	10%	1	13	2	1	2	24	
VOC	17	4%	2	3	3	6	3		
toxic substances	23	5%		12	2	7	1		1
CFC	7	2%			3	4	1		
general air policy	2	0%							2
Subtotal environment	444	100%	9	212	12	66	10	133	3
% of sector in total		100	2	48	3	15	2	30	1
Non-environmental, but related investments									
gasification,etc.	648		1		8	5	35	598	
transport	22								22
Total environ. +	1114		10	212	20	70	46	732	25

As can be seen, more than half of the investments are related to 'energy-policy' (shift from brown coal to gas). It is questionable whether such investments (mainly in gas infrastructure) should be regarded as 'compliance with approximation' or even 'environmental'. The same applies to investments for transport which relate to investments for trolley-bus infrastructure.

If these are not taken into account, then overall environmental costs are clearly dominated by SO_2 in the oil industry, and the gas and power sector. Costs in the oil industry and power sector account for 78% of the total costs.

5.3.5 Urban Transport and Air-pollution: Trends and Policy Options, Case studies for Moscow, Budapest and Warsaw, (draft final report) World Bank, 1995

This is the only study in which costs of compliance with environmental regulations for motor vehicles is investigated as a separate issue (in IIASA, these costs cannot be separated).

The scope of the study is limited, however: the main traffic air-pollutants (NO_x, SO_2, particles, lead, VOC and CO) are investigated in three large cities, Moscow, Warsaw and Budapest. The aim is not to show compliance costs, but to definer options to reduce compliance costs without harming environment. The scenarios simulated in the study relate to a certain extent to EU-standards (3 way catalysts, cleaner fuels).

The model used is based on the COPERT model, used in the EU to estimate emissions and costs of emission reduction. It estimates of the vehicle fleet up to 2010, emission-factors, estimates of annual distance travelled per vehicle and cost factors for various policy options. The options evaluated in the model are a reference scenario (compliance with technical standards of EU) and traffic management, inspection and maintenance, fuel shift, improved fuels, technical devices efficient freight, and public transport scenarios. For each of the options cost factors are incorporated and effects on emissions.

The cost factors that relate to EU legislation are:

- regulated catalysts (ECU 714/vehicle); particle filters (ECU 9,500/truck); adjustment LPG installation (ECU 238/vehicle)
- low-sulphur diesel (up to 0.2%S: ECU 657/t SO_2; up to 0.05%S: ECU 890/t SO_2).
- unleaded petrol (ECU 79/kg Pb).

Traffic in the cities is assumed to grow by 60-70% in the period 1995-2010. This assumes a passenger car-fleet of 840,000 in Budapest, of 710,000 in Warsaw.

A summary of the results of the study is given in Table 5.7 for Budapest and Warsaw.

Table 5.7 Costs of emission reduction in urban traffic, 2010 (MECU/year)

Type of measure	Budapest		Warsaw	
	Minimal	**Maximal**	**Minimal**	**Maximal**
control devices, fixed costs	59.5	103.6	49.5	108.5
control devices, variable costs	16.8	19.7	10.0	13.0
unleaded gasoline	15.2	15.2	15.7	15.7
low sulphur diesel	2.1	3.0	3.0	4.9
Total	93.6	141.5	78.2	142.7

5.3.6 Poland Country Economic Memorandum, The Environmental Implications of EU accession (draft), World Bank, 1997

In this working draft, a number of results for Poland are discussed, based on several sources including a study by the Polish Academy of Sciences. Table 5.8 summarises the main investment costs as identified in this paper.

Table 5.8 Environmental investments related to air pollution for Poland (billion ECU)

	min. estimate	max. estimate
particulates	5.1	6.8
SO_2-power generation[1]	1.7	2.5
SO_2-power generation[2]	30	3.5
Total	70	10.3

[1] Polish government
[2] Academy of Sciences

Total investment would amount to ECU 7-10.3 billion, of which a largest part would be due to particulates. The figures for SO_2 are somewhat larger than those from the TME study but are significantly lower then the estimate from ifo Institut. For particulates, on the contrary, the World Bank estimates are much higher then the TME study and the ifo Institut study.

5.3.7 National Environmental Action Programme of Romania, Ministry of Waters, Forests and Environmental Protection, 1995

As in case of Slovakia, the Romanian Ministry of Waters, Forests and Environmental Protection has made an assessment of the investment needs for the execution of environmental policy.

The Plan makes clear statements about the needs for certain types of environmental action to achieve approximation with the EU. It covers air, wastewater, solid waste, noise, nature, institutional capacity building.

Two scenarios are considered: scenario A: assuming that environmental investments count for about 0.6% of GDP (the current level, as is stated in the plan), and scenario B: assuming two times higher investments. Scenario A is the basis of the Plan, as it is the most realistic, given the economic situation in Romania.

For the period to 2000, the Plan lists more than 100 concrete projects in annex, which are included in the estimated investments. These total MECU 450. For the complete execution of the Plan, investments are estimated at ECU 1.2 billion. These investments include all environmental protection activities.

Table 5.9 Estimated investments for control of air-pollution in Romania 1996-2000 (MECU)

Type of investment	Total investment
Modernisation	155
Purification	91
Total	245

Total investments are estimated at MECU 245. However, the amount of environmental investments in the strict sense is much lower: only MECU 90. The other investments do not directly relate to the installation or purchase of environmental equipment, but to the modernisation of industries with beneficial environmental side-effects.

Assuming the structure of the investments after 2000 has more or less the same division between environmental sectors as in the short term, total investments in the framework of the environmental action programme for the air sector can be roughly estimated at 2.5 times higher than the MECU 90.

5.4 Findings

Since all the studies have different starting points, it is difficult to compare the results.

Comparison is even more difficult because IIASA reports annual costs for 2010, ifo Institut reports investments for the same year (but for only the power sector), the Slovak and Romanian NEAPs also report investments, TME (Poland) reports investments and costs for the year 2000, the TME (three cities) costs for 2010.

Differences in the assumptions about economic growth are quite large, which may have a major influence on the outcomes as shown by TME.

1. The IIASA study is pessimistic about economic growth, assuming that it will be less than 1% annually (about 20% in total) in the period 1990-2010; it assumes that regional energy demand increases by less than 8%, although it gives large differences between countries - for Poland 18% growth, for Hungary 22%, but for the Czech Republic it assumes a reduction of 6%.
2. ifo Institut assumes an overall increase in electricity demand of 65%, it may be assumed that this will be due to efficiency improvements of power stations and the use of fuels in the power sector.
3. TME (Poland) took government growth projections as starting point, which leads to an increase of production by about 45% in the 'high' scenario. Autonomous emission growth is less due to efficiency improvements; for the power sector a growth of 32% between 1990-2000 is assumed.
4. In the Slovak NEAP, no reference is made to economic growth.
5. TME (three cities) makes 'best-educated guesses' for the growth of the main explanatory factor (the vehicle fleet).
6. In the Romanian NEAP economic growth is mentioned, but it is doubtful whether any attention is given to this in the estimation of investments.

Another point is the difference in the levels of unit-cost of pollution control. The three studies (IIASA, ifo Institut and TME) mention 'data' taken from 'solid sources'. Still there are differences: The TME study uses the most detailed data, but they may be out of date (late 1980s, early 1990s). The IIASA study uses less detailed but more recent data (not paying much attention to differences in unit costs due to scale of operation. Ifo Institut uses the roughest data, but it is also relatively recent.

It is hard to tell which study comes closest to reality, but from the point of view of international institutions seeking guidance for their activities in the region, the benefit of the doubt should be given to IIASA.

Ifo Institut and IIASA assume that for new natural gas-fired power plants, basic measures (low NO_x burners) do not lead to additional costs, whereas in the TME study, investments (albeit relative low ones) are needed for such technologies.

In the field of traffic, the basic data used by IIASA and TME differ. Whereas IIASA has relative low-cost estimates for catalytic converters, it also assumes costs for diesel engine modification, while TME does not. IIASA's cost-estimates for 'clean diesel' are more than twice the estimates of TME (but, as shown by the results of the TME study, they have minor impact on the total cost figure).

Sectoral coverage also differs: IIASA is the most complete, including major stationary air-pollution sources and all mobile sources. The ifo Institut study is the most limited, only covering the power-sector. The TME (Poland) study is in between, covering the eight most polluting sectors. In the Slovak and Romanian NEAPs, all industrial sectors are covered, but not traffic.

The broadest is the IIASA study.. The others are much more limited.

TME and IIASA leave room for simulations of cost-effective policies; the ifo Institut-study and the NEAP of the SR do not touch that issue. In the TME (Poland), cost-effectiveness is simulated by 'emission-trading' between sources with relative low and high marginal pollution control costs. The study shows that given the assumptions up to 20% cost-reductions can be achieved to arrive at the same level of emissions (by comparing scenarios for 'regulation' and 'market based policy'). The IIASA study uses another understanding of cost-effectiveness, allowing emissions trading to air quality standards. In the TME (traffic) study, cost-effectiveness is mainly simulated by 'non- or semi-technical' measures (traffic management, inspection and maintenance, efficient freight transport) that also will have effect on other policy areas (congestion, energy).

In the IIASA and the ifo Institut studies, no clear separation is made between costs that have already been made at the beginning of the approximation process (1990) and total costs at the end of the period. This may - in theory - lead to over-estimation of the compliance costs for approximation. Since the TME study on Poland comprises cost analyses for 1991, 1995 and 2000, such an analyses is possible (and these figures are shown here). Especially in the field of particulate emissions, considerable investments and costs have been made before the approximation process started. In the NEAP of Slovakia and Romania it can also be assumed that only additional investments are summarised. The TME traffic study shows that at the beginning of the approximation period, compliance cost were close to zero, so the estimates for 2010 can be used as a best estimate.

Table 5.10 Coverage by pollutant and sector of the different studies.

	SO_2	NO_x	Part	Other	Total
Power sector	IIASA-totals ifo Institut invest TME - Poland, Slovak Romania. investm	IIASA-totals ifo Institut invest TME - Poland, Slovak, Romania investm	IIASA ? ifo Institut invest TME - Poland, Slovak, Romania investm	Slovak, Romania investm	IIASA-totals ifo Institut-invest TME Slovak, Romania investm
Industry	TME - Poland, IIASA-totals Slovak, Romania investm	TME - Poland, IIASA-totals Slovak, Romania investm	TME - Poland, Slovak, Romania investm	Slovak, Romania investm	IIASA-totals TME - inv& ac Slovak, Romania investm
Transport	IIASA-totals	IIASA-totals			IIASA-totals TME Urban Poland

5.5 Conclusion

The cost of implementing EU legislation in the air sectoris very high: 1.4% of GDP annually, compared to the 0.2% in EU-15. Many of these investments need to be made in the private sector and in transport and thus depends largely on economic development.

As explained above in Chapter 5.3, the IIASA study seems likely to provide the most reliable estimates on air pollution costs and their cost figures for the annual cost in 2010 (Tables 5.1 and 5.2) are used for the best estimates in Chapter 8. Nevertheless, there remains a high degree of uncertainty about its accuracy. Some of the issues raised could be resolved by more detailed work, others probably could not. A particular problem is how to deal with particulates. Second, IIASA assumes an unrealistically low rate of economic growth.

Although the RAINS model used for the IIASA study can generate figures for investments, these were not reported in the study and could not be made available within the period of the preparation of our report. Therefore, the best estimate for investments in Chapter 8 uses the figures from the ifo Institut. Because this study assumes a high economic growth, these costs may rather be a maximum figure.

6. WASTE[28]

6.1 EU legislation

The Commission has based its legislative proposals in the waste sector is its Communication to the Council, the 1989 Community *Waste Management Strategy*, setting out principles, policy objectives and actions. The resulting waste legislation[29] can usefully be divided into three types, framework texts dealing with wastes themselves (waste, hazardous waste and the movement of waste), more specific legislation on their disposal (incineration), and finally texts which deal with the environmental effects of certain products when they become wastes (a very diverse list including packaging materials, batteries, PCB/PCTs, titanium dioxide, waste oils, sewage sludge in agriculture).

The Commission's 1995 *Report to the Council and the European Parliament* points out that implementation is bedevilled by a number of interrelated difficulties, including incomplete implementation by Member States, the lack of reliable data, the lack of clarity or ambiguity of concepts in EU legislation, and the poor functioning of the consultation process foreseen by the legislation.

The 1996 Communication from the Commission on the review of the waste management strategy sets out a programme aiming to remedy these weaknesses. It maintains the hierarchy of principles established previously[30], adding that its implementation should be guided by considering the best environmental solution taking into account economic and social costs. The European Parliament's recent Resolution on the communication is that it does not go far enough to resolve current difficulties, nor indeed to answer the requirements of the 5th Environmental Action Programme.

6.2 Problems and key issues

The legislation has proved difficult for EU countries to implement: certain of its practical requirements or institutional structures and procedures have not been put into place. The problems met within the EU are likely to be exacerbated in the CEECs, where there is often a lower starting point in terms of the efficiency of

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[28] This section was prepared by Jochem Jantzen, Institute for applied for Applied Environmental Economics, currently on assignment in Slovakia.

[29] Most legislation in the sector has been adopted since 1989, but some specific issues are covered by earlier directives, such as waste oils and titanium dioxide.

[30] 'Prevention of waste shall remain the first priority, followed by recovery and finally by the safe disposal of waste'.

industry in minimising waste production, a poor network of disposal sites and processes, and institutional structures with little experience of the types of management issues involved, especially at local level.

The cost implications for the CEECs cannot be determined with accuracy.

First, the legislation imposes a general obligation for countries to take appropriate measures to encourage prevention through technical improvements in production processes which reduce amounts of waste, and through recovery or (lastly) energy production. The measures which any country introduces are likely to impose costs through process changes, though these are likely to be partly or wholly recovered through better resource use. An analysis of the effect of such national measures would entail the review of the current and likely industrial base of each country and a comparison with equivalent sectors in the EU to determine any 'improvability' and its cost.

Second, cost calculations for waste disposal based on existing waste production levels are likely to be over-estimates to the extent that (undefinable) improvements in industrial processes are achieved, and under-estimates to the extent that municipal waste production levels are likely to increase as economic improvements are reflected by changes in consumption patterns, offset by any improvements in separation and recycling (which is likely to successful at local rather national level and therefore to present wide variations in effectiveness nationally).

Third, costs vary considerably according to the disposal method used, but until the management plans required by the legislation are drawn up which set the proportions of waste dealt with by different methods, totals cannot be estimated with any accuracy.

Because waste is one of the areas in which there is framework EU legislation and because this includes management as well as technical requirements, the institutional obligations are particularly comprehensive. Whilst they do not go beyond what EU countries have created to manage waste issues, they have imposed changes in practice which have not all been assimilated. The CEECs, which often start from a different base, using different categories and procedures (degree of separation of hazardous and non-hazardous wastes, for example) will have considerably further to go to meet their accession obligations.[31]

EU waste legislation does not deal with historic pollution problems such as contaminated land. In most CEECs, there are significant amounts of municipal and

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[31] The 1991 proposal for a Landfill Directive has been withdrawn and a replacement has not yet been agreed. This leaves a very large gap in the coverage of EU waste legislation which has significant repercussions for compliance cost calculations for the CEECs. The issue is whether to include consideration of a possible Landfill Directive or not. The EU waste strategy foresees landfill as a disposal method, and common sense requires it to be one of the main disposal tools available in all countries; its costs are high, but there is currently no comprehensive set of EU standards governing landfill operations.

hazardous waste dumped without adequate protection or control. Its safe redisposal will also impose costs.

6.3 Studies reviewed

Compared to air and water, the waste sector has been less studied. Two studies have been identified in which some data concerning compliance costs for waste management are summarised for some CEE-countries, moreover three official documents on compliance costs is identified:

- ifo Institut: *Environmental Standards and Legislation in Western and Eastern Europe Towards Harmonisation: Economic Costs and Benefits of Harmonisation*, out for DGXI and the EBRD. It is linked directly with approximation, and gives (rough) estimates for the needed investments to comply with European guidelines. It covers most of the Phare-countries

- TME: *Cost-assessment of medium term Polish Environmental Policy Goals*, for the Dutch and Polish Ministries of Environment. It aims at estimating compliance costs/investments with Polish legislation and policy objectives. It uses the MOSES model and covers the eight main polluting sectors of the Polish economy.

- Ministry of the Environment, Slovakia: *National Environmental Action Programme.* It includes information is collected by several Ministries, other state institutions, regional and local administration, private enterprises and NGOs. There is a certain link to approximation, though not primarily aiming at showing costs thereof..

- Romania, National Environmental Action Plan

- Slovenia, Strategic guidelines on waste management.

6.3.1 Economic Costs and Legislation in Western and Eastern Europe Towards Harmonisation, Adler et al, ifo Institut, 1994

The general approach of the ifo Institut study has been discussed in Chapter 5.

A case study for the Czech Republic and Slovakia is used to estimate investment and operational costs of waste management. In the model applied by ifo Institut, the starting point is quantities of waste. For each country an estimate (or better ‘simulation’) is made of estimated waste-quantities in 2010 - applying a ‘waste coefficient’ - for the following types of waste:

- Domestic (0.45 t/inhabitant/year)

- Construction waste (1.84 t/inhabitant/year, although on page 247 it is stated that this coefficient is about 1t/inhabitant/year)

- Hazardous waste (0.02 t/$1000 output)

- Industrial waste (1.2 t/$1000 output)

- Ashes and slag (based on energy use).

These 'waste-coefficients' take into account the structural change of industrial production; it is assumed that the German coefficient for 1990 can be applied in 2010.

Thus, total waste production is estimated to increase in the short run (from 600 million tons in 1990 to 750 million tons by 2000) but is estimated to decrease in the longer run (to 450 million tons by 2010). This is due to changes in industrial waste and ashes and slag, whereas domestic waste (10% of total waste in 1991), remains more or less constant. By comparison with western European data, the waste coefficients for domestic and construction waste are relatively high (for instance, production of construction waste in the Netherlands is less than 1 ton per inhabitant).

It estimates costs and investments use on the basis of German data adapted to local circumstances.

Table 6.1 Cost-estimates for waste treatment (investment in ECU/ton capacity; operational costs in ECU/ton):

Region	Type of cost	Compost	Recycl.	Inciner.	Landfill
Baltic states, Hungary	investment	75	85	150	20
	operating costs	20	17	30	3
Czech Republic, Slovakia, Bulgaria, Romania, Yugoslavia.	investment	55	75	125	15
	operating costs	15	15	25	2
Poland	investment	110	125	205	25
	operating costs	27	25	40	4

It is unclear how the investments for landfill should be interpreted (since capacity of a landfill is a stock parameter, whereas capacity of the other waste management technologies is a flow parameter).

For each country, two scenarios are considered. First, a minimum investment scenario which only considers landfill - total investment needs for the CEEC amount to ECU 19 billion. Second, an 'optimal' waste-scenario is simulated with a 'linear optimising model'. In this way, quantities of waste per type of technology are estimated for each of the reviewed countries.

The total investment needs for the optimisation scenario are only 25% higher then the minimum investment scenario. Of the total investment need of ECU 26 billion, about 50% goes to landfill, whereas composting and recycling together take account of 25%. The optimisation scenario does not include the incineration option, so no investments for incineration are required. It favours reuse, although reuse poses an enormous challenge to find 'technological solutions for secondary waste material management, even if the CEEC have a tradition of a high rate of material reuse (about 50% in 1990).

The main cost difference between the minimum investment and optimisation scenario are the high operating, collection and transportation costs. The operating costs are five times higher in the optimisation scenario than in the minimum investment scenario. The latter does not account for additional transportation and collection costs.

It is unclear how the ifo Institut study has estimated the largest investment cost component (collection and transport). The only information is that it is based '... according to German pattern.' This does not increase the credibility of the results. Therefore, these costs are not included in the total in Table 6.2.

Table 6.2 Estimated investments and operational costs for waste management in selected CEE-countries: Cost-effective scenario, ifo Institut (billion ECU)

	Investments						Operational costs
	Compost	Recyc.	Landfill	Inciner -ation	Total investm.	Collec./ transp.	
Baltic States	0.1	0.1	0.35	0	0.55	0.15	0.2
Bulgaria	0.65	0.65	1.15	0	2.45	2.65	0.95
Czech Rep. and Slovakia	0.4	0.4	0.8	0	1.6	1.7	0.8
Hungary	0.5	0.5	1.7	0	2.7	4.4	0.75
Poland	0.9	0.9	1.5	0	3.3	2.9	1.7
Romania	0.35	0.35	0.65	0	1.4	1.4	0.65
Total CEE	2.9	2.9	6.15	0	12	13.2	5.05

6.3.2 Cost Assessment of Medium Term Polish Environmental Policy Goals, Jantzen and De Bruyn, TME, 1994

TME's study for the Polish Environmental Action Programme is already explained in Chapter 5. The MOSES model is also used.

The estimates for waste management (hazardous waste, industrial waste, and ash and slag) are based on the 1990 waste treatment in industry (mainly recycling and storage/landfill) and current policy objectives (increased recycling and safe storage/landfill).

Some typical unit-cost figures are (NL£/ton):

- Existing recycling: 0.00
- Additional recycling of ash and slag: 10.00 (1st step) and 30.00 (optimal); additional recycling of industrial waste: 20.00 (1st step) and 50.00 (optimal); additional recycling of hazardous waste: 200.00 (1st step) and 390.00 (optimal);
- Incineration of industrial waste 110.00; incineration of hazardous waste 870.00
- Landfill: basic 2.60; safe: 11.00 additional.

These costs include the costs of collection and transport.

The unit costs in the MOSES databases are difficult to compare with the ifo Institut study, because ifo Institut uses investments, whereas MOSES uses annual costs.

The scenario 'high growth, market-based policies' is used as being most representative for 'approximation' (for air legislation we have selected the same scenario, see Chapter 5).

The results of this scenario for the six sectors are presented in Table 6.3.

Table 6.3 Annual costs for the Polish Environmental Policy Plan, 2000, additional costs in comparison with 1991. 'High-growth market-based policy' scenario (MECU)

Sector	Ash and slag	Industrial waste	Hazardous waste	Total
Paper	0.1	1.5	0.0	1.6
Refineries	0.0	0.0	7.9	7.9
Org chemical	0.1	0.4	2.2	2.7
Fertilizer	0.2	6.2	0.0	6.4
Other chemical	0.2	8.0	47.8	56.0
Iron&steel	1.0	0.6	0.0	1.6
Non-ferro	0.2	97.9	0.0	98.1
Power	5.8	1.2	15.5	22.5
Total	7.7	115.8	73.4	196.9

6.3.3 National Environmental Action Programme, Ministry of Environment, Slovakia, 1994

The scope of the Slovak 'National Environmental Action Programme' has already been discussed in Chapter 5.

A summary of the investments for waste management is given in Table 6.4.

Table 6.4 Investments for waste management in Slovakia (MECU)

Environmental problem	Paper	Refin	Chem	Metal	Other	Gas& power	Public	Total
Landfill							98	98
Hazardous waste	0		7	25	2	9	6	49
Recycling					0		6	6
Hospital waste							18	18
Composting							2	2
Waste management							8	8
Soil sanitation	0		17	8			44	71
Total	0	0	25	34	2	9	182	252

Upgrading of landfills takes about 40% of total investments, soil sanitation about 30% and hazardous waste management about 20%.

6.3.4 National Environmental Action Programme of Romania, Ministry of Waters, Forests and Environmental Protection, 1995

The Romanian NEAP mentions investments in waste management. Eight projects are defined with a total investment of MECU 18. This figure includes a facility for hospital waste , some landfill, and recycling units.

Clearly, this figure cannot be considere the total compliance cost for approximation because there is no comprehensive overview of specific needs and consequent investments in various types of facilities.

6.3.5 Strategic guidelines on waste management for the Republic of Slovenia, Ministry of environment and physical planning, 1996

This document gives a comprehensive overview of the needs in the field of waste management to comply with EU standards and requirements. Moreover, clear waste management objectives are defined for the period until 2010. It covers all aspects of waste management in Slovenia (Domestic waste, industrial waste, etc.; collection, transport, treatment, recycling, incineration and landfill.).

Table 6.5 documents the required investments per item. Although it is not really possible to assess the reliability of the estimates, since no direct relation could be made between the amounts of waste and corresponding investments), some simple evaluations show that the unit costs on which the estimates are based are comparable with cost figures for western Europe (e.g. the required investment for controlled landfill can be estimated roughly at ECU 7/ton, the costs of incineration at roughly ECU 500/ton of incineration capacity).

The document pays no attention to the question of financing, other then at the municipal level the charge system should take into account the (large) investment needs to realise the objectives of waste management policy. Therefore, it is not possible to assess the credibility of the cost estimates in terms of the likelihood of obtaining resources which are comparable to the financial needs.

Table 6.5 Investments for waste management in Slovenia (MECU)

Waste management	Investments	%
Landfill in compliance with EU standards	334	29%
Recycling	157	14%
Incineration	286	25%
Industrial and construction waste	323	28%
Agricultural and forestry waste	47	4%
Total	1147	

6.4 Findings

Only the ifo Institut study and the Slovenian waste management plan being the only ones taking approximation explicitly as a starting point. Hence, it is difficult to compare the results.

The ifo Institut study comes to very high estimates of investments, but not all assumptions are very clear. They relate to the future development of waste production and 'cost-effective' selection of waste management options. (e.g.; no incineration).

Second, it is unclear to which extent the operating costs are additional to the current expenditures for waste. As waste production is very high for industry, it is estimated to decline in the long run. So the costs of collection and transport cannot all be seen as additional costs related to approximation.

The Slovenian Waste Management Plan has very high estimates for waste management investments, but it seems that these needs comply with the objectives outlined in the plan.

The Slovak NEAP estimates the cost of investment in the waste sector at MECU 250, whereas ifo Institut estimates total costs of compliance in the Czech Republic and Slovakia at ECU 3.3 billion, of which roughly 30% can be allocated to Slovakia. So, the ifo Institut-estimate is four times higher than the Slovak government's official estimate (and local experts think that even these official numbers are unrealistically high).

The total investments for Poland are estimated by ifo Institut at ECU 6 billion and operating costs at ECU 1.7 billion. Assuming capital costs (depreciation and interest on investments) of about 10%, the total annual costs in Poland would be ECU 2.3 billion. The TME-study comes to roughly ECU 150 million for the eight most polluting sectors (excluding domestic waste). Although these estimates are not fully comparable, they are much lower than the ifo Institut estimates.

The figures from the Romanian NEAP cannot be seen as realistic estimates of investment needs for approximation. The amount of MECU 18 can only be seen as a preliminary and limited set of projects, which will need to be followed by many more projects.

Ifo Institut maximum estimate of waste management costs in the CEECs is close to the average for the EU-15. For example, they estimate ECU 55 per capita for Poland, whereas the figure for region is ECU 74 per capita. This figure is in line with costs in the most developed EU Member States such as Germany, Netherlands, UK, France and Austria.

On the other hand, these costs are much lower capita for Portugal, Finland and Spain. The ifo Institut estimates for waste management costs for the CEECs at 3.6% of GDP, whereas the average for EU-15 is 0.3% with a maximum of 0.5% for the UK. For the Cohesion countries, the costs as a percentage of GDP are also below 0.5%.

6.5 Conclusions

Since the numbers of the different documents reviewed are hard to compare and differ up to a factor ten or more, it is not easy to define a reliable ‘best estimate’. The two most comprehensive studies (Ifo and the Slovenia Waste Management Plan) show high investment needs. As indicated in Chapter 6.3, these costs are at the same level or even higher than in the EU.

Ifo Institut offers the best available estimates of investment costs.

From the relative lack of studies, we can conclude that the investments in the solid waste sector are less important than investment in wastewater treatment and air pollution control. They appear to amount to only 10-20% of total investment needs. These investments were also less important in the Cohesion countries (6.4% of total).

There is much greater uncertainty regarding operating costs, and, hence, regarding the annual costs. The estimate of additional costs compared to the current costs for collection and treatment is particularly uncertain. Ifo Institute’s minimum-maximum estimate shows that the percentage of costs attibutable to waste management can vary from 17-45% of total annual environmental costs, compared to 33% for the EU. In the maximum case, waste would be the most important environmental sector from the perspective of annual costs, as is now the case in Italy and Ireland.

7. OTHER EU ENVIRONMENTAL LEGISLATION

Several groups of directives and regulations covering a wide range of environmental issues have not been considered in the previous sections. All of these will entail implementation costs which may include investment, operational and institutional costs. The most important are those dealing with chemicals and genetically modified organisms, noise, nature, and forests, plus a number of horizontal measures. This section comments briefly on the implications for the CEECs of implementation in each of these areas.

7.1 Chemicals and genetically-modified organisms

The European Union has a remarkably comprehensive and consistent framework for the regulation of chemical substances and preparations that has been in development since 1967. It is part of a harmonised OECD system of chemicals testing and risk assessment that was developed in parallel with the EU system. The cornerstones of the system are the premarket testing and notification of new chemicals, combined with a hazard assessment that ensures that all hazardous chemicals and preparations are labelled with a prominent symbol and standards risk and safety phrases. The list of hazardous chemicals and labelling requirements is updated several times per year. The chemical industries are participating in a systematic testing of a priority list of chemicals which were on the market before 1971 to identify their potential risks to health and the environment.

Genetically-modified organisms must undergo a more rigorous system of testing and risk assessment under two directives focusing on GMOs used in contained circumstances and those intended for release into the environment. The industrial producer or importer bears the cost burden on testing and notifying the chemicals and GMOs, on the grounds that this is an acceptable responsibility to place on a commercial activity under the Treaty’s Precautionary Principle (Article 130r).

Asbestos

The European Community adopted Directive 87/217EEC in 1987 severely restricting the presence of asbestos in air, water and soil. It supplements the marketing and use restrictions on asbestos already adopted under Directive 76/769/EEC.

We have not been able to find any reliable information on the use of asbestos in construction and other activities in the CEECs. However, tables giving Soviet-period tonnages of building materials produced show asbestos cement produced, sometimes in large quantities. It thus must be assumed to have been used in some form in construction.

In addition to general duties to prevent asbestos emissions so far as reasonably practical in the course of its use, the directive states that work with asbestos products and the demolition of buildings may not cause significant pollution by asbestos fibres or dust. It is extremely expensive to ensure that work with products in the course of transformation of a building or its demolition does not release fibres or dust. At his stage no costs can be estimated, we recommend that an initial review is undertaken to provide an order of magnitude of the potential problem.

7.2 Noise

EU technical requirements to achieve limits on noise emissions have all be placed on products, and hence were based on Article 100 or 100a, the Treaty clauses concerning the preservation of the single market. The range of products is small: a variety of vehicles and tools used in construction, civil subsonic jet aeroplanes, motor vehicles and motorcycles, and lawnmowers. As in the case of chemicals, the industrial producers and operators are required to bear most of the costs related to fulfilling the requirements of the directives, plus the governments must supervise and control compliance through the appropriate regulatory agencies.

7.3 Nature

The crucial text is the Habitats Directive, though the Protection of Wild Birds Directive also imposes obligations with cost repercussions. In addition, the Convention on International Trade in Endangered Species (CITES) and its implementing Regulation[32] requires an important control apparatus.

With both directives, direct capital costs may generally expected to be low in the majority of CEECs where the core land areas will already be in public ownership under a protection scheme.

However, the situation is complicated by the need to take into account the indirect costs of taking land out of economically productive activity, or of limiting its potential for (intensive) production in order to maintain carrying capacity, either as a protected area, or (for Habitats) as a corridor within the Natura 2000 system.

In this context, issues such as the need to add costs to transport infrastructure construction programmes in order to install channels allowing species movement have to be taken into account. Current work on a strategic environmental assessment of the motorway network in Poland[33] estimates such measures as a percentage of capital costs.

The operational costs of creating and maintaining sites and networks are likely to be a relatively high percentage of total costs, especially if CAP-type environmental subsidies are considered necessary in order to maintain biodiversity through extensive

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[32] A new Regulation was adopted by Council of 12/12/96. this has not appeared in the OJ at the time of writing and is not considered.

[33] Sir Alexander Gibb for the Polish Ministry of Environment and Forestry, funded by Phare.

farming practices. These are likely to increase in time as economic factors put pressures on the agricultural sector to 'modernise' - that is to intensify.

Institutional costs are more likely to remain stable, since inspection and enforcement activities will remain whatever the agricultural regime. They do not necessarily need to be looked at as a separate head, but as part of a broader set of costs involved in the management of economic activities, such as forestry or fisheries management, especially in those countries where ministries of the environment are also natural resource managers.

The type of management activities, and in particular the site identification, registration and management reporting requirements of the Habitats Directive in particular will impose a particular institutional burden. One particular issue to raise in this context is the difficulty several CEECs are going to face of having to adopt new legislation and the accompanying procedures matching EU requirements only a very few years after having adopted new laws replacing soviet or soviet-style ones (Estonia, for example).

The implementation of CITES could be deemed not to impose any additional costs, since the CEECs are signatories to the Convention and therefore already have obligations which are equivalent to those under the EU Regulation.

7.4 Forests

EU legislation covers the protection of forests against atmospheric pollution and against fires. The Commission provides a measure of financial support for monitoring and R & D activities in both areas but also requires extensive and complex reporting procedures to be put into place. Two actions undertaken in the framework of the Phare Multi-Country programme (1995 budget) may give some cost information of use in the context. These are the Commission's MARS-MERA land use monitoring and the sustainable forests and biodiversity projects.

7.5 Horizontal measures affecting industry

The replacement for the Seveso Directive (industrial accident and emergency response) and the IPPC Directive impose far-reaching obligations on industry and government at all levels. The Directive on Environmental Management and Assessment System (EMAS) aims to encourage industry to improve itself through self-analysis, but is a voluntary system. The Ecolabel system aims to inform consumers about the environmental quality of products, requiring industry to demonstrate that its manufacturing process and that 'cradle to grave' product characteristics are environmentally sound.

the new Seveso aims to establish cooperation procedures in identifying and controlling industrial accident risks, and setting up response procedures for accidents which are broader in scope of the original 'Seveso' Directive. Under it, operators are required to take measures to prevent accidents and to prove that he has done so through a reporting procedure and by allowing inspections, this involves the preparation of internal emergency plans. Designated authorities draw up external emergency plans. Government has an oversight and information collection and dissemination role, (local) competent authorities collaborate with operators and the government, operators have to establish procedures, an inspection system is needed to ensure they have done so.

The great majority of costs will be recurrent manpower costs, except where operators or designated authorities identify an infrastructure need as part of their plan preparation. Few can be separated out as exclusively related to the directive; most will be additional to those which would normally arise as part of health and safety activities at plants, of emergency response preparedness by the competent authorities and of permitting and monitoring activities by inspectors.

The Integrated Pollution Prevention and Control Directive aims to bring together aspects of pollution prevention and control which in the past have been legislated for separately. And it goes further than other environmental directives have, by requiring for example that energy is used efficiently. The EU has given itself three years to bring it into national law, an unusually long period of time reflecting the profound changes needed to the normal practices of many countries.

In principle, the system is a simplification since it calls for a single permit to cover all environmental aspects of operations; in practice it involves a level of analysis and description of operations which is of a higher order than for ‘traditional’ permits. The impact in the CEEC will fall both on operators needing the permits, who need to describe operations in a new way, and on the authorities issuing them, who need to understand the implications of the information presented them.

The cost of implementation is entirely administrative, and is likely to involve considerable training. No figure could satisfactorily be put to it.

EMAS and Ecolabel mechanisms are similar in that they require industry to be able to review its operations (or have them reviewed by third parties) and to present the results to an appropriate authority.

The Environmental Impact Assessment Directive also needs practitioners and review authorities, who need to be able to consider the assessment and take into account in decision-making. It affects all promoters of projects likely to have a significant effect on the environment and not just industry.

7.6 Conclusions

These ‘other’ directives appear to fall into two main categories: those which impose the main burden of compliance on the relevant industrial sector, to be considered a normal cost of doing business in the European Union, and those which place the main burden on government to introduce and maintain a protection system, e.g. of natural habitats or endangered species.

Many of the directives focusing on industrial activities and products were at the vanguard of the European Union’s effort to internalise the environmental costs associated with industrial activity by increasing industry’s knowledge of the potential risks of their actions. Hence, they are considered ‘self-regulatory’ directives because they require enterprises to test and assess the health and environmental risks associated with their activities, and therefore encourage them to avoid activities which might lead to health or environmental damage in the future.

The EIA and Habitats directives may be considered in the same light, because their emphasis includes generating information about potential problems and risks and taking a decision according to a defined procedure with public access.

8. CONCLUSIONS

8.1 Findings

There is quite a lot of information available on the costs of bringing environmental policies and requirements up to - or at least close to - the level of the EU standards. Unfortunately, to date, this information has never been brought together in a transparent and consistent way.

This report contains a review and comparison of 15 recent and major studies which represent the state of art of estimating compliance costs for EU environmental legislation.

The main findings are:

1. There is much information available but its relevance is limited because the estimates are not directly linked to approximation and the results are hard to compare because of different assumptions and cost indicators.

2. In practice, it has proved to be very difficult to describe an ‘approximation to EU standards scenario’ and to compare it to a ‘non-approximation’ reference scenario. It is almost impossible to link cost estimates to individual directives or attribute specific costs to implementation of specific EU directives. Because the studies report total costs instead of additional costs, they over-estimate the cost of approximation.

3. A much more detailed analysis would be needed to understand how the estimates relate to individual EU directives. Such a broader approach, which looks at ‘western European standards, technologies and approaches’ in different sectors (water, air, waste) would probably give a better indication of CEEC compliance costs than the existing studies.

4. Although the total costs reported in the studies give a better indication of the financial effort the CEEC are facing to improve the environment, they overestimate the additional costs required to meet EU obligations, as explained in the following paragraph.

5. Total investment and annual costs depend on a number of assumptions (economic growth, policies selected) so that there is no single number indicating the costs of approximation. A separate detailed study would be needed to evaluate what impacts these assumptions and data inputs have had on the results and consequently, to determine the comparability of the results from the different. Our report gives only one ‘best estimate’ for the water and air sectors; two scenarios are given for the waste sector.

6. Selection of the most cost-effective policy options to reduce compliance costs is an important issue which has not been addressed in studies to date.

For example, the feedback effect of realistic pricing of natural resource consumption would lead to more efficient use of e.g. water and energy and, consequently, lower pollution abatement costs.

7. Municipal wastewater treatment and the control of certain air pollutants are the best covered sectors. Less information is available for water supply, waste management generally, industrial pollution control and nature protection. In general, more figures are available on investments than on annual costs. The use of different cost indicators (investment versus annual costs, different reference years, etc.) makes comparison difficult.

8. The cost figures overestimate the true economic costs to society because they do not take the economic benefits of related environmental improvements into account.

Notwithstanding the difficulties, the common lesson of the studies is that the required investments and/or annual costs will amount to a significant % of GDP over the coming years: a 'best estimate' of these costs is set out in below, inChapter 8.2.

8.2 Best estimates for compliance costs in the CEEC

The best estimates for cost of approximation of EU environmental legislation in the CEECs is set out in Tables 8.1 to 8.4, which draw together the conclusions of sectoral reviews in Chapters 3 to 7.

Tables 8.1 and 8.3 give details per country, while Tables 8.2 and 8.4 compare totals for the CEECs with similar figures for the EU-15 and the four Cohesion countries (Greece, Ireland, Portugal and Spain).[34]

8.2.1 Investment needs

The estimates for **wastewater** are the only reliable investment figures in the studies. The best estimate for air and waste are based on the ifo Institut study, because it provides figures for all CEECs, but these figures are surrounded by major uncertainties. For some countries, esp. Poland, more information is available for certain sectors and issues.[35]

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[34] All our earlier remarks on methodology and assumptions of course apply to these total estimates of the costs of approximation, as well.

[35] It is discussed in Chapters 3-7 and not repeated here.

Table 8.1 Total investments for approximation for the CEEC (billion ECU)[1]

	Water			Air	Waste		Total investment		Total/capita
	Supply	Waste-water	Total		min.	max.	Total min.[1]	Total max.[1]	(ECU)
Poland	4.4	13.7	18.1	13.9	2.2	3.3	34.1	35.2	927
Hungary	3.5	3.1	6.6	2.7	2.1	4.4	11.5	13.7	1306
Czech	2.2	1.1	3.3	6.4	8 [4]	3.8 [4]	10.4	13.4	1427
Slovak	1.0	0.9	1.9	1.9	0.3 [4]	1.60 [4]	4.1	5.4	760
Bulgaria	2.2	2.7	4.9	5.1	1.8	5.1	11.7	15.0	1668
Romania	3.8	6.3	10.1	9.1	1.0	2.7	20.2	22.0	943
Baltic total				8.45	0.45	0.85	8.90	9.30	1148
Estonia	0.13	1.38	1.50				1.50	1.50	n.a.
Latvia	0.11	1.60	1.71				1.71	1.71	n.a.
Lithuania	0.11	2.27	2.38				2.38	2.38	n.a.
Slovenia	n.a.[3]	n.a.	n.a.	0.69	1.15	1.15	1.84	1.84	n.a.
Total	17.5	33.1	50.5	48.2	9.7	22.7	108.4	121.5	1140
% of total max.	14%	27%	42%	40%		19%		100%	

[1] Figures for water supply, air and waste are based on ifo, for wastewater on ifo and WRc.

[2] Total min. includes the minimum estimate for landfill, total max. includes the maximum estimate for waste management.

[3] not available.

[4] 70% of the total estimate of ifo Institute for Czech and Slovak Republic can be attributed to Czech Republic and 30% to Slovak Republic

Total investment needs for **sewerage and wastewater treatment** amount to ECU 33 billion. This estimate is based on ifo and WRc. Only a small part (ECU 5 billion) of this is for industry. Less information was available for water supply, where the best estimate points to an overall investment need of ECU 17 billion.

On a per capita basis, these costs are about 50% higher then those estimated for the Cohesion countries. About 30% of these costs are considered to cover 'urgent measures'. Related short-term five year investment needs for the water sector as a whole (water supply and wastewater) amount to ECU 14 billion or an average of 1.5% of GDP per year for five years, ranging from 0.9% for Slovakia to 3.4% for Romania.

The best estimate for **air** is based on the ifo Institut study, which covers SO_2, NO_x and particulates emissions from combustion plants. Because the ifo Institut assumes a high economic growth these estimates can be considered as a maximum estimate. Other sources give much lower data. But, on the other hand, ifo does not cover emissions from industrial processes or traffic. Therefore, this can only be considered an interim estimate. The investments cost estimates which underly the IIASA study results would offer a more complete and probably more reliable figure, but are not currently available.

The total investment needs for the CEE **combustion plants** amounts to ECU 53 billion, which corresponds to ECU 463 per capita. Because the timeframe is not given, it is difficult to estimate annual investment needs, but it would probably be bigger than for water-related investment needs. There is no comparable figures for the Cohesion countries.

The few estimates related to western European **waste management** legislation do not confirm each other. The only figure available for the CEECs as a group is from ifo Institut, and this is far higher than the other data. We have nevertheless used these data to estimate a minimum (related to landfill) and a maximum (cost-efficient) scenario. This range (ECU 10 to 20 billion) indicates that investments in the waste sector can be as important as water supply or wastewater. These figures are far much higher than data for the Cohesion countries.

It was not possible to generate a best estimate for the **other environmental sectors**, such as chemicals, industrial risk management, noise and nature protection. Some additional information is available in country studies regarding industrial processes and related EU directives. However, as these other environmental sectors (nature protection, etc.) only represent 5% of the total environmental costs for EU-15[36], they are not likely to have been important in the total cost estimates for the Cohesion countries.

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[36] OECD, *Pollution abatement and control expenditure in OECD countries*, 1996.

Table 8.2 Best estimates for total environmental investments in the CEECs, compared to EU figures for 1992 (billion ECU)

	CEECs			Cohesion[4]		
	Total invest.[1] (billion ECU)	Costs /capita[2] (ECU)	% GDP[3]	Total invest [4] (Billion ECU)	costs/ capita (ECU)	% GDP[3]
Urban waste water	33.1	270	0.62	10.6	167	0.09
Industrial waste water	5	48	0.11	4.6	73	0.04
Drinking water	17.5	168	0.39	6.5	102	0.05
Air	< 53	< 463	< 1.07			
Waste				1.1	11	0.01
min.	9.7	93	0.21			
max.	23	218	0.50			
Other	n.a.[5]			0.7	17	0.01
Total[5]	122+	1168+	2.90	17	373	0.20

[1] Total annual investment in 1996, in billion ECU
[2] In ECU/capita, total average for CEECs and Cohesion-4
[3] Annual investment = total investment over 20 years; % of 1994 GDP.
[4] Total investment for Cohesion-4 to 2005, in billion ECU.
[5] not available.
[6] Total includes the maximum figure for waste management (row 7).

Hence, this gap in the data is unlikely to have an important impact on the orders of magnitude of the overall total costs estimates for the CEECs. The data for the former GDR point to potentially high costs for nature restoration, soil clean up, and nuclear waste clean-up. No information was found for the CEECs for these sectors.

In conclusion, the investment costs of bringing environmental management in the CEECs up to the level of advanced western European countries will be relatively high. Total investment costs for water, air and waste would amount to at least ECU 1000 per capita[37].

[37] Note that these investments figures are based on ifo Institut, but exclude waste. These figures (apart from waste) are consistent with the figures mentioned by EBRD in its *Transition Report 1995*, p. 80.

The impact these investments will have on the economies of the CEECs will to a large extent depend on the timing of the investments. Annual investment needs appear very high when expressed as % of GDP (almost 3% of 1994 GDP, assuming investments are spread over 20 years). The CEECs' investment needs are larger then the needs projected for the four Cohesion countries, in absolute terms, as well as in investments per capita (on average three times higher) or as a percentage of GDP.

The total annual costs for municipal wastewater treatment amount to ECU 3.7 billion, of which 45% is for operating costs. On a per capita basis this is only half the costs for the EU-15. No data are available for the capital costs related to industrial wastewater treatment or for water supply.

8.2.2 Annual capital and operating costs

Good information is available for annual costs[38] (capital costs and operating costs) for municipal wastewater and air. For waste, operational costs are available but very uncertain, especially insofar as these are to be regarded as additional costs.

The best estimate for annual costs for **air** are of the same order of magnitude as those for waste water, and are based on the IIASA study. Comparison with other studies is very difficult, as IIASA's estimates cover total SO_2 and NO_x emissions of all sectors and are not disaggregated. We believe they indicate a lower cost boundary because they do not include costs related to particulates (probably an important gap) nor other pollutants (VOCs, ground-level ozone, other substances for which the Commission will propose limits under the new Air Framework Directive). As these last pollutants are mostly generated by the private sector their future quantities will depend on economic development in the countries. Further study of IIASA's results and underlying model would allow us to draw many more conclusions.

Total annual costs for municipal wastewater treatment, air pollution control and operational costs for waste management would range from ECU 8-12 billion, which corresponds to ECU 80-120 per capita. Although this is only two-thirds of the average per capita figure for the EU-15, it corresponds to a much larger share of GDP (5.4% for CEECs compared to 1.02% for EU-15).

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[38] See Chapter 2 for definitions.

Table 8.3 Total annual costs (capital and operating costs) of approximation for the CEECs[1] (MECU)

	Wastewater			Air			Waste				Total[3]	
	Capital	Operating	Total	Capital	Operating	Total	Capital	Operating min.[2]	Operating max.[2]	Total	min.	max.
Poland	760	625	1385	n.a.[4]	n.a.	1557	n.a.	350	1700	n.a.	3292	4642
Hungary	210	173	383	n.a.	n.a.	456	n.a.	150	750	‘	989	1589
Czech	155	170	324	n.a.	n.a.	741	n.a.	105[5]	560[5]	‘	1170	1625
Slovak	81	88	169	n.a.	n.a.	305	n.a.	45[5]	240[5]	‘	519	714
Bulgaria	189	147	336	n.a.	n.a.	159	n.a.	200	950	‘	695	1445
Romania	466	385	851	n.a.	n.a.	198	n.a.	100	650	‘	1149	1699
Baltic total				n.a.	n.a.	19	n.a.	50	200	‘	69	219
Estonia	32	27	59	n.a.	n.a.		n.a.			‘	59	59
Latvia	54	44	98	n.a.	n.a.		n.a.			‘	98	98
Lithuania	76	62	138	n.a.	n.a.		n.a.			‘	138	138
Slovenia				n.a.	n.a.	126	n.a.	n.a.	n.a.	‘	126	126
Total	2023	1719	3742	n.a.	n.a.	3561	n.a.	1000	5050	n.a.	8303	1235 3
per capita (ECU)	19	17	36			34		10	49		79	118

1 Figures for water are based on WRc, for air on IIASA, and for waste on ifo Institut.
2 For waste, the operating min. includes the minimum estimate for landfill; the operating max. refers to the cost-efficient scenario.
3 Total min. includes the minimum estimate for waste, total max. the maximum estimate for waste management.
4 not available.
5 70% of the total estimate of ifo Institute for Czech and Slovak Republic can be attributed to Czech Republic and 30% to Slovak Republic

Table 8.4 Best estimate for annual environmental costs in the CEECs, compared to EU figures for 1992 (billion ECU/year)

	CEEC			EU		
	Annual costs[1] (billion ECU)	Costs per capita[2] ECU	% of GDP[3]	Annual costs[4] (billion ECU)	Costs per capita[2] ECU	% of GDP[5]
Municipal wastewater	3.7	35	1.6	21	60	0.36
Industrial wastewater	n.a.[6]			10	30	0.17
Drinking water	n.a.			n.a.		
Air	3.6	34	1.6	8.5	29	0.14
Waste				20	60	0.32
Min.	1	10	0.4			
Max.	5	48	2.2			
Other	n.a.			3.3	9	0.06
Total min.[7]	8.3+	79+	4+			
Total max.[7]	12.3+	118+	5.4+	63	183	1.02

[1] Total annual costs for CEEC, for waste only operating costs are available.
[2] Costs in ECU per capita, average for CEEC and EU-15 as a whole.
[3]% of 1994 GDP.
[4] Total annual costs (investment + expenditure)for 1992, based on Ereco 1993 and OECD.
[5] % of 1992 GDP.
[6] not available.
[7] Total min. includes the minimum estimate for waste, whereas total maximum includes the maximum figure for waste. Total max. is not a real maximum because it does not include all annual costs, e.g. capital cost for waste or water supply.

8.3 Recommendations for future work

It would be relatively easy to considerably improve the comparability of future work in this area if a minimum number of arrangements could be made regarding methodologies and assumptions, and if future studies are transparent in approach and the source and use of the underlying data.

Although a relative limited number of groups are working in this area, there is apparently no forum to discuss and agree on common issues, or organise collaboration or the exchange of data. The EU could be a catalyst to organise such collaboration.

Some sectors or types of environmental measures can be easily covered by the standard ‘technical-economic studies’, but other areas with important long term institutional, economic and environmental impacts have hardly been covered. (e.g. chemicals, industrial risk management, noise, nature conservation).

Given the relatively high economic costs of environmental measures, it is very important to identify the most cost-efficient approaches to achieve the envisaged environmental objectives. All evidence suggests that there is a wide scope to improve the cost-effectiveness of environmental policies which were adopted in western Europe over the last twenty years.

Past studies have mainly covered investment and operating costs, because financial constraints are seen as a major potential barrier to the implementation of environmental policies. However, institutional development is an equally important potential barrier to progress.

If the governments do not have the funds to train and staff their authorities at central, regional or local level to manage the relevant environmental protection systems, implementation of the law will not be possible. Therefore, even if administrative costs seem limited compared to costs of investments, they equally important potential constraints for implementation and timing. This issue has not been dealt with in most studies. Future work should treat institutional development and administrative issues separately and compliance deadlines should take them into account.

BIBLIOGRAPHY

Alder et al, *Environmental Standards and Legislation in Western and Eastern Europe Towards Harmonisation: Economic costs and benefits of harmonisation*, IFO, Munich, 1994

Amann et al, *Cost-Effective Control of Acidification and Ground-Level Ozone* (second interim report), IIASA:, for the EU, DG XI, December 1996

Business Consulting Services, *Costs of Compliance with Environment directives in Greece*, report for DG XVI, Thessaloniki - Athens., 1992

Blackwell, Jonathan and Associates, 1992*. Study on the Environment and Regional Development in Ireland,* Report prepared for the EU, DG XVI for Regional Policies.

EBRD and EU, *Environmental Standards and legislation in Western and Eastern Europe, Towards Harmonisation*, Water Sector Case study by Zabel, Buckland, Glennie, Warren of WRc, final report of task Vib, 1993

EBRD, *Transition Report 1995*

ECN-SRC International Prague, *Environmental Costs of transport and policies*', *Case studies for Poland, Bulgaria, Czech Republic*, for EU, DG XII, July 1996

IIASA, 'Water Qualty in Central and Eastern Europe, Good to the last drop', IIASA *Options* Journal, 1996

Jantzen & de Bruyn, *Cost-assessment of medium term Polish Environmental Policy Goals*, TME (Institute for Applied Environmental Economics) for the polish and Dutch Ministry of Environment, The Hague, April 1994.

Jantzen, 1995, *Urban Transport and Air-pollution: Trends and Policy Options, Case studies for Moscow, Budapest and Warsaw* (draft final report) for the World Bank, The Hague, 1995

Ministry of the Environment of Slovakia, *National Environmental Action Programme*, Bratislava, 1996

Ministry of Waters, Forests and Environmental Protection, *National Environmental Action Programme of Romania*, Bucharest, 1995

Minstry of Environment and Physical Planning, *Strategic guidelines on waste management for the republic of Slovenia,Ljubljana,* August 1996

OECD, *Pollution abatement and control expenditure in OECD countries,* 1996

Polish Ministry of Environmental Protection, Natural Resources and Forestry, *Designing a Programme of Compliance Schedules for Polluters*, final report by ERM, 1994

RIVM, *Scenarios for Economy and Environment in Central and Eastern Europe*, report N° 48 1505002, 1996

Regione Emilia-Romagna (1992), *Problemi di organizzazione dei servizi idrici in Emilia-Romagna*, Report N° CO 3109 by WRc

Somlyody Lazlo (1995) *Municipal wastewater treatment in central and Eastern Europe, Present situation and cost-effective development strategies*, report for the environmental action programme for central and eastern Europe, World Bank

World Bank, *The Environmental Impliiations of EU accession*, Draft working paper, World Bank, Poland Country Economic Memorandum, Feb. 1997, 27 p.

World Bank, Environmental Action Programme for Central and Eastern Europe, Document for the Ministrial Conference, Lucerne, Switserland, 1993

ANNEX 1

MOSES - A TECHNICAL-ECONOMIC MODEL TO ESTIMATE COMPLIANCE COSTS

Basics of the model is to evaluate cost and emission reductions for different technologies for (each category) of source of emissions. Model components to be analysed :

1. Sources of pollution are modelled (air: SO2, NOx, particles, VOC; water: COD, P, N, heavy metals; waste: Haz Waste, Ash, Industrial Waste) at the level of an industrial sector (or individual installation, or comparable installations, depending on the level of detail required for the analyses). The emissions (time serie) per year of the uncontrolled source is the starting point.

2. Given the type of source (pollutant, energy conversion process, fuel, concentration of emissions) a set of technologies are addressed. These technologies are marginally defined (marginal purification, marginal costs). So the data bases contains data on performance of the technologies (purification efficiency), and unit costs (NLG/kg, but the model allows for conversion to any other currency, and local conditions or local technologies and prices)

Different policy approaches can be evaluated. If needed one can model environmental standards (how much reduction is required, at what time) as to simulate individual permits and the like - there are various options to simulate with the model: first of all you can make a cost-effectiveness curve, putting in one graph marginal abatement costs and emission reduction you can also simulate current environmental policy: what is the emission reduction ? and which costs are involved? But due to the design of the model (with basically marginal cost curves for each source) one can also see what might happen if an emission tax or tradable permits are applied (assuming that firms will abate emissions up to the point where the charge-payments/price of permits are lower than the marginal abatement costs) This enables the evaluation of ‘market based’ versus ‘command and control’ policies.

The strength of the model is that it can be applied in almost any situation, making use of the standard data and typical emission data. The drawback is that for each case study, one should have insight in emissions, at the best detail available (and this often gives a problem). However, many studies on countries, as well as regions have been carried out with MOSES. MOSES is best equiped for air and water, (waste is more difficult).

Studies so far carried out with the model:

CEEC:

- Poland: 6 scenarios: current standards, (additional) policy objectives to be reached through (a) CAC or (b) MBI; low and high growth. Eight industrial sectors, SO_2, particles, NO_x, COD, P, haz waste, ind waste, ash&slag.
- Slovakia: estimation of revenues of environmental charges in the field of air, water and waste

Other countries:

- EU: cost assessment for SO_2, VOC, NO_x of 5th action programme (no real MBI scenario)
- Netherlands: cost-advantage of tradable permits for SO_2 and NO_x, 2010 targets of policy: power, refineries, chemical ind, base metal
- Flanders: industrial water pollution COD/heavy metals: current policy against MBI
- Brazil: Three industrial waste water case studies on COD/Heavy metals, studies on sewerage and sewage treatment (compliance costs)
- Mexico I: Coatzacoalcos-region (refineries etc): air pollution (SO_2/NO_x), water pollution (COD): CAC against MBI
- Mexico II: border region: sewage and sewage treatment (consequence of tariff policy of large treatment plants)

ANNEX 2

Economic assessment of priorities for a European environmental policy plan: An operational methodology for the integrated assessment of policy alternatives under the 6th Environmental Action Programme of the European Union

This collaborative study uses integrated environmental assessment to provide assistance in supporting the broad development of alternative policy schemes to be addressed in the European Union's 6th Environmental Action programme.

It covers:

- environmental priorities
- human activities/target sectors
- pollutants and impacts
- economic efficiency and cost effectiveness
- distributional incidence
- implementation alternatives.

For example, TME is currently assessing cost-effectiveness functions for hazardous waste, PM_{10} (fine particulates) and wastewater (COD, N, P). The objective is to create databases on emissions of these substances for each European country. Simultanously cost data on environmental technologies are collected to be incorporated in MOSES. The result is expected to be available by summer 1997 and will make it possible to assess costs and emission reductions simultanously for various policy scenarios.

The study is being carried out as a collaborative project by: RIVM - National Institute of Public Health and the Environment (The Netherlands), Centre for Social and Economic Research on the Global Environment/Economics for the Environment Consultancy Ltd. (CSERGE/EFTEC, UK), National Technical University of Athens (NTUA, Greece), International Institute for Applied Systems Analysis (IIASA, Austria).

In addition, collaborative networks are used including e.g. TME for cost estimates of abatement measures as far as not incorporated in IIASA's RAINS model and CML for substance flow analysis.