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Technical Report on Enlargement

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Abstract

The economic assessment of priorities for a European environmental policy plan focuses on twelve identified Prominent European Environmental Problems such as climate change, chemical risks and biodiversity. The study, commissioned by the European Commission (DG Environment) to a European consortium led by RIVM, provides a basis for priority setting for European environmental policy planning in support of the sixth Environmental Action Programme as follow-up of the current fifth Environmental Action Plan called 'Towards Sustainability'. The analysis is based on an examination of the cost of avoided damage, environmental expenditures, risk assessment, public opinion, social incidence and sustainability. The study incorporates information on targets, scenario results, and policy options and measures including their costs and benefits.

Main findings of the study are the following. Current trends show that if all existing policies are fully implemented and enforced, the European Union will be successful in reducing pressures on the environment. However, damage to human health and ecosystems can be substantially reduced with accelerated policies. The implementation costs of these additional policies will not exceed the environmental benefits and the impact on the economy is manageable. This requires future policies to focus on least-cost solutions and follow an integrated approach. Nevertheless, these policies will not be adequate for achieving all policy objectives. Remaining major problems are the excess load of nitrogen in the ecosystem, exceedance of air quality guidelines (especially particulate matter), noise nuisance and biodiversity loss.

This report is one of a series supporting the main report: *European Environmental Priorities: an Integrated Economic and Environmental Assessment*. The areas discussed in the main report are fully documented in the various *Technical reports*. A background report is presented for each environmental issue giving an outline of the problem and its relationship to economic sectors and other issues; the benefits and the cost-benefit analysis; and the policy responses. Additional reports outline the benefits methodology, the EU enlargement issue and the macro-economic consequences of the scenarios.

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Reports in this series have been subject to limited peer review.

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1. Introduction

To support the preparation of the next Environmental Action Program, The Environment Directorate General commissioned an economic and environmental analysis of future European environmental policies. This analysis looked at environmental trends, persistency of problems and their underlying causes, definition of new policy targets, robustness of policy responses, environmental expenditures, monetary damage, monetary benefits, efficiency, effectiveness, risk assessment and macro-economic impacts. Starting with the assessment of current socio-economic trend and the impact of current policies, the study computed the Baseline environmental trend, indicating the state of the environment in the year 2010. This projected state showed the possibilities for further enhancement of the EU environmental policy. Furthermore, the scope of such an enhancement was evaluated by comparing the impacts of a scenario of maximum feasible technology disregarding the costs with a scenario based on structural and behavioural measures based on least cost solutions.

The main report advocates and suggests so-called accelerated policies in particularly waste management, air pollution abatement, and climate change. Priorities for policy action lie in waste recycling, energy conservation, fuel switch and emission reduction of acidifying gases - as SO_x, NO_x, and NH_3 -, ozone precursors, heavy metals and persistent organic pollutants. Though recognised as potentially important and structural, the impacts of enlargement of the EU15 on the applied socio-economic and environmental trends were explicitly excluded from the analysis in the main report. In this report the robustness of the conclusions in the main report with respect to enlargement is investigated.

In the coming years, the European Union will be enlarged by the accession of Poland, Hungary, Czech Republic, Estonia, Slovenia, Slovakia, Lithuania, Latvia, Bulgaria, Romania. These are the so-called Accession Countries. There are some notable differences in the characteristics of the environmental pressures between existing EU Member States and the countries seeking accession. By and large, the Accession Countries have a lower population density, a less intensive land use, but a higher energy consumption per unit production. This makes the pressure on biodiversity and forestry less prominent and gives way for high levels of air pollution. The specific geography makes their rivers drain to sensitive water bodies, i.e. the Black sea and the Baltic Sea, rather than the insensitive Atlantic Ocean and Mediterranean Sea. Hence, one may anticipate that for the enlarged EU other environmental problems, such as coastal water protection, would call for attention next to the priorities established for the EU15 in the main report. However, to analyse this shift in attention was not the aim of the current investigation.

The main question addressed here relates to the priorities derived in the main report and reads:

> *Would the priorities for EU15 change if the ten Central and Eastern European countries would have enlarged the EU by 2010?*

There could be basically three reasons that would change the current priorities:

- as a result of the enlargement process, driving forces behind environmental pressures might change. It could for example be the case that enlargement leads to a higher level of economic activity in the EU15. This would lead to a larger pressure on the environment implying further actions to meet the same environmental targets. This would make the EAP more expensive;
- a difference in marginal costs between EU15 and Accession Countries which would make it more cost-effective to abate emissions in Accession Countries instead of EU15 Member States. This would make the EAP cheaper;
- a difference in marginal benefits between EU15 and Accession Countries, which would make it more profitable to shift (some of) the actions from EU15 to Accession Countries. This would make the EAP more efficient.

In addition two other questions have been addressed:

- which costs (for Accession Countries) are the result of the compliance with the main EU environmental directives?
- are there – within the Accession Countries – ways to achieve compliance with EU environmental directives in following the 'east costs' approach?

This investigation can be considered as a simple robustness analysis of the results of the main assessment. Consequently, no special scenarios were run to assess the effects of enlargement in a qualitative way. However, some recent reports and documents were available from Central and Eastern European studies on trade liberalisation (IVM, 1998), energy use (Capros et al., 1999), air emissions (Cofala et al., 1999) and economic instruments (TME, 1999). This enabled the investigation of the impact of enlargement in a (mostly) qualitative sense. The assessment of economic developments and driving forces (energy, transport, and agriculture) can be found in section 2.1. The expected environmental developments are analysed in section 2.2. Section 3 gives an update of a previous estimate of the costs of approximation to EU environmental legislation (EDC, 1997) by applying the data gathered in the framework of the PHARE DISAE facility. Section 4 summarises the conclusions drawn in the previous sections.

2. Assessments

2.1 Economic developments

In the transition to free-market economies, the Accession Countries experienced an initial fallback in their economic development. However, most economies recovered soon after. Table 1 shows the development op GDP/capita in the Accession countries for the period 1994-1997. On average growth of GDP was 4.2% in the period 1994-1997. Of the Accession countries highest growth rates can be observed in Poland, Estonia and Slovakia. Low growth (or even negative) is observed in Romania and Bulgaria in this period.

Table 1 GDP per capita in Accession countries, 1997, purchase power parity and real (in US$ per capita), development of GDP 1994-1997

	GDP per capita PPP (US$)	*GDP per capita real (US$)*	*development of GDP (% change)*				
	1997	1997	1994	1995	1996	1997	average
Poland	6380	3512	5.2	7.0	6.1	6.8	6.3
Hungary	7000	4462	2.9	1.5	1.3	4.6	2.6
Czech Republic	11380	5050	3.2	6.4	3.9	1.0	3.6
Slovenia	12520	9101	5.3	4.1	3.1	3.8	4.1
Estonia	5010	3230	-2.0	4.3	4.0	11.4	4.4
Latvia	3650	2211	0.6	-0.8	3.3	6.5	2.4
Lithuania	4510	2581	-9.8	3.3	4.7	5.7	1.0
Slovakia	7850	3624	4.9	8.3	2.5	2.7	4.6
Romania	4290	1549	3.9	7.1	3.9	-6.6	2.1
Bulgaria	3860	1227	1.8	2.1	-10.9	-6.9	-3.5
Accession countries	6325	3197	3.7	5.6	3.8	3.4	4.2

PPP: purchase power parity
Source: REC, 1999, based on EBRD data, total Accession country estimated by TME (based on REC, 1999)

The methodology of 'integrated environmental assessment' (see main report for details) requires the trend of economic and energy use towards the year 2010 to assess the changes in the state of the environment. In the 'Baseline for the Shared Analyses' (commissioned by the Energy Directorate General) an economic development (and energy) projection was developed for the Accession countries (Capros et al., 1999). The assumed development of GDP in Accession countries is given in Table 2. As these projections are based on trend analyses starting from the economic system of Communist times up to recent Eurostat data, the inhomogeneity of the data should make one careful in using them. However, they provide a baseline of potential economic developments in Accession countries and therefore are useful in this framework.

Table 2 Development of GDP in the 'Baseline for Shared Analyses', 1990 = 100

	1990	*1995*	*2000*	*2005*	*2010*	*2015*	*2020*
Poland	100	112	146	189	232	286	343
Hungary	100	89	107	131	158	190	225
Czech Rep	100	94	99	128	159	194	235
Slovenia	100	95	115	145	179	211	248
Baltic countries	100	62	81	105	129	159	191
Romania, Bulgaria, Slovakia	100	93	115	147	180	220	263
Total	100	93	115	147	180	220	263

Source: Capros et al., 1999

The average annual growth rate of GDP in Accession countries for the period 2000-2010 in the above projections is 4.5%. There is not much differentiation between the assumed growth rates: the highest rate is projected for Czech Republic (4.9%), the lowest for Hungary (4%).

To isolate the effect of enlargement, use can be made of results from a study carried out for the EEA (IVM, 1998). This shows that in the "enlargement scenario" the average growth rates in Accession countries would be 2% higher than in case of no enlargement of the European Union.

Assuming that the baseline for shared analyses provides a scenario for ‘accession’ rather than ‘no-accession’ (which is consistent with the main assumptions used in the shared analyses), the GDP-index (in table 2) for 2010 for “no-accession”would be 148 instead of 180.

2.1.1 Energy

Energy use in Accession countries has declined after 1990, mainly due to the introduction of market pricing - leading to better energy efficiency - and the decline of industrial production. As indicated in the previous section, a new set of energy projections were made for the so-called ‘Baseline for Shared Analyses’ (Capros et al., 1999). Unfortunately, these projections do not equal the energy projections used in the main report, though the methodology to derive them is the same.

Also for energy use, it is hard to isolate the effect of enlargement in the projections. On the one hand, the projections are based on trend analyses and do not pay specific attention to the enlargement-issue. On the other hand, it is reasonable to assume that the projections come close to what can be expected with 'accession' as the countries by introducing market pricing started to approximate Western standards. Table 3 shows the energy demand projections for the Accession countries. Total energy demand in Accession countries has declined between 1990 and 1995 by 15%. After 1995, energy demand started to increase again, but only by 2010 energy demand in Accession countries is expected to be at a higher level (2%) than in 1990.

Table 3 Final energy demand in Accession countries, in Mtoe

	1990	*1995*	*2000*	*2005*	*2010*	*2015*	*2020*
Poland	60	62	65	69	75	81	88
Hungary	20	16	17	19	21	23	25
Czech Rep	34	26	26	27	29	32	35
Slovenia	3	4	4	5	5	6	6
Baltic Countries	22	10	10	11	12	14	15
Romania, Bulgaria, Slovakia	139	118	122	131	142	156	170
Total	279	236	245	263	285	312	340

Source: Capros et al., 1999

In Table 4 the assumed development of energy-efficiency (expressed as energy use per € earned) in Accession countries is shown. Apparently, energy-efficiency gains are assumed to be at a high level in Accession countries: in the period 1990-2000 on average 2.6% annually, for the period 2000-2010, energy use per earned € will decrease by 2.9% per year. Again, the effect of enlargement can be analysed only partly. If Table 3 represent the situation of 'accession', it may be assumed that in a 'no accession' scenario energy use could be some 10% lower. If no additional energy efficiency gains are assumed, energy-demand in an 'accession' scenario would be some 20% higher in 2010 (compared to 'no accession'), as a result of additional economic growth of 2% annually in the period 2000-2010. However, it seems reasonable to assume that enlargement will accelerate the adaptation of technologies that are standard in EU. This would lead to higher energy efficiency gains than the (already high) 2.9% in the baseline. Assuming that annual energy efficiency gains would be raised by from 2.9% to 4% (resulting from a faster adaptation of technology), the increase in total energy demand in Accession countries would be limited to 10%. Possible impact of this higher energy use may affect the trade of carbon permits between EU and Accession countries. This will be discussed later.

Table 4 Development of energy-efficiency in Accession countries, in toe per thousand € GDP

	1990	*1995*	*2000*	*2005*	*2010*	*2015*	*2020*
Poland	1.30	1.19	0.96	0.79	0.70	0.61	0.56
Hungary	0.71	0.64	0.57	0.51	0.47	0.43	0.40
Czech Rep	1.56	1.29	1.21	0.99	0.86	0.77	0.70
Slovenia	0.25	0.31	0.27	0.23	0.21	0.20	0.19
Baltic countries	0.87	0.66	0.51	0.42	0.38	0.34	0.31
Romania. Bulgaria. Slovakia[1]	1.03	0.94	0.79	0.66	0.59	0.53	0.48
Total	1.03	0.94	0.79	0.66	0.59	0.53	0.48

Source: based on Capros et al., 1999

In the 'baseline for shared analyses' also the structure of energy consumption in Accession countries is projected. In Table 5, the share of each type of fuel is shown for 1990 and 2010. Replacement of old power plants and boilers in industry using solid fuels will result in a shift from solid fuel (decrease of 55% to 38%) to natural gas (increase of 15% to 30%). The share of liquid fuels remains constant, as a result of increased use in transport, but less use in industry.

Table 5 Structure of gross inland energy consumption in Accession countries (share in total energy demand), 1990-2010

Country	*Solid Fuels*		*Liquid Fuels*		*Natural Gas*		*Nuclear*		*Renewable Energy*	
	1990	2010	1990	2010	1990	2010	1990	2010	1990	2010
Poland	74%	52%	13%	18%	9%	23%	0%	0%	4%	7%
Hungary	22%	6%	30%	26%	31%	54%	13%	12%	1%	1%
Czech Republic	61%	42%	19%	21%	12%	29%	7%	7%	1%	2%
Slovenia	27%	13%	34%	39%	13%	25%	23%	17%	5%	8%
Baltic states	22%	11%	42%	34%	23%	32%	13%	18%	4%	7%
Slovakia, Romania, Bulgaria	55%	38%	22%	22%	15%	30%	6%	6%	3%	5%
Accession countries	55%	38%	22%	22%	15%	30%	6%	6%	3%	5%

Source: based on Capros et al., 1999

[1] In the baseline for shared analyses for 4 CEE countries (Poland, Czech Republic, Hungary and Slovenia) specific projections were made. The other 6 CEE countries were grouped in two groups: the Baltic States (Lithuania, Latvia, Estonia) and Slovakia, Romania and Bulgaria.

Projected shifts in final energy demand in Accession countries are shown in table 6. It shows that the share of final energy demand of industry will decrease, whereas the share of transport will increase. Residential and tertiary use will on average remain constant.

Table 6 Structure of final energy demand in Accession countries, 1990-2010

Country	Industry		*Residential Tertiary*		*Transports*	
	1990	2010	1990	2010	1990	2010
Poland	39%	32%	48%	52%	13%	17%
Hungary	32%	21%	52%	60%	16%	19%
Czech Republic	49%	49%	42%	36%	9%	15%
Slovenia	43%	27%	29%	35%	28%	39%
Baltic countries	31%	29%	58%	47%	11%	24%
Slovakia, Romania, Bulgaria	39%	33%	48%	49%	13%	18%
Accession countries	39%	33%	48%	49%	13%	18%

Source: based on Capros et al., 1999

Concerning energy demand, use and structure thereof, it can be concluded that enlargement will lead to an accelerated improvement of energy-efficiency throughout Central and Eastern Europe. It is also anticipated that there will be a shift that there will be a shift in the fuels used: the dominance of solid fuels in total consumption (>50% in 1990) will gradually diminish. By 2010, the share of solid fuels is less than 40%, whereas the share of natural gas in total consumption will have doubled. It is expected that the structure of energy demand will change: industry will use (relatively) less energy, the share of residential and tertiary energy demand remains constant, transport will require more energy.

2.1.2 Transport

Opposite to the decline of GDP in the beginning of the 90s, road transport has increased in Accession countries continuously after 1990:

- private car ownership increased considerably after 1990 in Accession countries (growth rates of 5% or higher per year);
- road transport increased, mainly due to the traditional small share of road transport in total freight transport in Accession countries.

Private car ownership in Accession countries in 1990 was on average 14 cars per 100 inhabitants. Accession countries with relative many private cars are Slovenia (29), Hungary (18), Czech and Slovak Republic (21). Poland (14), Bulgaria (14), Estonia (15), Lithuania (13) and Latvia (11) are near the average for the Accession countries. In Romania only 6 of each 100 person own a car (EEA, 1995, Dobris, statistical compendium, appendix p 332). With growth rates of 5%[2] (and even higher), in most Accession countries car ownership in 2000 will be about 20 cars per 100 inhabitants: half of the EU level for 1990 (about 40 cars per 100 inhabitants).

Growth of mobility in Accession countries is concentrated in urban areas, already creating 'normal' congestion of traffic in major cities in Accession countries like Warsaw, Budapest, and Prague. For example, in 1993 in Warsaw 36 cars per 100 inhabitants were already on the street (Poland on average 16), in Budapest 25 (Hungary on average 18) (TME, 1995).

Enlargement will affect transport between Accession countries and EU. This will result in considerably higher growth rates of freight transport between Accession countries and EU and vice versa. In the IVM-study it is estimated that due to enlargement of the EU transport volumes between EU-15 and Accession countries will increase annually 10% (5% with 'no-accession') and exports from Accession countries would increase 6% annually in stead of 3% (IVM, 1998, p. 48). Freight transport within the Accession countries will also increase but at a (much) slower rate than GDP growth due to large efficiency gains.

[2] In Poland car ownership increased by 5% annually between 1991 and 1995 (MoT Poland, 1995)

2.1.3 Agriculture

In the period 1989-1997 agricultural output in most Accession countries decreased by as much as 50% (Estonia, Latvia). Only in Romania and Slovenia, output remained more or less stable at 1990 levels. On average agricultural production in Accession countries decreased with 25% (IVM, 1998, p. 64, FAOSTAT). This drop in production was mainly the result of the still ongoing process of privatisation and was further enhanced by – subsidised – food imports from the EU.

Whereas in 1989 the use of artificial nitrogen fertiliser in Accession countries was on average at a slightly higher level than in EU (76 kg per ha compared to 74), use rapidly declined after 1989 to an average of 30 kg per ha in 1995. Large differences in fertiliser use remain and give rise to further decreases in pressures on the environment. In EU only a small decline (10%) was observed in the same period (IVM, 1998, p. 67, based on FAOSTAT).

The application of pesticides in general also decreased in Accession countries, though not so drastically as fertilisers, also there are large differences between countries with a colder and warmer climate. In Poland and the Baltic countries the application of active ingredients of pesticides dropped from slightly more than 1 kg/ha to less than 0.5 kg/ha. For warmer countries like Slovenia, Slovakia, Romania and the Czech Republic application levels dropped from between 2 and 3 kg/ha to between 1 and 2 kg/ha. Compared to Accession countries, pesticide application in EU is on average on a higher level of about 2 kg/ha (active ingredients) (IVM, 1998, p. 68, based on FAOSTAT). Livestock and pig and poultry densities (expressed as unit per ha) in Accession countries are – except for a few exceptions – considerably lower than in EU. In many Accession countries livestock densities dropped by more than 50% compared to 1989 levels (IVM, 1998, p. 69).

As Accession countries will become members of the EU, they also may profit from the Common Agricultural Policy of the EU. For some products affected by EU policy this may mean higher production levels, than in a no-accession scenario. For the EU an analyses has been made for the period 1994-2005 of the effects of Accession on agricultural output. It shows that, for some products, outputs additionally growth compared to a no-accession scenario. The following table summarises some findings.

Table 7 Agricultural output changes (in %) in Accession countries, 1994-2005: Accession scenario compared to No Accession scenario

	Accession scenario 1994-2005	*No Accession scenario* 1995-2005
Cereals	15	19
Oilseeds	43	14
Sugar	45	20
Milk	18	16
Beef	33	14
Pork	21	22
Poultry	50	22

Source: IVM, 1998, p. 76 based on Commission of EU.

Accession will have various impacts on agriculture in Accession countries (see IVM (1998), p. 77). On the one hand the unchanged implementation of the CAP in Accession countries will lead to increased inputs and outputs (as shown in table 7), scale enlargement and concentrations. As a result environmental pressure from agriculture will increase. On the other hand Accession will also lead to the implementation of EU nature protection and environmental legislation, which will have a positive effect on environment. As Accession is basically an economically driven process, this will result in gradual modernisation of agricultural practices in Accession countries. The net result thereof is difficult to assess. In some cases modernisation may have a positive effect (for example the construction of manure storage, more effective use of fertiliser), but the opposite also may be true. Scale enlargement, increased use of inputs (fertiliser, pesticides) will not decrease environmental pressures from agriculture.

2.1.4 Influence of enlargement on driving forces in the European Union

Accession also may influence production levels of driving forces in EU. Enlargement of the liberated energy market may affect production capacity and levels in the EU, as a result of import from Accession countries. Transport from EU to Accession countries will increase due to larger trade volumes. Inclusion of the Accession countries in the CAP may lead to a shift of some agricultural production from the current EU member states to Accession countries. See Box 1 for an account on the impact of land use changes in Poland.

2.2 Environmental developments

2.2.1 Climate change

Table 8 shows the projected development of carbon emissions in Accession countries. For the period 1990-2000 a downward trend can be observed: due to decreased energy use and changes in the fuel mix (less solid fuels). CO_2-emissions in 2010 are expected to be 7.5% lower than in 1990, although after 2000 energy demand increases and reaches a higher level in 2020 than in 1990. But as a result of the shift from solid to gaseous fuels and an increase in the use of renewable energy 2010 CO_2-emissions are about 100 Mton lower than in 1990.

Table 8 Carbon dioxide emissions in Accession countries, in Mtoe

	1990	*1995*	*2000*	*2005*	*2010*	*2015*	*2020*
Poland	340.9	330.1	330.1	339.6	348.1	358.8	374.4
Hungary	65.8	55.3	56.3	58.7	62.8	70.2	78.1
Czech Rep	145.0	114.6	112.8	120.9	131.3	137.1	145.1
Slovenia	12.5	13.4	13.7	14.8	16.4	17.9	19.8
Baltic countries	89.2	41.7	40.5	42.5	45.9	49.8	57.1
Romania. Bulgaria. Slovakia	653.4	555.0	553.4	576.4	604.5	633.8	674.5
Total	1306.7	1110.0	1106.9	1152.8	1208.9	1267.6	1349.0

Source: based on Capros et al., 1999

As the Kyoto reduction target for the 10 Accession countries together is 70 Mton $CO_{2\text{-eq.}}$ (EEA, 1999, p. 86), there would be a limited possibility for trade with EU (30 Mton) in the baseline for shared analyses projections. As discussed in the section on energy it is likely that the baseline projections for shared analyses are closer to an accession than a no-accession scenario.

The following two tables show the development of indicators for carbon dioxide emissions (in ton per capita and kg per earned €). After the decline between 1990 and 2000 with on average 15%, CO_2-emissions per capita slowly start to increase as a result of increased energy demand.

Table 9 CO_2-emissions per capita in the baseline for shared analyses (ton/capita/year)

	1990	*1995*	*2000*	*2005*	*2010*	*2015*	*2020*
Poland	8.9	8.6	8.5	8.7	8.8	9.0	9.4
Hungary	6.3	5.4	5.5	5.8	6.2	6.9	7.7
Czech Rep	14.0	11.1	10.9	11.6	12.5	13.1	13.8
Slovenia	6.3	6.7	6.9	7.4	8.1	8.8	9.8
Baltic countries	11.2	5.4	5.2	5.4	5.8	6.2	7.1
Romania, Bulgaria, Slovakia	9.5	8.1	8.0	8.3	8.6	9.0	9.6
Total	9.5	8.1	8.0	8.3	8.6	9.0	9.6

Source: based on Capros et al., 1999

Table 10 CO_2-emissions per GDP in the baseline for shared analyses (kg/€)

	1990	1995	2000	2005	2010	2015	2020
Poland	7.4	6.4	4.9	3.9	3.2	2.7	2.4
Hungary	2.3	2.2	1.9	1.6	1.4	1.3	1.2
Czech Rep	6.7	5.7	5.3	4.4	3.8	3.3	2.9
Slovenia	0.9	1.0	0.9	0.8	0.7	0.6	0.6
Baltic countries	3.5	2.7	2.0	1.6	1.4	1.2	1.2
Romania, Bulgaria, Slovakia	4.9	4.4	3.6	2.9	2.5	2.1	1.9
Total	4.9	4.4	3.6	2.9	2.5	2.1	1.9

Source: based on Capros et al., 1999

Table 10 shows that there are large differences between Accession countries. Compared to EU-level (which has CO_2-emissions of well below 1 kg/€), Poland and the Czech Republic have very high CO_2-emissions per unit GDP. Slovenia relatively has the lowest emissions, and comes near EU-efficiency. In the period 1990-2010 it is foreseen that the energy efficiency will increase by almost a factor 2. For the period 2000-2010, the annual gain in efficiency is about 3.5%. After 2010 this drops to 2.7%, still a high figure compared to EU countries. For the emissions of other greenhouse gasses like CH_4 and N_2O, no scenario analyses has been carried out. So only indications of trends can be given.

Main sources for methane emissions are landfill, coal -mines and livestock. Expected trends in Accession countries are:

- Accession countries will have to comply with the landfill directive. This sets rules for the control of methane emissions from landfills (new ones as well as old ones). Due to this methane emissions from landfills will decrease;
- The input and production of coal will decrease considerably. This will have a positive effect on methane emissions in Accession countries;
- Another important source of methane emissions is livestock. In the accession scenario, the beef production will be considerably higher than in the 'no-accession' scenario, on the other hand 'milk production' is a little lower (than with "no-accession"). If it is assumed that milk production is a better indicator for methane emissions than beef production (since beef production can be increased without increasing the average number of animal: they live shorter), it can be concluded that methane emissions from this source also will decrease slightly (about 2%).

The overall effect of enlargement on methane emissions will be reductions of more than 10% of methane emissions in the long run (if measures to comply with the landfill directive are implemented). For N_2O it can be concluded that Accession will not lead to additional N_2O emissions. In both the Accession and the no-accession scenario fertiliser use in 2005 is more or less the same (marginal differences).

Marginal costs and benefits

No systematic information is available on the level of marginal costs to reduce greenhouse gas emissions in Accession countries. However, it is clear that in Accession countries the reduction potential as a result of energy saving is large (it is estimated at 250 Mton (Jepma, 1997)), and at low (marginal) costs. In a list of potential joint implementation projects for the Netherlands it appeared that the average price would be $ 6 per ton of CO_2 (CCAP/SEVEn, 1996). This is well below the average for EU and well below the assumed permit price of about € 13.64 per ton CO_2. Another study shows that at a permit price of US$ 50 per ton CO_2 the potential for trading in Accession countries would be in total 700 Mton CO_2 (of which 250 Mton energy efficiency improvement, 250 Mt forestry, and some smaller options like renewables) (Jepma, 1997, p. 259). Also taking into account that specific energy demand per unit GDP is high, compared to EU-levels, one can conclude that CO_2-reduction options in Accession countries in general will be less costly than in EU-15 countries.

Marginal costs for measures to reduce methane and N_2O emissions in Accession countries in general will be lower than in EU due to price level differences. As in the EU, measures to reduce methane emissions from landfill, from oil and gas (distribution), coal mining and (to al lesser extend) livestock, could be implemented for a large part at below zero costs. On the other hand also marginal benefits in Accession

countries will be lower than in EU. This is mainly due to the fact that current income levels in Accession countries are (much) lower than in EU (which affects the statistical value of a 'human life').

Effect of enlargement on EU priorities
If enlargement takes place it may be expected that energy demand in Accession countries is some 10% higher in 2010 than with "no-accession" without additional energy saving. This would increase CO_2-emissions with more than 100 Mt. Combined with the above analyses of the baseline for shared analyses scenario, this would implicate that enlargement would decrease the trade potential of Accession countries to zero.

Therefore, enlargement of the EU with the Accession countries would have impacts on the Full Trade Accelerated Policies scenario. In this scenario about 240 Mt CO_2 reduction would be achieved by trading with the Annex B countries. Part of this trade would be with the Accession countries (this could be up to 100 Mton). The above analyses shows however, that enlargement would limit trade possibilities for Accession countries.

The restricted trade possibilities for EU may lead to (slightly) higher permit costs than the assumed € 63.70 per ton of carbon in the full trade scenario. This higher permit price could enclose additional energy conservation in Accession countries (since marginal costs in Accession countries are still much lower than in EU), or it would mean that permits would be obtained from more distant regions.
In such scenario, EU would benefit from the possibility for additional energy saving in Accession countries, as this would result in better trade opportunities. As long as energy saving measures in Accession countries can be realised at lower marginal costs than in EU, EU countries may have a possible financial interest in additional energy efficiency measures applied in Accession countries.

The possible impact of enlargement on climate change would be that in the EU-15 permits have to be purchased at a slightly higher price than € 50 per ton of carbon. This could have an influence of some 5-15% of total costs of climate change policy in EU in the AP-FT scenario.

2.2.2 Nuclear Accidents

Enlargement of the EU may lead to an acceleration of policies aiming at reducing risks, because EU can demand safety measures to be implemented in Accession countries. This will have a positive effect on risk reduction in EU.

2.2.3 Biodiversity

Enlargement may positively affect EU with respect to biodiversity. This would be the result of a mixture of consequences of policies. Enlargement implies that Accession countries will have to comply with various environmental directives of EU. As far as the implementation of these directives has transboundary effects, it may lead to a reduction of pressures. This will be the case for acidification and to a lesser extend eutrophication.

Admission of Accession countries to the Common Agricultural Policy (CAP) may lead to a shift of agricultural production in Europe. Due to relative lower production costs in Accession countries, it can be expected that some of the bulk production now taking place in EU will shift eastwards. This lowers the pressure in EU15 (smaller agricultural area) at the expense of an increasing pressure in the Accession Countries. Integration of environmental considerations into the CAP is therefore also crucial in the Accession Countries.

2.2.4 Acidification and Eutrophication

In Accession countries that are advanced in the implementation of economic reforms (the "first wave" of accession) energy consumption has dramatically decreased and the demand structures have changed towards cleaner fuels.

Also energy intensities decreased. Previous studies (e.g., Cofala et al., 1999) demonstrate that economic restructuring and convergence of energy intensities to the values typical for the EU member countries is likely to decrease total energy use in Central and Eastern Europe further.

Lower energy consumption and implementation of stricter air emission standards in some of the accession countries have already caused a decrease in emissions of air pollutants. In 1996 the emissions of SO_2 in the Accession countries were by 35 percent lower and those of NO_x 28 percent lower than in 1990 (EMEP, 1999). For 2010 it is expected that SO_2-emissions will be reduced further (59% lower than in 1990), but further reductions of NOx are not foreseen (EEA, 1999, p. 147).

Emissions will be reduced further as a result of harmonisation of air emission legislation with the EU standards. Studies performed by IIASA (Amann et al., 1999, Cofala et al., 1999) indicate that adoption of the EU standards combined with continuation of economic restructuring is likely to further decrease the emissions of SO_2 and NO_x by 70 percent and 60 percent respectively compared to the level of 1990. Lower emissions in the accession countries will bring benefits in the neighbouring countries. In Germany and Austria up to two percent of ecosystems can be additionally protected against acidification because of measures undertaken in the accession countries.

Applying the same environmental targets in the accession countries as the targets from the EU acidification and ozone strategy will result in positive environmental effects in the current EU member countries (EU-15). Because of lower emissions in the accession countries, the targets for the EU-15 can be achieved at lower cost. The cost savings are up to three percent of total cost of controlling pollutants contributing to acidification and ground-level ozone. Cost savings in the EU-15 are about 40 percent of extra expenditures in the accession countries necessary to achieve the EU standards and targets.

These examples clearly indicate that the European enlargement will have a positive effect on environmental situation also within the EU-15 group of countries. Approximation of emission control policies in Central and Eastern Europe with those of the European Union will make the achievement of environmental goals within the EU-15 easier and cheaper. Thus unification of environmental legislation in Central and Eastern Europe with that of the European Union deserves special attention and support.

2.2.5 Chemical risks

For chemical risks no specific information is available on the situation and trends in Accession countries. As is the case for Acidification it may be expected that the implementation of EU environmental regulations (for example stricter vehicle emission standards, phasing out leaded gasoline) will positively affect emission levels in Accession countries. Also the expected shift in the fuel mix (from solid fuels to natural gas) will have a positive effect on emission levels.

Some reductions come without costs, as these are the result of restructuring of the economy, but other reductions will be due to the implementation of environmental standards. Marginal costs in Accession countries will not differ much from those in EU15, because these are related to measures to be taken on for example vehicles, which are for the most produced outside Accession countries. Also the specialised equipment needed to reduce heavy metal emissions, poly aromatic hydrocarbons (PAHs), etc. will probably not be cheaper in Accession countries than in EU15.

2.2.6 Water Management

In the last decade emission to surface and ground water in Accession countries have decreased. Part of this is the result of the economic decline: for example the use of fertiliser in Accession countries decreased after 1990 with 60% on average, also the use of pesticides decreased (by about half). Also industrial discharges decreased, leading to less emissions of for example heavy metals. This influenced water quality in a positive sense. For example in the Czech Republic, heavy metal concentrations decreased considerably after 1990. In 1994 often these concentrations were only half of those in 1990. Also concentrations of P and N were reduced in this period (CEI, 1996, p. 128-133).

Due to the enlargement, Accession countries will have to implement the requirements of the urban wastewater directive and the nitrate directive. In many cases this implies the introduction of tertiary treatment on waste water treatment plants (advanced nutrient removal). This will lead to a significant reduction of nutrient discharges to the surface water. For example, for Poland it is estimated that P-tot emissions would be reduced by 50% between 1996 and 2010 as a result of the implementation of the urban wastewater directive. For N-tot emissions would be reduced by about 35% (TME, 1998, Annex 1, section 4.4). Compliance with the requirements of the nitrate directive may have a marginal positive effect on water quality too.

There are indications that marginal costs of improving nutrient management in Accession countries are low. An analysis made in the framework of the PHARE DISAE facility shows that in Poland, the efficiency of nutrient management at national scale can be improved considerably, without large costs. A rough indication shows that for approximately € 300 million per year an appropriate nutrients management system could be introduced on farms in Poland (TME, 1998, Annex 1, section 12). Due to efficient use of manure, savings in the same order can be expected (Sapek, 1997).

Excess emissions of nutrients in Accession countries (phosphate, nitrate) will both affect the national environment, and will be transported by rivers to other countries. As some rivers in Accession countries flow into EU15 seas (Baltic Sea, Adriatic Sea, Black Sea), water policy in some areas in the Accession countries will affect water (and coastal) quality in EU in a positive sense. Box 1 below discusses the future eutrophication state of the Baltic Sea with regard to the accession of Poland to the European Union.

Box 1 Will the future economy of Poland be more or less Baltic friendly?

Poland's territory accounts for 19% of the Baltic Sea drainage basin. At the same time, its 38 million inhabitant represent almost half of the 80 million people living in the region. Until now Poland's contribution to the eutrophication process in the Baltic Sea has been estimated at roughly 20% for nitrogen and 40% for phosphorus. These numbers indicate that in *per capita* terms the Polish economy discharges less than the other countries in the drainage basin do. Given insufficient treatment applied to sewage discharged from many Polish industrial or municipal plants, this only demonstrates how massive the other countries' discharges are. What this further means is that improvements in abatement efficiency may be more than offset by the growing overall scale of economic activities and given its demographic potential and recent economic growth rate, Poland will be pivotal for the future of the Baltic Sea.

The answer to the 'Baltic friendly' question is by far not obvious. On the one hand, there is little doubt about substantial improvements achieved in municipal and industrial wastewater treatment efficiency over the last decade. The volume of waste water requiring treatment decreased from 4.6 km^3 to 3.0 km^3 between 1985 and 1995, and the share of that untreated dropped from 43% to 23%. Between 1985 and 1994 the number of cities without sewage treatment plants decreased from 403 to 273 out of the total of 860, and this trend continues. On the other hand, however, the Polish agriculture will be under increasing pressure towards modernisation by adopting Western technologies and land use schemes. This implies quadrupled chemical inputs per hectare, and transition from a diversified landscape of small holdings separated by meanders of hedges to large-scale farming. Given uncertainties inherent in calculation methods and dispersion modelling, the share of Poland's agricultural emissions to the Baltic Sea are estimated in the range from 50% to 80% with respect to nitrogen and in the range from 20% to 50% with respect to phosphorus. Unmanaged quadrupling of fertiliser inputs will certainly have adverse effects for the eutrophication state of the Baltic Sea.

It is only now that the European Union member states initiated attempts to make their agricultural sectors more environmentally friendly by e.g. limiting chemical inputs, encouraging biodiversity conservation etc. These programmes require gigantic budgets and considerable social costs despite of its small farmers' population. Replicating such scenarios in Poland is hardly conceivable. Therefore the future of Poland's agriculture – key to the wellbeing of the Baltic Sea – calls for a radically new vision and innovative approaches. Prudent methods of agricultural landscape management provide a promising way out of the dilemma. By applying fairly simple methods of enhancing biological diversity of the farmland, a tradition in Poland's Leszno region, and controlling biochemical cycles, farmers can at least sustain their yields and limit environmental impacts.

Adapted from T. Zylicz, Agriculture and environment in Poland, personal communication, 1996.

2.2.7 Waste Management

Waste generation in Accession countries is different from the EU-average. Indications show that the current per capita generation of waste in Accession countries is on average 35% below the EU-average (500 kg/capita). On the other hand industrial waste production per capita is about 50% above the EU-average (EEA, 1999, p. 211).

In EU15 countries there is an almost linear relation ship between growth in consumption and (domestic) waste production. As in the EU, waste arisings in Accession countries are expected to continue to increase with economic growth. Therefore, the amounts of municipal waste to be processed in the future will increase considerably.

To comply with the landfill and packaging directive, Accession countries will have to change their waste management systems considerably. Currently the waste infrastructure in Accession countries is poor and mainly directed towards collection and landfill. Setting up separate collection and waste processing facilities (composting, recycling) will demand considerable investments. Also the closure and aftercare of existing landfills will require considerable investments, not in the least because in Accession countries large quantities of unofficial landfill sites exist, that will need to be closed and taken care of.

On the other hand, implementation of the landfill and packaging directive will reduce the amounts of waste to be land filled in Accession countries, thus also reducing emission of methane from landfills.

The expected changes in waste management due to 'accession' can be illustrated by the projected changes that would take place in Poland as a result of compliance with the landfill and packaging directive. Whereas the share of recycling (including composting) in the total waste stream counts for 1.2% in 1996, it is anticipated that by 2010 some 45% of the total waste stream could be recycled (TME, 1998, Annex 1, section 5.4).

As waste management is a regional and local problem no direct influence of enlargement on the EU is to be expected.

Due to the increased recycling activities, large amounts of secondary materials (paper, glass, metals, and plastics) will come on the market. This may affect the EU recycling market in both a positive or negative sense. In the short run, it may occur that recycling capacity in Accession countries is to small for the amounts recovered by the waste management system. This could lead to export to EU, having a negative impact on prices of secondary materials. In the long run, the opposite may occur: since labour costs in Accession countries are relatively low, and waste recycling is relatively labour intensive, recycling industries may shift to Accession countries. This could make recycling cheaper for EU member states.

2.2.8 Tropospheric Ozone

In Accession countries it is anticipated that transport, one of the main sources contributing to the formation of tropospheric ozone, will increase much faster than in EU15. At the same time the adoption of the vehicles directives will lead to lower emission factors as foreseen in the baseline scenario. As the formation of tropospheric ozone is hardly of a transboundary nature, policy and measures in the Accession countries will hardly affect tropospheric ozone levels in the EU.

For the reduction of VOC emissions in general no cost-estimates are available for the Accession countries. For part of the stationary VOC-emissions – those from oil storage and handling – it is estimated that total investment needs in the Accession countries would be about € 0.5 billion.

2.2.9 Coastal zones

Enlargement of the EU with the Accession countries will have a positive effect on the water quality of coastal zones. This will mainly be a result of the implementation of water management policies (as discussed under water management).

2.2.10 Urban stress

Urban stress – as measured as emissions per capita of certain pollutants (SO_2, NO_x, Benzene, PM_{10} and Benzo(a)pyrene) - is larger in the Accession countries than in EU-15. Especially SO_2 and PM_{10} emissions in urban areas are well above the EU-15 average. See table 11. For 2010 the situation in both EU and Accession countries is expected to improve considerably, due to the implementation of policies to reduce urban air policies (both on stationary sources and vehicles). Still for some pollutants emission levels will be considerably higher in Accession countries. Especially emissions of SO_2 and PM_{10} are expected to be at least 3 times higher in urban areas in Accession countries than in EU.

Table 11. Urban air quality trend in EU and Accession countries, 1990-2010, emissions per capita

Indicator	EU		AC	
	1990	2010	1990	2010
SO_2 (kg)	38	13	103	45
NO_x (kg)	28	14	31	19
Benzene (kg)	0.75	0.44	0.84	0.43
PM_{10} (kg)	2.6	2.1	8.8	6.8
B(a)P (g)	0.58	0.53	0.77	0.59

Source EEA, 1999, p. 327

Enlargement may accelerate the already visible trend in Accession countries towards adaptation of EU standards. As stricter controls apply, emission factors of both industry and traffic will decrease. In case studies for Warsaw and Budapest indications are given of the impact of EU standards for vehicles and fuels on traffic emissions. Especially emissions of PM_{10} (–55%), NO_x (-15%) and VOC (-20%) would be reduced additionally when EU rules would apply on top of national policies (TME, 1995, p. 79 and 81).

No systematic data is available on the marginal abatement costs for urban air pollutants in Accession countries, compared to EU. For PM_{10} also some cost estimates for Accession countries are available (see next chapter of this annex), but in these estimates the same unit costs as used for EU applied. As Accession countries have higher significant higher PM_{10} emissions per inhabitant, marginal abatement costs in Accession Countries still may be expected to be lower: 1 kg reduction in Accession countries is less costly than in EU.

As the analyses shows, enlargement will have a positive effect on urban environment in Accession countries. Enlargement will however, not affect environmental priorities in EU, as environmental quality in EU is not affected by changes in Accession countries.

2.2.11 Soil degradation

It is estimated that approximately 10% of Utilised Agricultural Area (UAA) in Accession countries is sensitive to soil degradation. It should be mentioned that the above estimate is very rough. For example, some other statements about soil degradation are: In Hungary 25% of the land suffers from light soil erosion, in Lithuania about 14% of farmed land is affected by soil erosion (IVM, 1998, p. 70). Both countries are excluded from the above estimate (as not having mountain areas). An explanation can be that in these countries suffer from wind erosion.

As discussed before it is expected that agricultural output in Accession countries will increase due to enlargement. At the same time a shift of some agricultural production from EU-15 to Accession countries may take place. The result of this may be that UAA in EU countries will decrease, whereas it increases in Accession countries. All of this depends on how these changes will be effected (for example: additional UAA in mountain areas in Accession countries or not, shift away from mountain areas in EU). Current data and information does not allow for a more comprehensive analysis.

The conclusion can be that enlargement will hardly affect soil degradation problems in EU-15. In the worst case, problems remain the same. In a more optimistic view, soil degradation problems may decrease in EU due to a shift of agricultural production. Soil degradation problems in Accession countries are also hardly affected by enlargement. It is likely that additional output will be generated through higher productivity of existing UAA, enlargement would not have effect on soil degradation problems.

3. Costs of compliance with EU environmental Directives in Accession countries

In the last decade a variety of studies have been performed on the costs of compliance with EU environmental directives in Accession countries. Most of these studies focussed on one aspect of 'approximation' (air-pollution, water) or on one region. In 1997 a study was performed for DGXI to investigate total costs of approximation for the ten Accession countries (EDC, 1997). The results of this study were based on various earlier studies covering part of the costs of approximation.

The following table gives an overview of the 'best estimate' of investment needs in Accession countries in the field of air, water and waste. It gives an overview of the costs of environmental approximation in Accession countries. These costs are lower than the well-known € 120 billion because costs as the supply of drinking water has been excluded (approximately € 30 billion). Estimates in the EDC study are mostly based on the Ifo-study carried out for the European Bank for Reconstruction and Development (Adler et al., 1994). In this study only a weak link is present between estimated investments and (technical) measures needed to comply with EU regulations. Non of the studies reviewed made explicit assumptions concerning the type of requirements that have to be fulfilled by Accession countries to comply with EU environmental legislation.

Table 12 Investments needed for approximation to EU environmental legislation in Accession countries, "best estimate" 1997 EDC-study (excl. drinking water) (in billion €)

	air	*water*	*waste*	*total*
Bulgaria	5.1	2.7	1.8	9.6
Czech Republic	6.4	1.1	0.8	8.3
Estonia	1.6	1.4	0.1	3.1
Hungary	2.7	3.1	0.6	6.4
Latvia	2.7	1.6	0.1	4.5
Lithuania	4.1	2.3	0.2	6.5
Poland	13.9	13.7	2.2	29.8
Romania	9.1	6.3	1.0	16.4
Slovakia	1.9	0.9	0.3	3.1
Slovenia	0.7	n.a.	1.2	1.9
TOTAL	48.3	33.1	8.3	89.6

Source: based on EDC 1997

After 1997 new studies became available, mainly carried out for the World Bank and in the framework of the Phare DISAE facility. From these studies it is possible to make a new assessment of investment needs to comply with EU environmental legislation. Table 13 gives an overview of these new estimates of the (investment) costs of approximation.

Table 13 Investments needed for approximation to EU environmental legislation in Accession countries (excl. drinking water) (in € billion), TME-estimate 1999 based on World Bank and PHARE DISAE data.

	Air	*Water*	*Waste*	*IPPC*	*Total*
Bulgaria	3.6	2.1	2.5	3.3	11.4
Czech Republic	3.4	1.2	1.2	3.7	9.4
Estonia	0.6	0.2	0.7	0.5	2.0
Hungary	2.5	1.7	0.5	1.8	6.4
Latvia	0.5	0.8	0.3	0.1	1.7
Lithuania	1.0	0.4	0.4		1.8
Poland	7.7	6.5	3.7	6.9	24.9
Romania	2.0	13.9	2.6	0.8	6.8
Slovakia	1.7	0.5	0.9	1.6	4.7
Slovenia	0.5	1.1	1.1	0.1	2.8
TOTAL	23.7	15.8	13.7	18.8	72.0

source: compilation of estimates by TME based on POL-101, EST-101, BUL-111, ROM-101, SLO-, SR-, CR-, WorldBank, TME estimates

Most of the studies reviewed for the compilation of Table 13 have paid a detailed attention to what exactly is needed to comply with EU-regulations. The physical requirements for compliance have been estimated. In general, better estimates for unit costs of various types of investments needed to comply with these requirements are available now than during the compilation of the Ifo study.

For ‘air’ the estimates include ‘large combustion plants’, ‘vehicles’, ‘VOC’ and ‘ambient air’ (fine particles), for water sewerage and sewage treatment (including nutrient removal), for waste in the costs for composting/recycling/land filling (sometimes incineration), closure of landfills (sometimes), hazardous waste management. For compliance to the IPPC directive, estimates for more strict air-standards (in Poland) have been extrapolated to other CEE-countries.

Although the new cost estimates covers more areas than the EDC ‘best estimate’, the total (investment) costs of approximation are estimated now about 20% lower than the ‘best estimate’ presented in the EDC-study. If the IPPC directive is excluded from this, investment costs in Accession countries to comply with air- water- and waste-related directives are € 53 billion, this is 40% lower than the 'best estimate' of the EDC-study. The following table gives a comparison of the old and new estimates. For Slovenia and Slovakia, new estimates are significantly higher than in the EDC-study. For the Baltic countries and Romania estimates are much lower.

Table 14 Comparison of needed investments per inhabitant according to old (Table 12, based on EDC, 1997) and new (Table 13, based on PHARE DISAE, 1997) estimates[a]

	Old	*new*	
	€ per capita	*€ per capita*	*difference new/old*
Bulgaria	1157	1374	19%
Czech Republic	806	916	14%
Estonia	2076	1330	-36%
Hungary	633	631	-0%
Latvia	1796	688	-62%
Lithuania	1769	489	-72%
Poland	770	644	-16%
Romania	729	302	-59%
Slovakia	574	875	52%
Slovenia	925	1406	52%
TOTAL	853	685	-20%

[a]: including IPPC

The following table gives an overview of the underlying estimates for Table 13. For all directives mentioned in the table estimates for one or more Accession countries were available. The available estimates were used to assess investment needs in other Accession countries, making as much as possible use of "explanatory parameters"[3].

Table 15 Detailed investment estimates for various directives in the ten Accession countries, in million €

	LCP	vehicles	air quality	VOC	sewerage	sewage treatment	drinking water	closure landfills	Recycling/ landfills	Haz waste	IPPC
Bulgaria	1627	1769	193	18	1534	522			2450	27	3261
Czech Rep	1858	1263	213	59	397	767			1120	32	3725
Estonia	312	273	42	13	119	49		611	72	15	489
Hungary	878	1332	206	63	602	1076			430	24	1761
Latvia	43	375	68	25	408	171	197	281	51	11	90
Lithuania	74	745	126	22	250	185		117	237	10	44
Poland	3456	3300	861	155	4860	1554	110	2070	1539	86	6927
Romania	402	1145	430	54	1385				2494	74	806
Slovakia	796	784	118	37	170	329			870	22	1596
Slovenia	180	319	21	20	914		235	321	477	275	50
TOTAL	9627	11304	2278	465	10640	4652	542	3400	9740	576	18748

sources:

- Large Combustion Plants (LCP): EST-101, Phare Lithuanian Approximation Strategy, TME-study for Latvia, POL-101, ROM-101, SLO-101 and TME-estimates based on POL-101 and EDC1987 for Bulgaria; Czech Republic, Hungary and Slovakia
- Vehicles directives: BUL-111, Lithuanian Approximation Strategy, other estimates based on adapted estimate for Poland (POL-101), use of gasoline 2010 in CEE countries used to estimate costs in other CEE
- Air quality: TME investment estimates for PM_{10} in CEE countries used as a rough estimate (TME, 1997).
- VOC: BUL-101, LAT-108, Lithuanian Approx. Strategy, SLO-101, for other countries estimates based on fuel use for road transport and costs for Lithuania.
- Sewerage and sewage treatment: BUL111, EST-101, Worldbank-Hungary 1999, TME-Latvia 1999, Lithuanian Approximation Strategy, POL-101. ROM-101, SLO-101. For Czech and Slovak Republic adapted estimate of EDC (50% of costs of sewerage).
- Drinking water: LAT-108, Lithuanian Approx. Strategy, POL-101, SLO-101 (BUL-111 results not used because it relates to drinking water supply, not quality alone)
- Closure landfills: EST-101, LAT-108, Lithuanian Approx. Strategy, POL-101, SLO-101
- Recycling/Landfills: BUL-101, EST-101, Hungary-Worldbank, LAT-108, Lithuanian Approx. Strategy, POL-101, ROM-101, SLO-101, others based on EDC 1997.
- Hazardous waste: EST-101, TME-Latvia 1999, Lithuanian Approx. Strategy, POL-101, SLO-101, others based on Polish costs (POL-101) and rough estimates of amounts of hazardous waste
- IPPC: EST-101, LAT-108, Lithuanian Approx. Strategy, POL-101, SLO-101, others based on Polish costs (POL-101) and estimated costs LCP.

[3] for example energy use, fuel use by transport.

4. Conclusion

Enlargement of the European Union with the ten Central and Eastern European countries will alleviate some of its environmental problems and increase total benefits of its policies. However, enlargement may also add to environmental problems if, for example, perverse EU subsidy regimes are extended to Accession Countries. Although the impact of enlargement on the environment was not fully appraised in this study, the following conclusions can be drawn from our findings:

- The enlargement can be expected to cause profound changes in the economies of the Accession Countries. In countries that are advanced in the implementation of economic reforms (the "first wave" of accession), energy consumption has dramatically decreased and the energy demand structure requires cleaner fuels. Energy intensities have also decreased.
- The enlargement will have a positive effect on the environmental situation in the Accession Countries. Implementation of the Urban WasteWater Treatment Directive in combination with a large effort on sewerage development with tertiary treatment, i.e. nutrient removal, will improve river water quality considerably. Particularly water quality in the Baltic and Black Seas may benefit from this effort. Other environmental problems profiting from enlargement are waste management and air pollution.
- For transboundary problems the enlargement will have positive environmental effects within the Accession Countries, but also within EU Member States. Approximation of emission control policies in Central and Eastern Europe to those of the European Union will make the achievement of environmental goals within the EU easier and cheaper.
- Additional benefits as a result of enlargement is expected if Accession Countries fully comply with the Montreal Protocol; this will help to reduce the health risk associated with stratospheric ozone depletion world -wide. Closing or upgrading unsafe nuclear power plants in Accession Countries brings about other benefits. Health risks associated with nuclear accidents will be reduced by almost 90% throughout Europe.
- In some economic sectors, the environmental performance is expected to improve, but the changes in the transport and agriculture sector may add to the deterioration of environmental quality. These sectors have, so far, not caused major problems in Eastern Europe. However, if, for example, current agricultural subsidy regimes remain unmodified, enlargement will lead to additional economic growth and, thus, to additional environmental problems, e.g. those of biodiversity loss. Integration of environmental considerations into economic sectors is therefore also crucial in the Accession Countries.

On the costs of compliance with EU environmental Directives in Accession Countries:

- The approximation process will lead to high investment costs in the Accession Countries, certainly in comparison with the available EU funds (e.g. PHARE, Cohesion funds). The effectiveness and efficiency of EU funding could improve if environmental impact assessment and cost/benefit analysis were applied.

- Although the new cost estimates cover more areas, the total (investment) costs of approximation are estimated now about 20% lower than the previous "best estimate" (EDC, 1997).

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