European Commission
Directorate-General Environment

Scoping study on cost-effectiveness of EU environmental policy

Final Report

August 2009

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Executive summary

This is the final report for the project "Scoping study on cost-effectiveness of EU environmental policy". The objective of this scoping study has been to:

- Investigate whether the costs per unit of benefits vary across the EU Member States as a result of different policy implementation.

The study has investigated the issue based on existing ex-post cost-effectiveness evidence and more indirect indicators of possible cost-effectiveness differences.

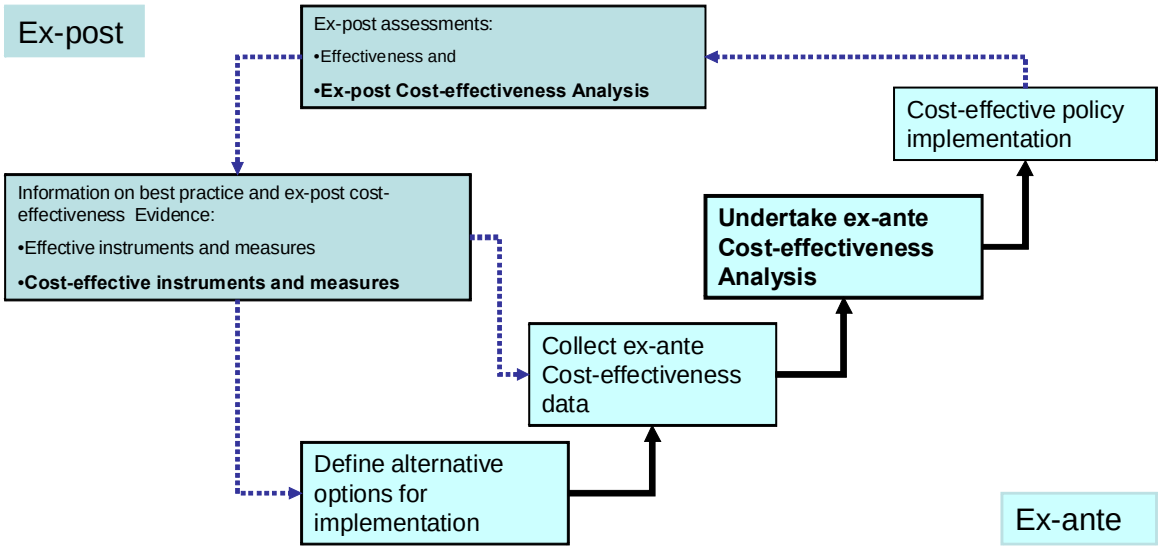
Overall finding of the study

There is little information on whether the cost of achieving a given environmental target is higher in some Member States than in others. One of the main explanations is that ex-post recording of costs and apportionment of the recorded costs to specific policies is very difficult. It is therefore not done in any systematic manner across the EU. Where there is information, it is often difficult to compare because the environmental targets vary or because other factors might explain differences (geography, industrial structure etc). However, direct and indirect evidence does suggest that there are differences in cost-effectiveness, at least in some sectors. The implication is that if best practice could be more widely identified and adopted, then the cost of environmental policy might be reduced, allowing for more to be done for less.

The role of cost-effectiveness analysis

The main function of ex-post cost-effectiveness assessments (CEAs) is to support policy implementation as illustrated in Figure 0.1: Either by identifying better options for implementation or by improving the estimates of costs and effects of alternative implementation options. This would allow for best practice to be identified and the cost of meeting environmental objectives to be reduced.

Figure 0-1 Use of ex-ante and ex-post assessments in policy implementation



The study has investigated evidence of cost-effectiveness through:

- Review of ex-post cost-effectiveness studies
- Review of indicators of ex-post differences in cost-effectiveness across Member States.

The literature review looked at data and information directly measuring costs and effects of policy implementation across Member States, while the indicator assessment identified the best proxies that could give insight into possible variations in cost-effectiveness across Member States.

Existing ex-post cost-effectiveness evidence

The literature review shows that there are very few studies documenting ex-post differences in cost-effectiveness across Member States. The reasons for the lack of very specific ex-post cost-effectiveness studies include:

- Few studies seem to assess ex-post cost-effectiveness within a Member State, let alone make a comparison between Member States. This makes it difficult to compare studies undertaken separately in different countries.
- Recording of actual costs in formats that allow for apportioning costs to specific policies or directives does usually not take place. Authorities responsible for implementing the measures set out in a policy are not interested in or able to apportion costs to policies (e.g. integrated process technology or commercial interests in not disclosing any detailed cost information)

- The environmental targets are often not defined as specific, measureable, achievable, realistic and time bound (SMART).
- Environmental quality has more than one dimension and/or is measured by many parameters rendering it difficult to aggregate it into one parameter.
- There are often several policies addressing the same environmental parameter.

All of this leads to a lack of comparable data. If data are not recorded with the specific aim of allowing for ex-post cost-effectiveness analysis, it is often very difficult to make such analyses.

Indicators of differences in cost-effectiveness across Member States

The lack of direct comparisons of the cost-effectiveness between Member States necessitated analysis of indirect measures. These would be able to give a partial, yet less robust, assessment of whether there are differences between Member States.

The table summarises the generic set of indicators developed to determine the likelihood of differences in cost-effectiveness across Member States.

Table 0-1 Indicators of cost-effectiveness differences across Member States

Name of indicator	How is it defined?	How is it measured?	How does it indicate a possible difference in cost-effectiveness across MSs?	Source of data
Ex-ante CEAs (general)	Difference in costs for alternative measures to attain the same environmental objective.	As % cost difference between alternative measures or instruments to achieve the same objective based on existing CEAs.	If there are different costs of alternative measures, then it is likely that cost-effectiveness differs across MSs unless all MSs have undertaken detailed CEAs as part of their implementation.	Ex-ante CEAs as part of either EU IA or MS IA.
Price/user fees of activity	Price for or costs of well-defined activity.	In € per unit of the activity.	Differences between MSs prices/costs are measures of differences in cost-effectiveness if the activity is the same. If there are differences in the way it is defined (e.g., different levels of cost recovery), then the indication is weaker.	Reporting from the organisation performing the activity.
Use of market-based instruments	Is a market-based instrument used in the implementation of the policy?	By reviewing whether any MS use a market-based instrument in the implementation? (Yes or no)	If market-based instruments are used in some MSs, there could be a difference in implementation efficiency. More widespread use of market-based instruments means higher degree of CE.	OECD databases of taxes, MS information, and EEA information.

Name of indicator	How is it defined?	How is it measured?	How does it indicate a possible difference in cost-effectiveness across MSs?	Source of data
CEA required as part of policy/directive	The legislative text specifies CEA as part of policy implementation.	Yes or no.	If a CEA is required as part of the directive, the likelihood of the directive being implemented in a cost-effective way increases.	The legal text and accompanying guidelines.
Environmental expenditure	Expenditure by environmental media.	Expenditure data reported to Eurostat measured either per GDP or per capita.	Data give a very aggregated indication of differences in costs per GDP or per capita for each environmental area.	Eurostat data.

Application of indicators to environmental areas

The indicators have been used to review each of the main environmental sectors covered by the study. The indicator assessments of each of the six environmental and two horizontal areas are summarised below.

Table 0-2 Indicator assessment of cost-effectiveness status by environmental area

Area	Overall level of expenditure	Indicator analysis	Comments and future prospective
Water	High	Indications of differences in cost-effectiveness	The main legislation, the WFD, requires CEAs to be made, so improvement is in the pipeline.
Waste	High	Indications of differences in cost-effectiveness	CEAs have been used to develop parts of the waste legislation.
Air	Medium	Indications of differences in cost-effectiveness	Overall air quality targets have been introduced based on CEA and CBA analyses.
Integrated	Low (IPPC: Medium)	Not sufficiently relevant data for indicator assessment	IPPC has been reviewed and some improvements identified.
Climate change	Possibly high in the future	Too early for ex-post analysis.	CEAs have been used to formulate the policies. EU ETS is an MBI with harmonised implementation
Bio-diversity	Low/medium	Not sufficiently relevant data for indicator assessment	How bio-diversity is to be measured is still unresolved, and this prevents more quantitative assessments.
Chemicals	Low	Overall, few indications of CE differences.	REACH as main policy has common EU-wide implementation and includes CEA requirements.
Cross-cutting (administrative activities: monitoring, permitting, inspection etc)	Low/medium	Indications of improvement potential	The operational efficiency of administrative activities could be increased.

The indicator assessment suggests that differences in cost-effectiveness do exist in most environmental areas. It is important to underline that the indicator assessment provides only 'indications' of potentials for cost-effectiveness improvements.

Studies on the costs of wastewater treatment have identified examples of differences in cost-effectiveness across Member States. The existence of such differences suggests that costs of water quality policies could be reduced or the level of quality increased at no extra cost. This identified example also points to the use of economic instruments as being more cost-effective in implementation of environmental policies.

For the main environmental areas, the assessment of which policy design factors could impact on cost-effectiveness is summarised in the below table. The table presents a subjective scoring based on the literature review and indicator assessment.

Table 0-3 Overview of the impact of factors influencing cost-effectiveness (from low impact to medium and high impact)

Area	Organisation of sector	Policy instrument choice	Operational efficiency including incentives to optimise	Comments
Water	Low	High	High	More incentive pricing and benchmarking of operations could improve CE
Waste	Medium/high	Medium	High	Organisational setup of the sector and the benchmarking of individual management operations could improve CE
Air	Low	High	Low	Increased use of MBI is likely to offer some improvement potential.

Improving cost-effectiveness

The cost-effectiveness of EU environmental policies can be improved through the following processes:

Provide more ex-post assessment and evidence:

- Sharing of benchmark or best practice information among Member States
- Benchmark and performance reviews of existing policies or specific activities including ex-post cost-effectiveness analysis.

Improve the use of ex-ante cost-effectiveness analysis:

- Best practice sharing of ex-ante CEA[1] in policy implementation
- A requirement to undertake CEA when developing and implementing new policies.

The key requirement for improving the level of cost-effectiveness is to undertake proper ex-ante CEAs as part of all stages of policy development and implementation. These ex-ante CEAs should be used to identify and select the best option at any stage. The role of ex-post CEAs is to support that.

If an ex-post assessment finds that one Member State has implemented a policy more cost-effectively than other Member States, for example using an economic instrument, then this finding based on historical data can be used as a basis for other Member States to make an ex-ante assessment of their implementation with a view to improving cost-effectiveness. It may not be recommendable to change the implementation for example if other factors may have changed. Therefore, a new ex-ante assessment is always needed before any change can be made. This is illustrated in Figure 0.1 which shows the iteration from ex-ante to ex-post and then back to ex-ante again.

The fact that new technologies or other 'external' factors change means that there might be a cost-effectiveness potential even if an ex-post assessment would show that all Member States were equally effective.

Introducing requirements to undertake both ex-ante and ex-post assessments involve policy initiatives and processes rather than conducting additional studies and providing more data.

Enhancing harmonisation of policy implementation could lead to more equal levels of cost-effectiveness across Member States, but depending on how it is achieved the overall level of cost-effectiveness might not increase. Differences in industrial structure, geographical conditions etc. could mean that implementation should be different across MSs and that the overall most cost-effective solution could imply that the costs of one unit of environmental quality will vary across MSs. Achieving more harmonisation in the implementation will be constrained by political feasibility; for example, concerns about distribution and equity will vary across Member States.

There are three main routes of supporting cost-effectiveness in policy implementation by providing more information and data through new studies.

[1] Naturally, Cost Benefit Analysis could provide similar benefits. Such analyses are practised systematically in a few Member States, under titles such as regulatory Impact Assessment or Impact Assessment. There is scope for using them more widely across MS.

Table 0-4 Approaches and routes to improving CE in policy implementation

	Feasibility	Expected impact on CE	Rank (Impact/ resources)
Benchmarking of well-defined activities to improve operational efficiency	Medium	High	1
Information and best practice sharing	High	Low	2
Ex-post benchmarking at directive/policy level	Low	Medium	3

This suggests that the most promising way forward is to undertake benchmark studies on similar or well-defined activities (e.g. a specific waste management operation or permitting). Information and best practices sharing is another way. An ongoing example is the IMPEL network which is focussed on the effectiveness of policy implementation. Ex-post assessment of the cost-effectiveness of directives and programmes is the least promising way. This scoping study has confirmed the difficulties in making ex-post CE assessments so any improvement will be very resource intensive.

Future studies

Based on the scoping study assessment, a number of potential studies are proposed. The study proposals include:

Table 0-5 Preliminary proposal for new studies

Title	Environmental area	Budget
Use of benchmarking applying CEA or similar to improve operational efficiency of environmental services	General	Medium
Assessment of how to support existing or new best practice sharing of efficient implementation of environmental policies.	General	Small
Development of scoreboard for cost-effective implementation of environmental policies	General	Medium/ large
Benchmark study of waste management operations to compare operational efficiency	Waste	Medium/ Large
Benchmark study of wastewater treatment to compare operational efficiency	Water	Medium
Development of sector indicators.	Waste	Medium

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List of abbreviations

BAT	Best Available Technique
BOD	Biological Oxygen Demand
CAFE	Clean Air For Europe
CBA	Cost benefit analysis
CE	Cost Effectiveness
CEA	Cost-Effective Assessment
DEA	Data Enveloping Analysis
DPSIR	Drivers, Pressures, State, Impacts, Responses
ECHA	European Chemicals Agency
EEA	European Environment Agency
EIA	Environmental Impact Assessment
ENVECO	Network across EU Member States for Environmental Economists.
EU ETS	European Union Emissions Trading System
GAINS	Greenhouse Gas and Air pollution Interactions and Synergies
GDP	Gross Domestic Product
GNP	Gross National Product
IA	Impact Assessment
IE	Inhabitant Equivalent
IEEP	Institute for European Environmental Policy
IIASA	International Institute for Applied Systems Analysis
IMPEL	Implementation and Enforcement of Environmental Law
IPPC	Integrated Pollution Prevention and Control
LCPD	Large Combustion Plant Directive
MBI	Market-based Instruments
MS	Member States
NEC	National Emission Ceiling
NECD	National Emissions Ceiling Directive
PE	Person Equivalent
RAINS	Regional Air Pollution Information and Simulation
REACH	Registration, Evaluation, Authorisation and Restriction of Chemical Substances
SEA	Strategic Environmental Assessment
SMART	Specific, Measurable, Achievable, Realistic and Time Bound
SPRU	Science and Technology Policy Research
TSAP	Thematic Strategy on Air Pollution
UWWTD	Urban Waste Water Treatment Directive
WEEE	Waste Electrical and Electronic Equipment
WFD	Water Framework Directive

1 Introduction

This is the final report for the project "Scoping study on cost-effectiveness of EU environmental policy".

1.1 The purpose of the study

The purpose of this study is to investigate the existing state-of-the-art experiences with cost-effectiveness analysis (CEA) of EU environmental policy.

It is a scoping study aiming at providing a broad assessment of all evidence of cost-effectiveness differences across Member States. The overall questions addressed by the study include:

- Have any studies and data assessed whether cost-effectiveness differences exist across Member States for specific environmental policies?

- Can any indicators be used to understand where potential differences in cost-effectiveness may exist across EU Member States?

Based on these experiences and the screening of potentially CE relevant data, the study has identified areas where future studies can support improved cost-effectiveness in implementation of EU environmental policy. This can be done through improved procedures as well as through more comparative ex-post cost-effectiveness analyses aimed at identifying specific improvement potentials.

The study has covered the following environmental areas:

- Air,
- Water,
- Waste,
- Climate change,
- Biodiversity,
- Chemicals, and
- Integrated policies.

The aim of this scoping study has been to find relevant examples of cost-effectiveness analyses of environmental policies, rather than to cover all these areas in detail.

1.2 Approach to the study

This scoping study has investigated the following:

- What is the existing evidence of cost-effectiveness differences across EU 27 for all key environmental areas (water, waste, air pollution, climate change, chemicals, integrated policies and biodiversity):
  - ex-post CE data
  - indicators on possible cost-effectiveness differences.
- What are the areas where cost-effectiveness could be different?
  - What seem to be the main reasons for differences in cost-effectiveness?
- What are the routes or approaches to improving cost-effectiveness?

This has been done through a number of activities.

1.2.1 Activities

The following activities have been undertaken:

1 Literature review

2 Surveys:

2.1 ENVECO and IMPEL

2.2 Business survey.

3 Indicator analysis based on reviewed literature, Eurostat expenditure data, impact assessments and similar data.

The main activity has been the broad literature review supplemented with small surveys to identify any missing studies or data. The limited number of ex-post cost-effectiveness studies led to the third activity, an assessment of broader indictors of possible cost-effectiveness differences.

1.2.2 Literature review

The literature review aimed at identifying all relevant documents that examine cost-effectiveness of environmental policies. The result is attached as Annex A, which includes a long list of literature with 150 entries.

The identified literature has been organised according to main environmental area, EU directive (if relevant) and with a description of the type of cost-effectiveness analysis included.

1.2.3 Surveys

The members of the ENVECO and IMPEL working group were asked to answer a short questionnaire. The purpose of the questionnaire was to capture literature and other relevant data sources not included in the literature review - especially with respect to sources in national languages. Responses were received from members of the ENVECO/IMPEL in Denmark, Romania, Latvia, the Czech Republic, Belgium, Bulgaria and Sweden. This has added a few more studies to the literature list (Annex A) while comments have been used in the overall assessment.

A business stakeholder consultation was set up with enterprises that have production facilities in more than one Member State. Three companies were interviewed about their experiences with cross-country differences in the administration and implementation of the environmental legislation. They did not have any specific experience of cost-effectiveness differences. The industry experience focused on the total cost differences which are often results of different ambition levels across Member States.

1.2.4 Indicator analysis

The scarcity of direct cost-effectiveness analyses and evidence has led to a refocus of the effort during execution of the study.

By identifying existing data and information that could be used as indicators of differences in cost-effectiveness, it became possible to expand the data review and extract more information about cost-effectiveness compared to the literature review. Using the indicator approach made it possible to give an overview of the situation in each of the environmental areas. By nature, the indicators do not provide hard evidence of cost-effectiveness differences and associated improvement potentials. The limitation of the indicator assessment is that there is no room for sound judgments of the individual Member States' implementation of environmental policies in terms of cost-effectiveness.

1.3 Organisation of report

Chapter 1 includes the present introduction. Chapter 2 discusses the issue of defining cost-effectiveness and how cost-effectiveness analysis can be used on the policy process. Chapter 3 is about how to measure ex-post cost-effectiveness, including Section 3.2 on definition of possible indicators of cost-effectiveness. Chapter 4 presents the indicator analysis of the environmental areas. The findings of the indicator assessment is presented in Chapter 5, while the suggestions for future studies to further support the process of achieving cost-effective implementation are included in Chapter 6.

The structure of the investigation therefore includes:

- Definition of cost-effectiveness (Chapter 2).
- How to measure cost-effectiveness (Chapter 3).

- Indicators by environmental area (Chapter 4).
- Conclusions about ex-post cost-effectiveness differences (Chapter 5).
- How to improve cost-effectiveness and suggestions for studies to follow up on this scoping study (Chapter 6).

2 Definition and use of cost-effectiveness

2.1 Definition of cost-effectiveness

2.1.1 How to define cost-effectiveness across Member States

In its basic form, cost-effectiveness is about achieving a given target at the lowest costs. The European Environment Agency (EEA) defines cost-effectiveness as: *"a comparison of the effects of a set of measures with the costs of implementing them. A more cost-effective measure will have achieved greater results for less money".* (EEA 2001:9). Examples of environmental policy targets could be quality, norm, limits, time limits, collection percentage etc.

This scoping study addresses the issue of differences in cost-effectiveness across Member States. *In this context, cost effectiveness can be defined as the comparison between the costs of implementing the same environmental legislation in the different countries.*

The basic definition is straightforward, but the actual measurement of cost-effectiveness is more complicated. The costs of implementing a given environmental policy comprise several components:

- Administrative costs for the regulator of using a given policy instrument
  - Permitting
  - Monitoring and enforcement
- Compliance costs for the regulated:
  - Investment in abatement equipment or changed behaviour
  - Current costs of abatement or changed behaviour
  - Administrative costs of applying for permits etc.
- External costs:
  - Environmental and resource costs

- Social and other external costs.

The external costs are not those related to the target of the policy, but other 'side effects'. If water quality is addressed by a policy, which through additional wastewater treatment leads to air pollution and GHG emissions, then the last mentioned effects are side-effects that ideally need to be included in a CEA. Most studies on cost-effectiveness focus on the administrative and/or compliance costs. External costs are rarely covered explicitly.

It is important to define what is included from the perspective of analysing cost-effectiveness. Whether conclusions can be drawn from CEAs that do not cover all elements depends on the specific case. Assessing, for example, permit costs related to a specific directive across Member States can provide useful results even without having assessed the compliance costs.

2.2 Use of cost-effectiveness in policy implementation

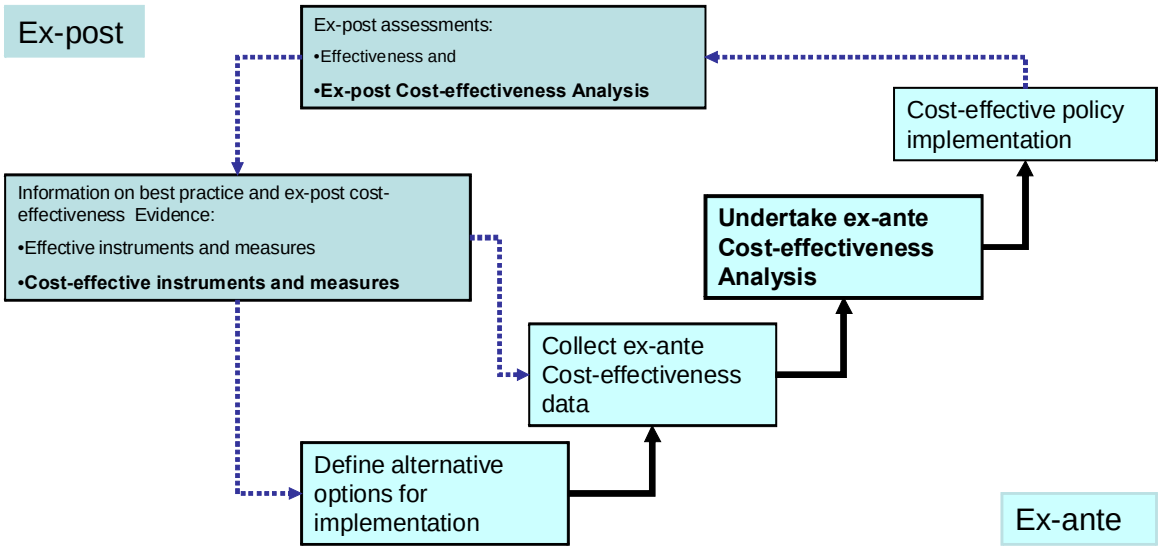
The overall objective of this scoping study is to review the evidence on the costs of achieving one unit of environmental benefit across EU27 in order to identify differences in cost-effectiveness.

Depending on the reasons for such differences, a potential for reducing the costs of achieving the given environmental standard is present. Therefore, a potential welfare improvement can be realised if less cost-effective Member States would adopt the most cost-effective practice.

Before discussing the challenges of such evaluations, it is worth noting that cost-effectiveness is not static. If new technologies and organisational practices become available, what is cost-effective could change. It also means that even if a country is currently the most cost-effective in achieving a certain target, there could still be a potential for even further improvements.

Figure 2.1 illustrates an idealised policy implementation process. It shows that a key element in achieving cost-effectiveness is undertaking ex-ante cost-effectiveness analysis before implementation. Ex-post evaluations can either identify certain areas that seem to hold a potential for improvement or they can be used to improve the ex-ante assessment and, indirectly, improve CE.

Figure 2-1 Use of ex-ante and ex-post assessments in policy implementation



It should also be noted that improving cost-effectiveness can be supported by cross-Member State benchmarking, but it can also happen over time by reviewing how an internal benchmark develops over time.

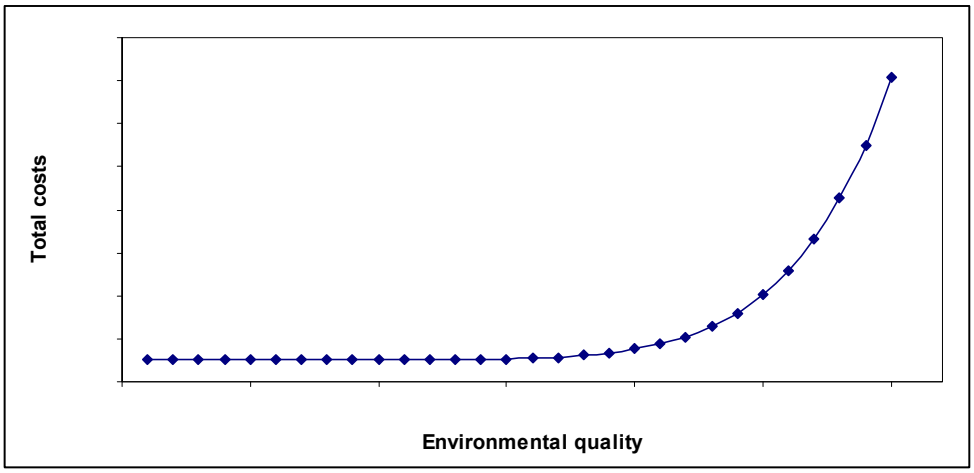
2.3 Factors affecting cost-effectiveness across MSs

Several factors can affect the level of cost-effectiveness. A natural starting point is to look at the relationship between the environmental target and the costs of achieving the target.

The below illustration is the 'traditional' understanding of the relationship between environmental quality and the costs of achieving the quality.

It shows how the total costs increase with the level of environmental quality. Marginal and average costs would have a similar appearance in this illustration.

Figure 2-2 Relationship between environmental quality and costs



If two Member States are at a different level of environmental quality, the costs per unit of environmental quality - whether measured as the average or marginal costs - in the country at a high level of quality would be higher than the country at a lower level of quality.

This is important. When comparing cost-effectiveness, it should be clear whether any difference is caused by different levels of environmental quality. Otherwise there could be a risk of suggesting to 'improve' cost-effectiveness simply by reducing the quality. This risk of reducing costs simply by reducing the quality is particularly important to consider in situations where quality is difficult to measure. Then great care is required to make sure that any change is actually improving cost-effectiveness and not just reducing costs by reducing the quality.

If the environmental quality is the same in two Member States, cost-effectiveness could still be different due to 'natural' conditions. Many environmental and social factors can explain differences in both costs and effects. From the perspective of improving cost-effectiveness, it is crucial to be able to distinguish between the effect of factors that can be controlled and affected by policy actions, and effects that are the result of 'natural' conditions and circumstances.

Table 2-1 Factors that define the degree of cost-effectiveness in policy implementation

Policy factors	Natural or policy external factors:
Sector organisation (ownership, financial incentives etc.)	Population size, age composition and density
Choice (and design) of policy instrument	Economic structure and activity
Choice of technology	Price and cost levels
Operational efficiency	Industry composition, technological level
	The existing environmental quality
	Landscape characteristics
	Soil conditions
	Climate conditions
	Social and cultural traditions
	Administrative traditions.

Though this list is not exhaustive, it includes most of the key explanatory factors for differences in cost-effectiveness across countries.

The analysis of the environmental areas in Chapter 4 includes preliminary findings on cost-effectiveness differences and the main reasons for these differences.

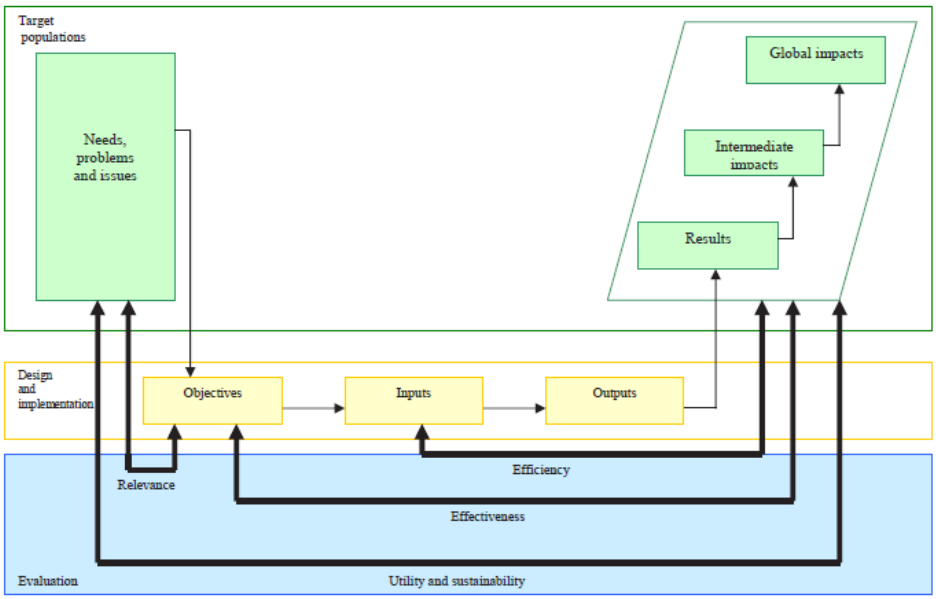
3 How to measure cost-effectiveness

3.1 Measures of ex-post cost-effectiveness

Cost-effectiveness analysis can be used in both ex-ante and ex-post assessment or evaluation. Most cost-effectiveness analyses are ex-ante where alternative options to attain a given objective are compared. In principle, one can make ex-post CEA assessments in a similar way though there are some differences. Ex-ante CEAs are done at the EU level when developing new EU legislation and subsequently some Member States undertake their own CEAs as part of their implementation of the legislation.

Ex-post evaluations assess what has been implemented, and therefore there are no alternative options to consider. The EU guidelines on ex-post evaluations focuses on a number of key evaluation criteria where efficiency is one; see below illustration. Efficiency is defined as whether the effects are achieved at reasonable costs, however omitting the question whether it has been done in the most cost-effective manner.

Figure 3-1 Evaluation framework



Source: EC (2004) Evaluating EU activities

It is only possible to assess cost-effectiveness ex-post when a given policy has been implemented differently across Member States or regions. Such assessments are not required by guidelines for ex-post evaluation in the EU or the Member States.

The evaluation logic behind the EU evaluation guidelines defines how a policy using certain inputs results in certain outputs and then the outputs leads to results and impacts. Though not necessarily intuitive at first, the logic allows for detailing the ex-post evaluation into evaluation of each step in the process.

Cost-effectiveness can be measured in different ways. One can in particular distinguish between[2] cost-effectiveness in relation to output or to results/impacts. Using the evaluation terminology and as an example treatment of wastewater to reduce the discharge of nutrients, it is possible to compare:

- Operational efficiency[3] for different wastewater treatment plants (comparing the cost of removing one unit of nutrients from similar treatment plants)

- Cost-effectiveness of results by comparing costs of removal of nutrients by means of alternative measures (comparing the costs of removing nutrients in domestic and industrial wastewater using alternative approaches for example comparing a treatment plant with reduction at source)

[2] Eureval C3E (2006) makes this useful distinction. This study includes a detailed assessment of the use of CEA in evaluation of EU interventions in all policy areas.

[3] Operational efficiency is the same as cost-effectiveness of output (Is the given output produced with least inputs?)

- Cost-effectiveness of impacts by comparing costs of achieving the same water quality through alternative measures (e.g. comparing treatment of wastewater with reduction of diffuse pollution with nutrients from agriculture).

Going from operational efficiency to cost-effectiveness of results and impacts also means going from the simple to the more complex analysis. The environment quality is affected by many factors as described above, so to account for all these different factors in order to allow for conclusion on level of cost-effectiveness, a more complex analysis is required. It is especially more complex to make such comparisons across countries. In ex-ante CEA comparing alternative measures to achieve a specific goal in one country, all the external conditions are the same, and therefore the comparison of costs is more simple, leading to comparable cost-effectiveness ratios.

The scoping study literature review has searched for evidence and data on all types of cost-effectiveness and operational efficiency. As the assessment of operational efficiency is easier, it is also the type of ex-post cost-effectiveness analysis where the majority of results (though still only very few) have been identified.

3.2 Indicators of cost-effectiveness

No indicators have been defined specifically to measure ex-post cost-effectiveness of environmental policy implementation. The literature review has focused on identifying studies that have compiled and analysed data to make such ex-post CE comparisons possible.

To supply the search for specific ex-post CE evidence, this study has reviewed existing data and information with respect to their use as proxies or indicators of cost-effectiveness and, more precisely, cost-effectiveness differences across Member States.

3.2.1 Types of indicators

Indicators or proxies of differences in ex-post cost-effectiveness could include the following types:

- Data on policy implementation processes and instruments, including
  - Information on whether ex-ante cost-effectiveness analysis is required as part of the policy implementation
  - Data on use of market-based instruments.
- Prices, costs or fees related to specific products/services or activities (water prices, fees for permit application etc)
- National data on expenditure in certain environmental areas

- Ex-ante assessment of the cost-effectiveness of alternative instruments.

Ex-ante CEA requirement as part of policy implementation
A pre-requisite for achieving ex-post cost-effectiveness is that a proper ex-ante CEA has been undertaken. For legislation where a cost-effectiveness analysis is a mandatory part of the implementation, it is more likely to find fewer differences in cost-effectiveness across Member States. Also requirements in Member States to undertake CEAs as part of policy implementation are important to note; see Section 5.5 for a summary of IA and similar requirements in Member States.

Ex-ante CEAs
If ex-ante cost-effectiveness assessments of measures and policy instruments are available they can be seen as an indicator of cost-effectiveness. An ex-ante CEA from one Member State can be used as indicator if such an ex-ante shows that there are significant ex ante CE differences between alternative measures or instruments. The reason is that CEA differences in one Member State increases the probability of CEA differences in other Member States. Therefore, all Member States should undertake specific ex-ante CEAs to design the optimal implementation in their case. This, combined with the fact that not all Member States undertake CEAs, leads to an indication of an improvement potential.

Formal CEA is neither required nor a standard procedure in all Member States. Although in most cases, considerations on CE have been made before implementation, it is unlikely that all Member States have implemented the policy in the same and equally cost-effective way. Ex-ante CEAs can therefore be used to identify policy areas where a potential for further investigation exists. These ex-ante CEAs can originate from either EU impact assessments, from MS impact assessment or from other sources such as academic studies on cost-effectiveness.

Use of market-based instruments
Economic instruments are often found to be cost-effective from an ex-ante perspective. If some MS have used economic instruments, while others have not, this can be seen as an indictor of a cost-effectiveness improvement potential in those MSs that have not used economic instruments. If no MS has used economic instruments then it could be because they are not relevant of feasible for the policy in question. It could also be that there is an improvement potential in all MS. In such cases, it can be difficult to apply the indicator without further detailed analysis.

Prices and fees
Prices of comparable products/services or activities are indicators of operational efficiency as explained in Section 3.1 above. These could in some cases be potentially relevant indicators of differences in cost-effectiveness. This type of indicator is in particular available for waste and wastewater management. They could also be analysed for activities such as authorisations, permitting, inspection and enforcement.

National expenditure data
Aggregated cost or expenditure data show differences between Member States. Without data on the effects on or the state of the environment, such cost differences are not necessarily a sign of cost-effectiveness differences. In the indicator analysis, Chapter 4, aggregated data are presented, including a discussion of whether the identified cost differences could be the result of cost-effectiveness differences.

Overview of generic indicators
The characteristics and data sources for each indicator are presented in the table below.

Table 3-1 Indicators of cost-effectiveness differences across Member States

Name of indicator	How is it defined?	How is it measured?	How does it indicate a possible difference in cost-effectiveness across MSs?	Source of data
CEA required as part of policy/directive	The legislative text specifies CEA as part of policy implementation.	Yes or no	If a CEA is required as part of the directive, it is more likely that the directive is implemented in a cost-effective way leading to less risk of cost-effectiveness differences across MSs.	The legal text and accompanying guidelines
Ex-ante CEAs (general)	Difference in costs of alternative measures to attain the environmental objective	As % cost difference between alternative measures or instruments to achieve the same objective based on existing CEAs	If there are different costs for alternative measures, then there is a likelihood of differences in cost-effectiveness across MSs.	Ex-ante CEAs as part of either EU IA or MS IA
Price/user fees of activity	Price or costs of well-defined activity	In € per unit of the activity	Differences between MS prices/costs are measures of cost-effectiveness differences if the activity is the same. If there are differences in the way it is defined, the indication is weaker.	Reporting from organisation performing the activity
Use of market-based instruments	Is a market-based instrument used in the implementation of the directive?	Yes or no	If market-based instruments are used in some MSs, there could be a difference in implementation cost-effectiveness.	OECD databases of taxes, MS information, and EEA information.
Environmental expenditure	Expenditure by environmental media	Expenditure data reported to Eurostat measured as either per GDP or per capita	Data give a very aggregated indication of differences in costs as % of GDP or per capita for each environmental area	Eurostat

Use of indicators to infer ex-post cost-effectiveness differences
When using these kinds of indicators or proxies, one should be aware of the fact that they often provide limited information, and no firm conclusions should be drawn on the basis of them. They may, however, be used to identify differences between Member States which could be the subject of a more thorough analysis.

The analysis of indicators by environmental area will discuss to what extent conclusions may reasonably be drawn and the perspective in further development of indicators and ex-post CEA and in cross country comparisons.

4 Indicators for cost-effectiveness analysis

Each environmental area has been analysed separately with the aim of finding possible proxies or indicators of how cost-effective the policies in the area are implemented in each Member State.

The outcome of the analysis varies across the different environmental areas. For waste and wastewater, much more data are available as these areas include services or activities that are traded and/or priced. The other areas are more diverse or heterogeneous with respect to activities, and therefore fewer proxies/indicator have been identified.

Each section on a specific environmental area ends with a discussion of how to develop new indicators. If data were collected or recorded with respect to cost-effectiveness, more analyses could be made and more improvement potentials identified.

4.1 Review of water sector indicators

The key EU directives for water quality include:

- Urban Wastewater Treatment Directive
- Nitrates Directive
- Water Framework Directive
- Groundwater Directive
- A number of directives addressing specific types of water or issues such as the Bathing Water Directive, Shell Fish Directive etc[4].

The review of ex-post cost-effectiveness studies only identified one study with cross Member State comparison. This was in relation to the implementation of the UWWTD.

[4] The Drinking Water Directive is considered as a mainly health driven legislation, though part of it is related to protection of drinking water resources. This element will be part of the WFD in the future.

4.1.1 Effectiveness of urban wastewater treatment policies in selected countries: an EEA pilot study

The study investigated the effects, effectiveness and cost-effectiveness of implementing wastewater policies in Denmark, France, the Netherlands, Spain, Estonia and Poland. Wastewater treatment policies aim at improving the water quality of surface waters. The Urban Waste Water Treatment Directive (UWWTD) from 1991 sets minimum requirement standards and guidelines for the efforts to improve sewage treatment.

Because of difficulties in correlating the specific link between policy measures and water quality, the study uses a pressure indicator - measured as net discharge of biological oxygen demand (BOD). The pressure indicator is only related to effluent discharge from major point sources.

The results of the study include:

- The study attempted to compare the investment in wastewater treatment resulting from the UWWTD. Differences in the phasing of the implementation due to different deadlines and compliance levels mean that the comparison was only possible for two out of the six Member States. The costs of investment in sewage treatment infrastructure were therefore only compared between Denmark and the Netherlands.

- The expenditures on the implementation of the UWWTD were much higher in Denmark (€804 per capita) than in the Netherlands (€181 per capita). Calculated as cost per inhabitant equivalent (IE)[5] capacity unit costs, the cost in Denmark was €127 per IE and €132 per IE in the Netherlands, thus the unit cost in the Netherlands was slightly higher than in Denmark.

- The Dutch approach with more comprehensive use of economic incentives entailed a reduced discharge of mainly industrial wastewater. In Denmark, the late introduction of wastewater charges and cross-subsidisation of industrial discharge until 1992 appear to have led to a comprehensive capacity of public wastewater treatment plants. The result is that the Netherlands has constructed 40 per cent less public sewage treatment plants than Denmark. The early and consistent implementation of economic incentives in the Netherlands has resulted in higher cost-effectiveness in the Netherlands compared to Denmark. It is also concluded that there seems to be savings on operation costs in the Netherlands compared to Denmark.

- Where cost recovery is not implemented early, there is a risk of making excess investments in wastewater treatment infrastructure. The study points to the effect of pricing policies on the need for capacity in wastewater treatment: If the determination of capacity is not based on careful de-

[5] The term inhabitant equivalent is used in the study. The term person equivalent (PE) is normally used in the literature. Henze et al. (2002): Wastewater Treatment: Biological and Chemical Processes. Springer: Berlin.

mand analysis using the expected future price for wastewater treatment, investment in too much capacity may be the result. A comparison of the situation in two Member States seems to confirm this, but data did not allow for an estimate of the EU level cost-effectiveness improvement potential.

There are some factors that were not accounted for in the study or instances where the information presented does not allow for an assessment of how the factor has been dealt with. Examples of important issues that should be further investigated before drawing too firm conclusions are the following:

- It is unclear to what extent the expenditure on the industrial pre-treatment and/or process changes have been included. As there could be differences in the composition of industrial wastewater between Member States, it is important to consider not only the cost of investment in public systems but also all treatment and/or prevention costs.

- The study does only include the discharge of BOD in the study. The composition of the wastewater with respect to BOD, nitrogen and phosphorous is important for the costs of treating the wastewater. Lack of BOD in wastewater can for instance entail increased costs of treatment of wastewater with high nitrogen content (Henze et al. 2002). It is not evident from the study whether the wastewater charges in the investigated countries are set up in a way that provides incentives for discharge of wastewater with an optimal composition of components.

Despite these issues, the study is important as an example of how the use of economic instruments is important to consider to find cost-effective solutions.

Given the limited availability of specific ex-post CEA studies, it is necessary to look for indictors to be able to assess more broadly relevant EU water policies.

4.1.2 Existing indicators

The list of potential water sector indicators includes the following based on the generic indicators defined in Section 3.2:

- Requirements to undertake ex-ante CEA

- Existence of ex-ante cost-effectiveness analyses

- Economic instruments:

  - Use of economic instruments as part of the directive implementation

  - Unit costs of wastewater treatment.

- Environmental expenditure combined with water qualities.

The use of each indicator and the possibility of combining them to better address the cost-effectiveness perspective are discussed below.

Requirements to do ex-ante CEA

The Water Framework Directive includes a requirement to undertake a CEA as part of its implementation. It means that each Member State should complete a CEA of the implementation programme. It means that the WFD can be expected to be implemented in cost-effective way though it is still too early to make any judgements as the first planning cycle of the directive requires new measures to be in place by 2012. None of the other water quality directives include similar requirements. They are therefore likely to have led to less cost-effective results.

Ex-ante CEAs

In relation to the WFD, much work is currently done on comparing alternative measures. This is mainly caused by the requirement of the WFD to undertake a CEA as part of the justification for the specific implementation of measures to achieve the objective of the directive.

Examples of cost databases with information about measures to improve water quality include examples from several Member States. It is not possible to draw any simple conclusion about which types of measures are more cost-effective. For removal of traditional water pollutants such as BOD[6] or nutrients, additional wastewater treatment can be cost-effective as can measures to reduce nutrient run off from agriculture. It requires a specific analysis to determine the optimal package of measures. A few examples can illustrate the issue.

Table 4-1 Examples of costs of removal of phosphorous at wastewater treatment plant (Data from UK 2007)

Population equivalent (p.e.)	£/kg P removed
0-249 p.e.	157
250 - 1999 p.e.	157
2000 - 9999 p.e.	54
10,000 - 99,999 p.e.	28
> 100,000 p.e.	8

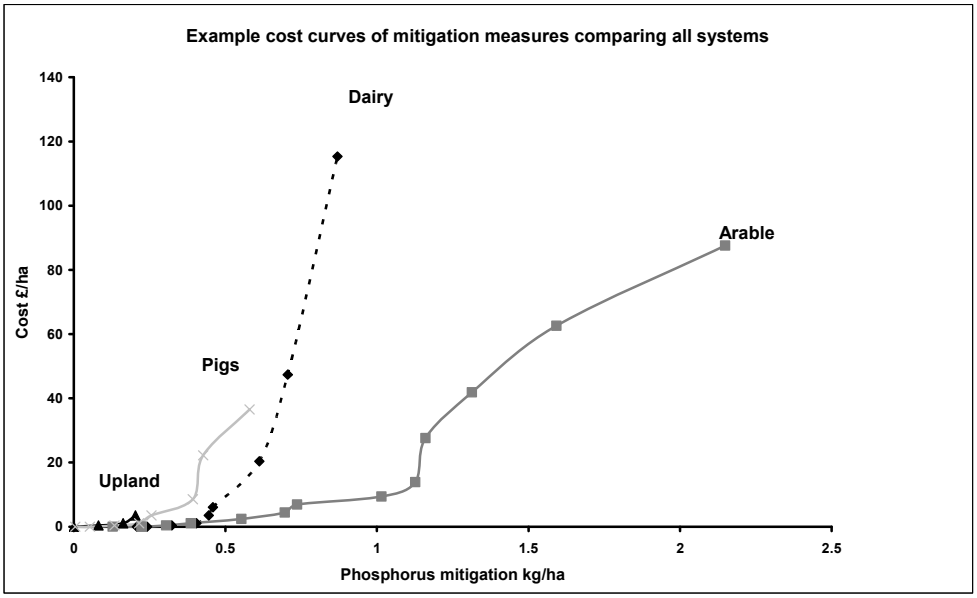
Source: Preliminary cost-effectiveness analysis of the WFD; Defra 2007

This example shows that the cost per kg of phosphorous removed depends on the size of the treatment plant. A few large plants will be much more cost-effective than many small ones, but the population density and sizes of agglomerations determine what can be achieved as transport of wastewater will be very expensive.

An example of cost curves for removal of phosphorous from agriculture is shown below. It indicates that there are significant differences depending on farm types and the specific measure applied.

[6] BOD=Biological Oxygen Demand

Figure 4-1 Cost curves for removal of phosphorus in agriculture (Data from the UK)



Source: Defra 2003.

Combining the information on removal of phosphorous from wastewater treatment plants and from agriculture, which is one of the issues discussed in relation to further improvement of the water environment, these examples show that the cost-effective solution will be depend on local specific conditions.

If more phosphorous can be removed from large wastewater treatment plants, it is likely to be cost-effective, whereas if further reductions can be made only from medium or small-sized treatment plants, farm measures are likely to be more cost-effective. This is not a general conclusion, but illustrates the importance of undertaking ex-ante cost-effectiveness analyses.

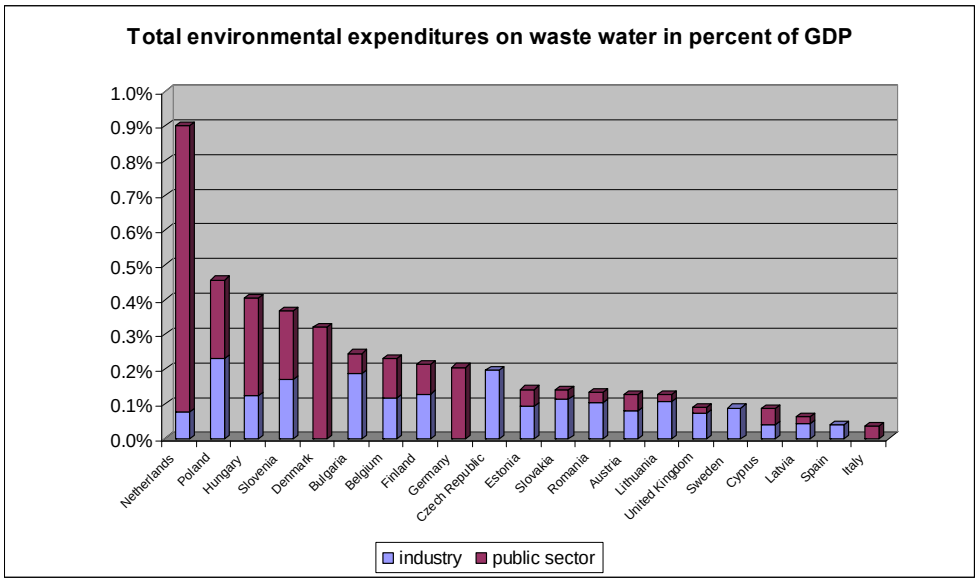
The Water Framework Directive requires Member States to make specific cost-effectiveness analyses of new management plans. Based on the recently published draft river basin management plans, Member States have only to a limited degree undertaken the cost-effectiveness analyses.

Environmental Expenditure

This indicator could in principle give an idea about differences in overall costs across Member States. Figure 4-2 shows the total expenditures on wastewater in percentage of GDP for both the public sector and the industry. First of all, it can be seen that there is large variation between the Member States with regard to the total expenditures. The variation is more than a factor of 10.

Furthermore, it can also be seen that the relation between expenditure in the public sector and the industrial sector varies across Member States. For some countries, only data from one sector are reported in the statistics leading to some uncertainties about the real levels of expenditure and the division between public and industrial expenditure.

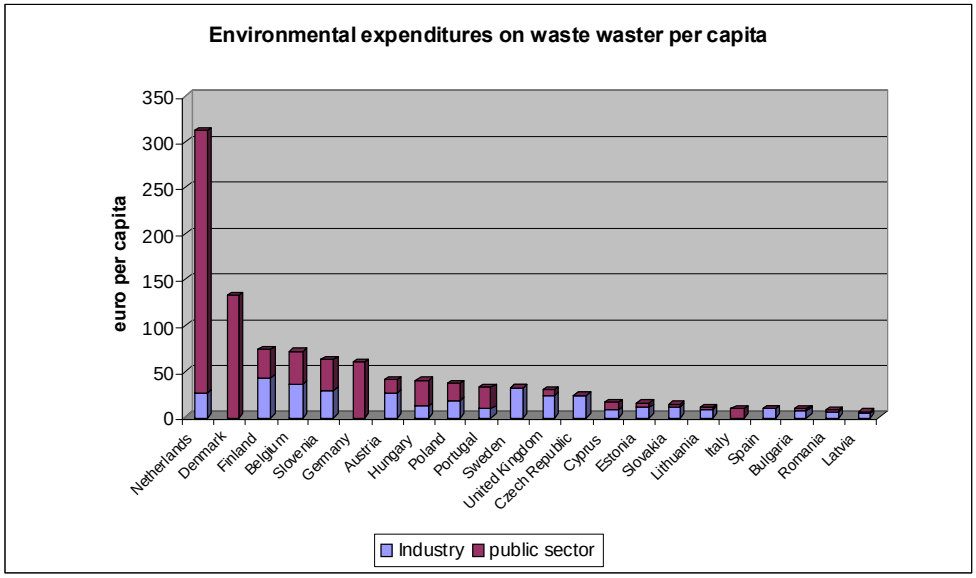
Figure 4-2 Total environmental expenditures on wastewater in percentage of GDP



Source: EUROSTAT

In Figure 4-3, the same data are shown, but per capita instead of as a percentage of GDP. It shows the same type of variations.

Figure 4-3 Total environmental expenditures on wastewater per capita



Source: EUROSTAT

There are many reasons for differences in expenditure on wastewater. Main factors comprise:

- Different level of compliance with the Urban Wastewater Treatment Directive including different timetables for old and new Member States and over or under compliance
- Population density and stress on water environment
- Price/cost levels
- Differences in data reporting and accuracy.

How much of the variation is explained by each of these factors cannot be estimated due to insufficient data on all these factors. Data are clearly incomplete as not all Member States report data on these expenditures. The reliability of the data is difficult to check without a detailed data collection exercise.

Germany, the Netherlands and Denmark are among the Member States which currently comply with the UWWTD, which could explain the high public costs as most of the wastewater is treated in public treatment works. However, investments are being made in the new Member States, which have until 2010 to reach compliance.

The costs related to wastewater treatment depend on the level of treatment, which is again governed by the designation of areas into sensitive or non-sensitive areas. Small Member States with intensive agriculture such as the Netherlands and DK have designated all territories as sensitive, and this requires the highest level of wastewater treatment - tertiary treatment. This further explains a high expenditure level in these countries.

Price and cost levels vary across Member States. How that affects the costs of wastewater would require a detailed assessment of the costs elements and how they should be adjusted.

Overall, the total expenditure on wastewater comes out as a relatively weak indicator. The very high numbers for the Netherlands are not explained. The 2005 EEA pilot study concluded that the Netherlands had invested less than Denmark in public wastewater treatment due to the application of a wastewater charge. This does not seem consistent with the total expenditure data, which suggests much higher total expenditure per capita in the Netherlands compared to Denmark.

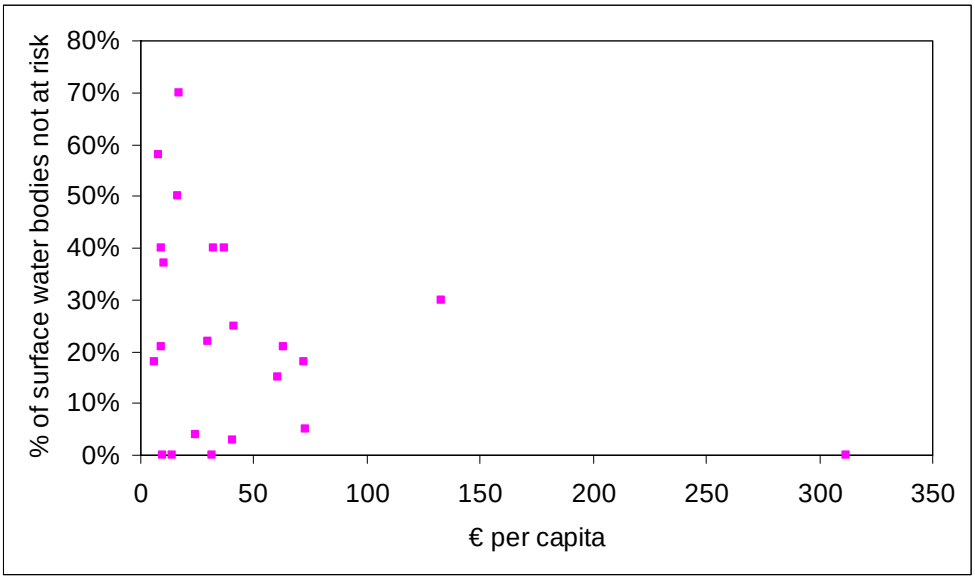
The next step is to consider whether the expenditure data can be combined with indicators of water quality, or whether unit costs from the wastewater utilities can be used as a relevant indicator.

Water quality

There is no simple measure of water quality. It will be determined by the concentration of organic material, nutrients, pesticides and other hazardous substances. Most Member States have classifications of water bodies and as part of the WFD, and these classifications are now harmonised. As part of the WFD, all water bodies have been characterised. This is a complicated and still unfinished process. The figure below shows the share of surface water bodies

that are not at risk of failing to meet the WFD objectives. This a simple indicator of water bodies of good quality. This is shown against the total expenditure per capita.

Figure 4-4 Relationship between share of surface water bodies not at risk of failing to meet the WFD objectives and total expenditure on wastewater treatment



One could interpret this figure as an indication that Member States with better quality spend less on wastewater treatment. That more effort is required in Member States with poorer quality is in line with what could be expected. It has to be stressed that the correlation is not very strong and care should be taken before drawing any conclusions. The variations within the same level of quality could be caused by differences in cost-effectiveness though the other factors need to be taken into account before any firm conclusions can be drawn.

User charges and economic instruments

In relation to the water sector, the use of economic instruments can take form of user charges for specific services and as environmental taxes or charges aimed at internalisation of external costs. Using the terminology presented in Section 3.1, comparing for example user charges on wastewater, is a way to assess the operational efficiency of the wastewater treatment plants.

User charges for both water supply and wastewater collection and treatment exist in most Member States. User charges on wastewater collection and treatment could be used as an indicator of cost-effectiveness. The service performed is very similar across Member States and therefore relatively comparable.

The regulating body for the privatised water industry in England and Wales, Ofwat, has undertaken a detailed benchmarking study comparing user charges in a number of countries. The study has gathered data from England and Wales, the Netherlands, six Scandinavian cities, Portugal, Australia and the US; though for wastewater only data from some of the areas where comparable.

The data show major differences between the analysed countries, where England and Wales (E&W) and Scotland have a much higher unit cost than SCG ("six city group" of Scandinavian cities) and Australia.

Figure 4-5 Sewage collection unit costs in pence per m^3

p/m^3	England and Wales	Scotland	Scandinavian group of cities	Australia
Cost of operations	35	36	21	35
Cost of capital maintenance	30	29	15	35
Return on capital	33	88	16	7
Total	98	153	52	77

Source: "International comparison of water and sewerage service 2007 report", Ofwat 2007.

It should be noted that the user charges or prices had to be adjusted as many factors (price levels, accounting principles etc) complicate cross-country comparisons.

The report does not explain in any detail why costs differ. It would have required a detailed assessment of all the operating conditions for each utility. One factor could be that the Scandinavian Group includes only cities with high population density, while the other companies cover regions with cities and towns of different sizes. It would require more detailed assessments to understand and explain the differences. Our experience with benchmark analysis suggests that it is very data and time consuming to do proper benchmark analysis.

The study also compared water prices (the supply of drinking water). The results are somewhat similar.

Figure 4-6 Water supply unit costs in pence per m^3

p/m^3	England and Wales	Scotland	SGC	NL	Australia	USA
Cost of operations	33	29	16	51	33	31
Cost of capital maintenance	23	33	10	20	15	7
Return on capital	20	18	7	18	9	22
Total	77	80	33	89	58	61

Source: "International comparison of water and sewerage service 2007 report", Ofwat 2007.

Here, differences are slightly smaller apart from the SGC which also for water supply operates at overall lower costs. There are similar differences in terms of population density, age of the distribution net and here also quality of water. Electricity prices are low in Norway and Sweden due to cheap hydropower which further reduces in particular the operating costs of SGC.

The examples of prices or user charges for water supply and wastewater treatment show much variation. Though much of it can be explained by the specific conditions in the Member States, there should be room for various improvements.

4.1.3 Summary and scoring of indicators

A summary of existing indicators by directive is presented in the below table. It includes some of the more important directives within the water sector.

Overall, the main indicators are price/user charges for water and wastewater services and ex-ante costs assessment comparing the cost-effectiveness of alternative measures. With the Water Framework Directive being implemented and taking the lead as the key water quality legislation, there should be more focus on CEA in the future.

In none of the water directives considered, indicators point in only one direction. Overall, the indicators suggest that there are likely differences in cost-effectiveness across Member States. For the WFD, it is still too early in the process of implementation to draw firm conclusions as this is the only directive that specifically calls for a CEA as part of the implementation.

Table 4-2 Application of cost-effectiveness indictors by directive

Directive	CEA required as part of directive	Use of market based instrument in MS as part of implementation	Ex-ante CEAs exist and show differences between the CE of alternative measures	Prices or user charges of specific activities show CE differences	General ex-post expenditure data show differences in costs
Urban Waste Water Treatment Directive	No	(Yes) in some MSs the industry pays user charge according to pollution content	Yes. Ex-ante cost estimates show limited differences among technologies	Yes Prices show difference within MSs and across MSs	Yes, though they can include other expenditure than those caused by the UWWTD.
Water Framework Directive (WFD)	Yes	(Yes) Cost recovery of water services is required	Ex-ante cost estimates of alternative measures	NA	No (Management plans will include expected expenditure)
Groundwater Directive	No	No	Ex-ante cost estimates of alternative measures	NA	NA
Nitrates Directive	No	(Partly through cross compliance on agriculture payments)	Ex-ante cost estimates of alternative measures	NA	NA

In the table below the different indicators are scored in a simple way where # means that the indicator points to differences in cost-effectiveness across

Member States. On the other hand, ≈ means that the directive is implemented cost-effectively in all Member States judged by the indicator. The overall score is given as a simple average of the available indicators.

Table 4-3 Application of cost-effectiveness indictors by directive - illustrative example of simple scoring of indicators

Directive	CEA required as part of directive?	Use of market-based instrument in MS as part of implementation?	Ex-ante CEAs exist and show differences between the CE of alternative measures?	Prices or user charges of specific activities show CE differences?	General ex-post expenditure data show differences in costs?	*Overall*
Urban Waste Water Treatment Directive	#	≠	≠	#	≠	**≠**
Water Framework Directive (WFD)	≈	≠	#	NA	NA	**≠**
Groundwater Directive	#	#	#	NA	NA	**#**
Nitrates Directive	#	≠	#	NA	NA	**#**

#: Significant differences in CE across MSs
≠: Some difference in CE across MSs
≈: Limited difference in CE across MSs

If CEA is not required, the chances of similar levels of cost-effectiveness are judged to be poorer; therefore the score are low for directives that do not require CEA as part of implementation.

The implementation of WFD means more focus on the use of CEA. The implementation process has been supported by the Common Implementation Strategy, which is in the process of developing common guidance and best practices. Participation from Member States has been varying.

The main consideration for future work on cost-effectiveness in the water sector concerns whether there is a need for further support to the WFD process. It principle, it should ensure a high level of cost-effectiveness due to built-in requirements for CEA as part of the implementation. As already mentioned, it is currently too early to estimate the effect, but the effort so far has varied significantly between Member States.

This is discussed further in Section 6.2 on future studies.

4.2 Review of air pollution indicators

Air pollution and air quality are regulated by many directives and initiatives. The following list comprises some of the most important in terms of achieving improved air quality:

- Large Combustion Plant Directive (LCPD)

- Air Quality Framework Directive
- Clean Air For Europe Programme (CAFE)
- National Emission Ceiling Directive (NECD)
- Vehicle emissions standards (e.g., amended directives for light (Directive 98/69/EC) and heavy duty vehicles (Directive 2005/55/EC))
- Integrated Pollution Prevention and Control Directive (IPPCD) (covered as part of the integrated policies).

Similar to other areas, the regulation has developed from the emission source reduction (the Large Combustion Plant Directive) into framework directives setting overall recipient quality targets. This should in itself promote more cost-effectiveness than the source-oriented legislation.

4.2.1 Existing indicators

The list of potential air quality indicators includes the following based on the generic indicators defined in Section 3.2:

- Requirement to undertake cost-effectiveness analysis
- Ex-ante cost-effectiveness analysis results
- Environmental expenditure combined with an air quality indicator
- Use of economic instruments as part of the directive implementation
- Unit costs of other relevant operations (e.g., monitoring).

The use of each indicator and the possibility of combining these to better address the cost-effectiveness perspective are discussed below.

4.2.2 Major findings

Ex-ante CEAs

None of the air quality legislation has a requirement to undertake CEAs as part of the implementation.

However, in preparing for the air quality legislation, a number of ex-ante CEAs have been undertaken.[7] It means that a lot of evidence on expected costs differences exists. These ex-ante CEAs show that the CE of alternative measures and

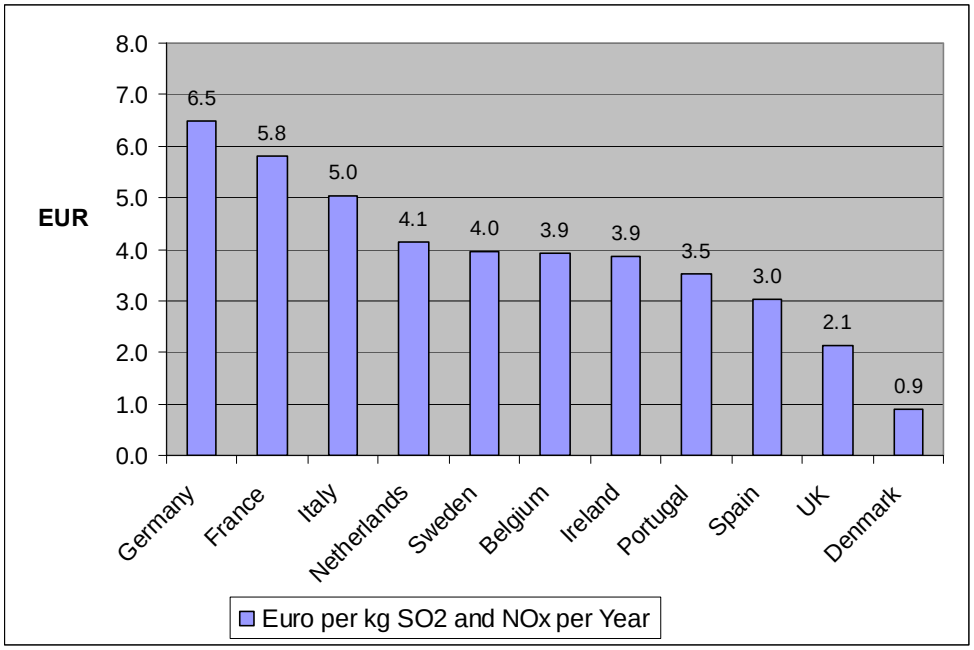
[7] For example: IIASA has developed models that allow estimation of cost-effective reductions of air pollutant. These models, RAINS and GAINS have been used in ex-ante assessment in relation to the Emission Ceilings Directive (see Appendix A with a number IIASAS studies: IIASA (1998) to IIASA (2008)

instruments varies significantly. Considering the ex-ante CE differences and the fact that not all Member States undertake CEAs as part of the implementation indicates that CE differences are likely to exist between Member States.

Ex-ante cost data

The costs of air pollution control are calculated for a range of the old Member States (Figure 4-7). The figure reflects the costs of air emission pollution control per kg of SO_2 and NOx. The cost data are based on model data for air pollution control of all types of air pollutants. The unit costs are only calculated for the emission of SO_2 and NOx. Hence, the data can only be used as a rough indicator of cost differences. The figure shows that significant cost differences exist between Germany (€6.5 per kg SO_2 and NOx) and Denmark (€0.9 per kg SO_2 and NOx). The relatively low costs of air emission control in Denmark are related to the significance of the shipping sector (Federal Statistical Office, 2008: p. 28)[8].

Figure 4-7 Cost of air emission pollution control for SO_2 and NOx



Note: Data on emission of NOx and SO_2 are from 2002-2003. Cost data are based on model data for total costs of air pollution emission by 2020.
Source: Federal Statistical Office (2008: pp. 21-22: figures 11 and12); IIASA (2008: p. 28; Table 5.4).

A range of ex-ante cross-national cost estimates have been made of the costs of reducing emission of air pollutants. These cost estimates primarily draw upon

[8] The regulation of NOx emissions from the shipping sector is less strict than emissions from land-based sources, and the costs of air emission control are therefore lower per kg NOx in Denmark compared to other EU countries.

models developed by IIASA (RAINS and GAINS). Such models calculate the total expected costs for Member States to achieve air quality targets using the most cost-effective solutions, i.e. the models are based on the use of the most cost-effective technologies. Consequently, such ex-ante data cannot be used to provide information on actual differences in cost-effectiveness, and hence cost-effectiveness indicators cannot be directly based on such data.

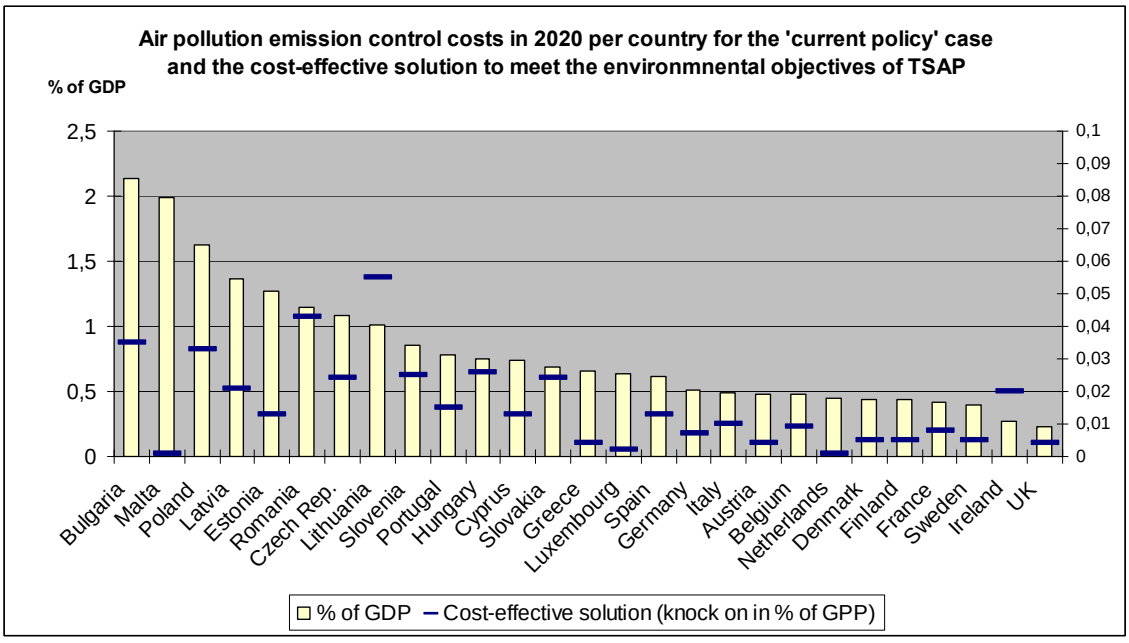
Figure 4-8 shows that there are significant differences across the EU in the costs of air pollution control. The figure shows the annual air pollution control costs (as a share of GDP) that Member States will have to comply with existing air regulation by 2020. This is shown by means of the white columns and the costs in percentage of GPD are reflected in the left side value axis.

Compliance with the environmental objectives of the Thematic Strategy on Air Pollution (TSAP) by 2020 will entail additional costs for the Member States. The cost-effective solutions are shown in the figure as the horizontal lines. The costs linked to the cost-effective solutions as a share of GDP are reflected in the right side axis.

Assuming that cost-effective measures are applied, the expected costs of compliance vary greatly across EU. The costs related to the current policy case are significantly higher for the new Member States than for the old Member States. The additional costs of complying with the TSAP objectives are in general also higher in the new Member States (with the exception of Malta).

The technological level of equipment and the energy supply structure are two parameters that influence the costs of complying with air quality policies.

Figure 4-8 *Air pollution emission control costs in 2020 per country for the 'current policy' case and the cost-effective solution to meet the environmental objectives of TSAP*



Source: IIASA (2008: p. 28; Table 5.4).

Economic instruments

With respect to the National Emission Ceiling (NEC) Directive, EU legislation on air quality plays an important role in national implementation of the NEC Directive (through climate policies, the Large Combustion Plant Directive, IPPC Directive, EURO standards for vehicles, the Solvent Directive and the Directive on the sulphur content of liquid fuels).

However, some national differences exist with respect to the type of instruments used.

Most measures used by the Member States are of the 'command and control' type. A range of measures are, however, used to influence the behaviour. Denmark, Germany, Sweden and the UK use a range of economic instruments to reduce emissions. Belgium uses voluntary instruments to reduce emissions from electricity production.

Sweden has a tax on SO_2 and NOx emissions, Denmark has a tax on SO_2 emissions and the Netherlands has an emission trading scheme for NOx. The AEA (2008) concludes that use of such economic instruments may provide additional opportunities for emission reduction in other Member States.

Transport sector

The distinct national measures used in national plans to comply with the NEC Directive were:

- congestion charging
- the use of low emission zones
- road pricing
- financial incentives for switching to less polluting vehicles and transport models
- actions focusing on driver behaviour
- promotion of public transport
- sustainable transport in more broad terms

Denmark, Sweden and the Netherlands have specific measures that aim at reducing emissions from shipping.

Domestic sector

Some Member States have measures that target the domestic sector, e.g., the Netherlands and France have requirements for low NOx or type-approved boilers.

Agriculture

The national measures for emission reduction include reduction of livestock numbers, promotion of low emission fertilisers, aeration of animal housing, changes of animal feed and use of anaerobic digesters for biogas production.

There are significant differences in the instruments used by the Member States. Sweden and the Czech Republic use a higher proportion of fiscal and other economic based instruments than the other Member States. Germany and Austria predominantly use regulatory measures. France uses a relatively high proportion of information and educationally based instruments (AEA, 2008: p. 8).

These national differences in the implementation of the NEC Directive may entail differences in cost effectiveness and can therefore be used as an indicator of cost effectiveness. The use of economic instruments in Denmark, Germany, Sweden and the UK may entail higher cost-effectiveness.

Compliance with regulation

Differences in the degree of compliance with the regulation on air quality affect the assessment of indicators of cost-effectiveness. The implementation of the NEC Directive is proceeding very differently in the Member States, and especially with respect to emission of NOx, many Member States are expected not to comply with the Directive by 2010.

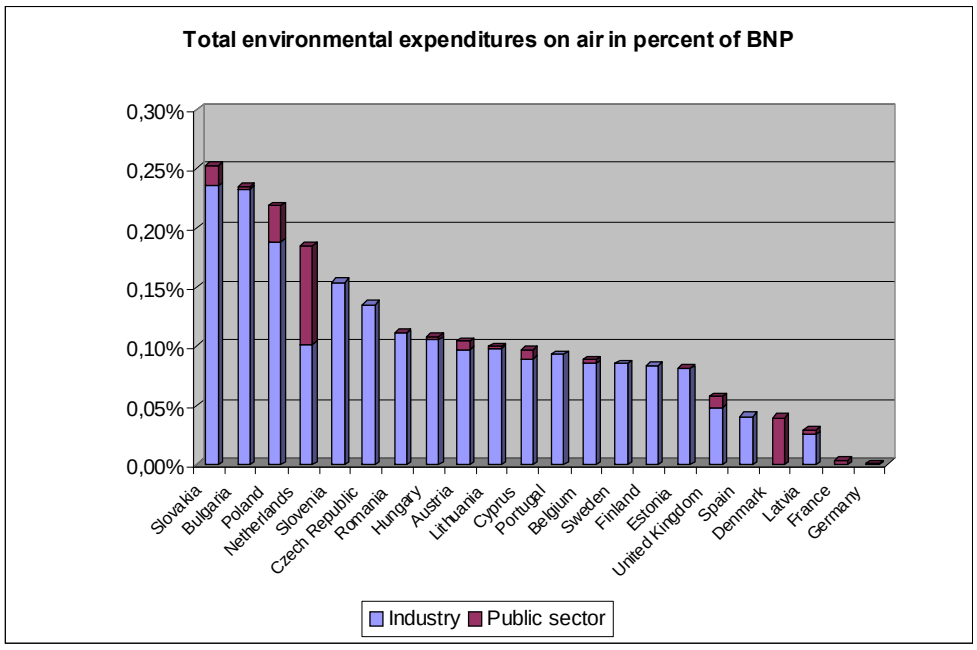
Environmental expenditure

Total expenditure on air pollution control can also provide some indications. It is based on the data from EUROSTAT on air pollution control expenditure.

Figure 4-9 shows the expenditure in percentage of GDP for both the public sector and the industries. First of all, it is seen that the total expenditure varies greatly among the Member States. The variation is more than a factor of 10.

Furthermore, Figure 4-9 shows the split between the expenditures in the public sector and the industries. (For some countries, only data from one sector are included so the real value could be higher). In Denmark, the Netherlands and Poland, the public sector pays much more for air protection than in all the other Member States where it is entirely or almost entirely paid by the industries.

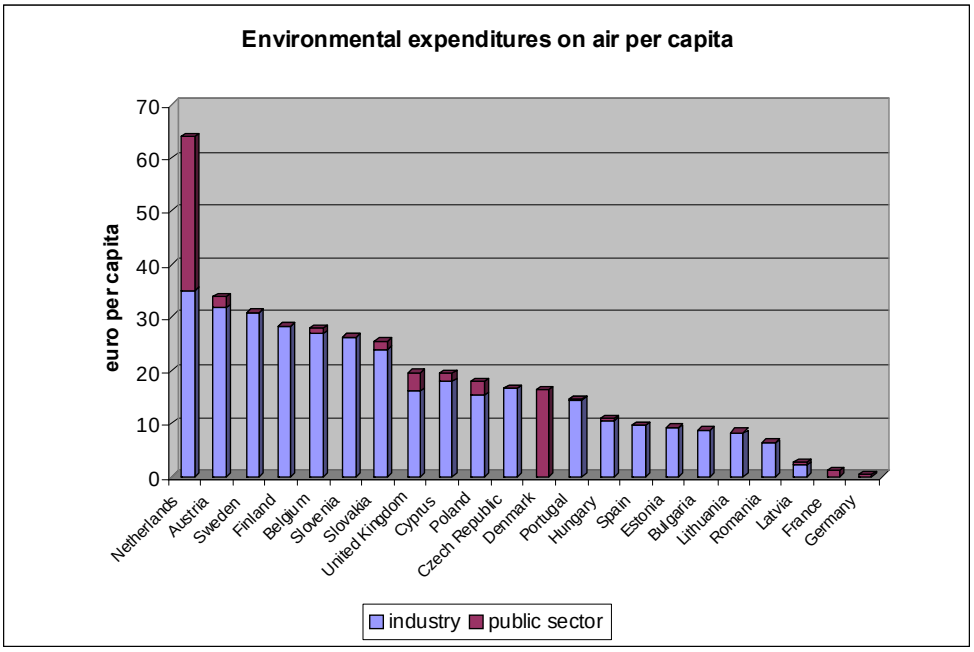
Figure 4-9 Total environmental expenditures on air in percentage of GDP



Source: EUROSTAT

Figure 4-10 shows the same data, but as per capita instead of as a percentage of GDP. This changes a bit the order, and the expenditure of the Netherlands looks much more extreme.

Figure 4-10 Total environmental expenditures on air per capita

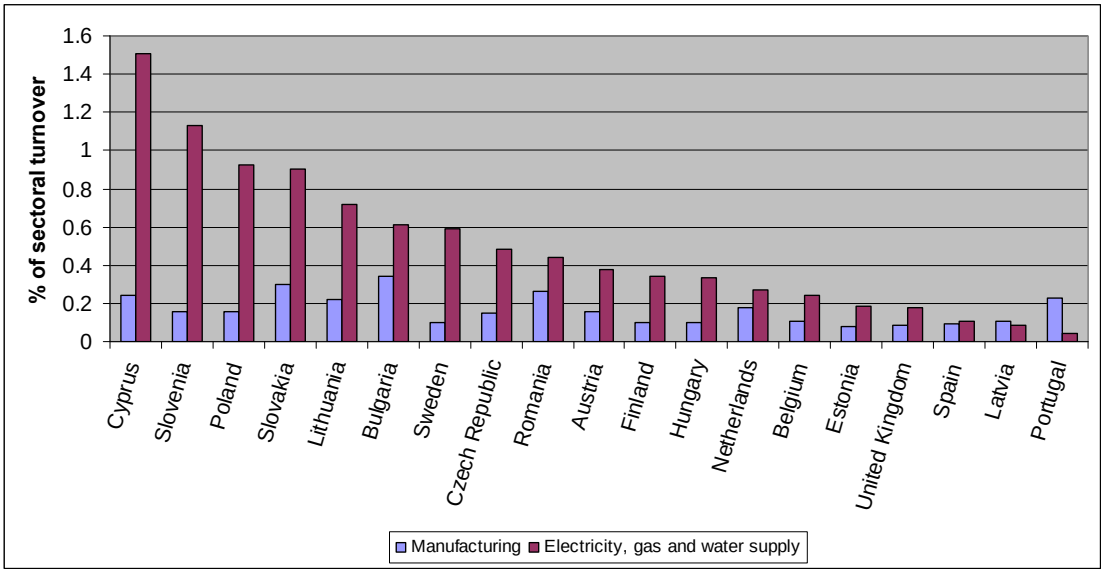


Source: EUROSTAT

Figure 4-11 shows the environmental protection expenditure for air quality reported by some industries as a percentage of sectoral turnover. The environmental protection expenditure as a share of sectoral turnover is highest for electricity, gas and water supply in Cyprus, Slovenia, Poland and Slovakia (more than 0.8 per cent of sectoral turnover). The environmental protection expenditure is lowest in Portugal and Latvia (less than 0.09 per cent of sectoral turnover).

In the case of the manufacturing sector, the environmental protection expenditure is highest in Bulgaria (0.3 per cent of sectoral turnover) and lowest in Estonia (0.07 per cent of sectoral turnover).

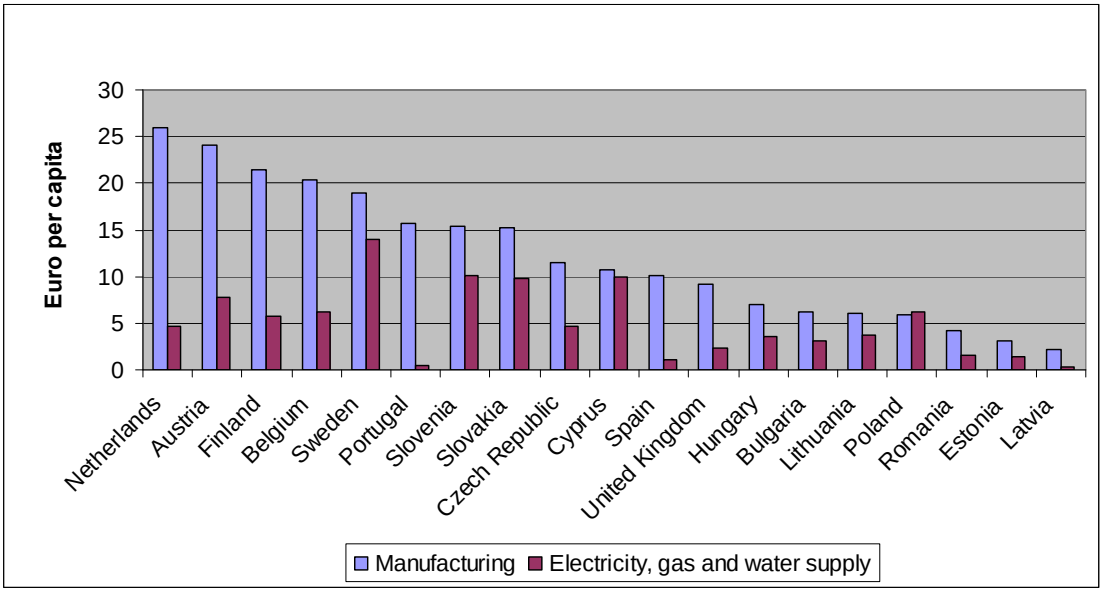
Figure 4-11 Environmental protection expenditure for air as % of sector turnover



Source: Eurostat

Figure 4-12 shows the environmental protection expenditure for industrial sectors per capita. The costs of manufacturing are highest in the Netherlands (€25.9 per capita) and lowest in Latvia (€2.1 per capita).

Figure 4-12 Average annual environmental protection expenditure for air for industrial sectors in Euro per capita



Environmental protection expenditures for electricity, gas and water supply per capita are highest in Sweden (€14.0) and lowest in Latvia (€0.3). The four Member States with the highest environmental expenditure per capita are Sweden, Slovenia, Cyprus and Slovakia.

In the Netherlands, the environmental protection expenditure for air within the manufacturing industry is very high compared to the population. The manufacturing industry, however, has a very high turnover and the relative sectoral costs are therefore limited. Hence, environmental expenditure as a percentage of sectoral turnover is a better indicator than costs per capita.

In Cyprus, Poland, Slovenia, Slovakia and Sweden, the environmental protection expenditure is relatively high, measured both as sectoral turnover and as costs per capita. There could be several explanations to this. High costs in Sweden could be explained by a high environmental performance, and high costs in Cyprus, Poland, Slovenia and Slovakia could be explained by the transformation of the energy sector in these countries. However, this does not explain why the industry in for example Latvia has relatively low costs.

A lot of data is available on air quality and emission of air pollutants. However, without relating environmental impact data to the costs associated with reducing emissions and/or improving air quality, the data only contain limited information on cost-effectiveness.

Conclusions

A few studies have targeted cross-country ex-post analysis of cost-effectiveness of environmental air policy within the EU. A study (SPRU, 2000) investigating the cost-effectiveness of the implementation of the LCP Directive correlates national differences in implementation of the Directive with differences in the market structure of electricity producing companies in four Member States (France, Germany, the Netherlands and the UK). The study takes into consid-

eration the extent of compliance with the Directive and the political willingness to achieve reductions in emissions. It was concluded that the implementation of the Directive was more cost-effective in the UK and France, lower in the Netherlands and lowest in Germany. The study did not directly draw upon cost data.

It has only to a limited extent been possible to gather comparable cross-country ex-post cost data for air emissions for particular pollutants or cost data related to the implementation of specific directives. The costs of abatement and mitigation of SO_2 and NO_x seem to vary across the EU. The sectoral analyses of data on environmental protection expenditure show that there are differences between Member States. The industrial differences between Member States with respect to sectoral turnover are quite significant.

In order to evaluate the reasons for differences in this cost data, it is necessary to make further investigations into the sectoral differences across the EU, namely differences with respect to use of technology, differences with respect to use of fuels, and correlate costs ex-post with different pollutants.

EU policy on air quality, e.g., the NEC Directive is to some extent implemented differently in Member States. The use of fiscal market-based instruments and command and control instruments respectively varies across the EU. This could be an indicator of possible differences in cost-effectiveness.

There are also differences in the compliance with regulation across Member States. It is not possible to compare cost-effectiveness of the implementation of policies on air quality between Member States that comply with the EU regulation with Member States that do not.

Monitoring data on air quality are available for a range of air pollutants (e.g., SO_2, NOx, PM), and the comparison of such data across Member States can to some extent be used as indicator of the activities undertaken to reduce the emissions.

If data on the sectoral structure (e.g., number of installations by size or type) are compared with costs for installation of cost-effective technological solutions (in terms of, respectively, prevention and rinsing measures), it can be assessed to what extent the sectoral expenditures for air pollution protection are cost-effective. It has not been possible to compile the data needed to make such assessments within the framework of this study.

4.2.3 Summary and scoring of indicators

The indicator assessment is summarised and presented together with a scoring based on the indicators in Tables 4-4 and 4-5.

Table 4-4 Indicator assessment of air quality legislation

Directive	CEA required as part of directive?	Use of market-based instrument in MS as part of implementation?	Ex-ante CEAs exist and show differences between the CE of alternative measures?	Prices or user charges of specific activities show CE differences?	General ex-post expenditure data show differences in costs?
Large Combustion Plant Directive	No	No	Ex-ante cost estimates show some differences between technologies	No user charges - not relevant	Yes, but they cover all air quality expenditure, not any specific directive.
Air Quality Framework Directive	No	No	Ex-ante cost estimates of alternative measures and show differences in costs	No user charges - not relevant	Yes, but they cover all air quality expenditure, not any specific directive.
National Ceilings Directive	No	Yes	Ex-ante cost estimates of alternative measures and show differences in costs	No user charges - not relevant	Yes, but they cover all air quality expenditure, not any specific directive.
Transport vehicle emission legislation	No	No	Ex-ante cost estimates of alternative measures and show differences in costs	No user charges - not relevant	No, not included in the expenditure data.

A subjective scoring of each directive or legislation is presented in the below table.

Table 4-5 Application of cost-effectiveness indicators by directive - illustrative example of simple scoring of indicators

Directive	CEA required as part of directive?	Use of market-based instrument in MS as part of implementation?	Ex-ante CEAs exist and show differences between the CE of alternative measures?	Prices or user charges of specific activities show CE differences?	General ex-post expenditure data show differences in costs?	*Overall*
Large Combustion Plant Directive	#	≠	≠	#	≠	**≠**
Air Quality Framework Directive	#	#	#	NA	NA	**#**
National Ceilings Directive	#	#	#	NA	NA	**#**

Directive	CEA required as part of directive?	Use of market-based instrument in MS as part of implementation?	Ex-ante CEAs exist and show differences between the CE of alternative measures?	Prices or user charges of specific activities show CE differences?	General ex-post expenditure data show differences in costs?	*Overall*
Transport vehicle emission legislation	#	#	#	NA	NA	**#**

#: Significant differences in CE across MSs
≠: Some difference in CE across MSs
≈: Limited difference in CE across MSs

It should be mentioned that, in the air quality domain, there are a number of ex-ante assessments that have compared different measures. Such ex-ante CEAs form the basis for cost-effective implementation if the conclusions have been followed. As there is no indicator that shows to what degree Member States have used those assessments on the actual implementation, the above evaluation could be biased towards suggesting more significant differences that actually exist.

4.3 Review of integrated policy indicators

Integrated legislation that has been included in this study includes:

- IPPC
- EIA
- SEA.

The IPPC covers industrial pollution from major installations and has provided significant air pollution reductions. It has been included here because it covers all environmental impacts.

The legislation on environmental assessment is of different nature. Both the EIA and SEA is about requiring that certain types of analysis of environmental impacts are undertaken.

The outcome of the EIA and SEA is ultimately to make sure that environmental impacts are addressed and mitigated when necessary. The outcome is not a specific environmental quality or outcome. It is therefore not possible to estimate the cost-effectiveness of such legislation across Member States.

4.3.1 Existing indicators

The IPPC and the EIA/SEA are discussed separately.

IPPC
The indicators investigated for cost-effectiveness of implementation of the IPPC Directive are:

- Level of implementation of the Directive
- Similarity between pre-IPPC permitting regimes and the IPPC regime
- Differences in fees and charges
- Administrative structures and resources.

The set of indicators used for the other areas is not so useful in the case of the IPPC. The IPPC Directive has been through a detailed review phase. This included assessment of possible streamlining of the Directive which included cost-effectiveness considerations.

Implementation

The level of implementation of the IPPC Directive with respect to issuing of permits differs significantly across EU.

The compliance with the permit issuing varies across EU (ENTEC, 2008):

- Four Member States (France, Lithuania, Luxembourg and Slovakia) have reported completion of their permitting activity under IPPC (100 per cent progress).
- The majority of Member States have reported 80 per cent or greater progress of permitting progress
- Bulgaria, Italy and Portugal have reported 50 per cent permitting progress or greater.
- Greece and Slovenia have reported less than 50 per cent permitting progress.
- Malta has reported a 0 per cent permitting progress.

A large number of installations (estimated to approximately 36,000 in 2007) are covered by the IPPC Directive. The majority of the installations are in Germany, France, Spain and France.

Flexibility

The Directive allows certain flexibility in the implementation, which implies that there are cost differences between the environmental performance of the top and bottom range of BAT. With respect to large combustion plants the costs and benefits of the plants vary significantly depending on the damage costs function for the Member States - and the damage costs function varies widely across the EU.

The Member States have developed a range of instruments (e.g. market-based mechanisms) that impact on the regulatory costs and effectiveness. These instruments cannot be an alternative choice to IPPC, as the IPPC is a legal obligation. Still, these instruments interact with the IPPC. The mix of such instruments has an impact on cost effectiveness, competitiveness and administrative

costs. This raises the issue of achieving the optimal policy mix that entails the greatest extent of cost-effectiveness (IEEP, 2004: p. 6).

Pre-IPPC permitting regime and the IPPC regime

The needs for changes to the pre-IPPC permitting regime entailed by the Directive varied significantly across EU. Some Member States had to restructure the national permit system fundamentally, whereas other Member States only had to make incremental adjustments to the existing permit system. In the electric steelmaking and glass production industries, competitive impacts may have occurred in the Member States where the previous permit system differed from the IPPC system. This indicates that there have been differences in the cost-effectiveness of the implementation of the Directive.

Fess for permits and annual charges

There are significant differences across Member States in terms of fees and annual charges the industry charged for administrative issues. Such differences may entail competitive distortion. This, however, is not the case in the steel making and glass industries.

Administrative structures and resource

For the steelmaking and glass industries it is concluded that differences in the approach to inspection across the EU entail competitive distortion.

Evidence from self-perception among competent authorities in Member States suggests (Ifo, 2006) that for some countries the permit system is characterised by:

- too many authorities being involved
- unclear distribution of competences
- no well-established coordination among competent authorities.

This seems especially to be the case for Spain and to some extent Italy (Ifo, 2006).

Industries investigated

The cement, non-ferrous metal, pulp and paper, steelmaking and domestic glass industries are the industries that have been investigated for cost-effectiveness. Focus of the studies has not been on cross-country differences.

Summary

There are several indications that there are differences across the EU with respect to cost-effectiveness of the implementation of the IPPC Directive.

The study on streamlining the IPPC directive (Entec, 2007) found that moving to single permits for all IPPC installations could potentially save €10 to 60 million. This amount was estimated to about 1 per cent to 6 per cent of the total permitting costs for the 38,000 IPPC installations. The estimate is based on a number of assumptions, for example, how many Member States still have multiple permit systems. This information was uncertain.

Interesting areas to investigate for cost-effectiveness in the IPPC Directive are:

- Significance of flexibility in implementation of the Directive in terms of defining what is meant by BAT
- The significance of national pre-IPPC permit regimes
- Impact of integration of national policy mix with the IPPC Directive
- Differences in administrative resources and structure for issuing permits and inspection installations
- Impact of differences in fees and annual charges for administrative issues.

4.3.2 EIA and SEA

As mentioned above, the nature of the legislation of the EIA and SEA means that there is no fixed objective with which to compare costs, and therefore a cost-effectiveness analysis of the costs and effects of the legislation cannot be made.

In principle, the administration of the directives and how the requirements are interpreted could be compared. There is a report that compares the implementation of the EIA and SEA in different Member States[9]. The differences are mainly caused by the different institutional setups in Member States. It is therefore not possible to evaluate the implementation in terms of CE. If there are differences with respect to how detailed and comprehensive an EIA or an SEA should be then that is more a question of cost-benefit than cost-effectiveness. Requiring a more detailed assessment increases the costs of undertaking the EIA but it should also increase the chances of achieving a higher quality of the assessment. This should lead to a higher level of protection against the adverse impacts from the project that requires the EIA.

4.4 Review of waste sector indicators

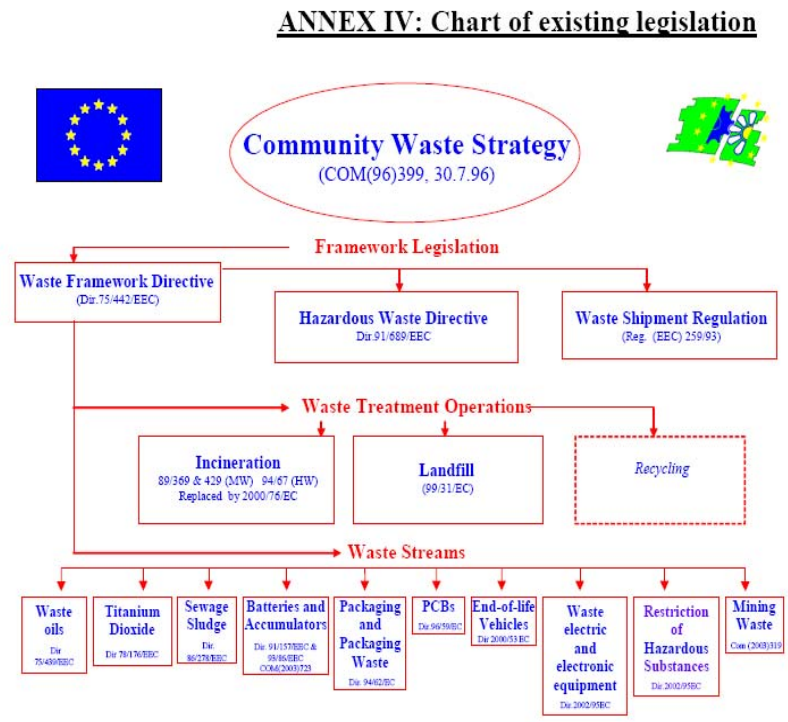
Waste management is an area that is covered by many directives such as:

- Waste Framework Directive
- Municipal Waste Management
- Package Waste Management
- Regeneration and Incineration of Waste Oils
- RoHS Directive
- WEEE-Directive

[9] Imperial College (2005), "The relationship between the EIA and SEA directives", Imperial College London Consultants, 2005, Report to the European Commission.

- Batteries Directive
- End of Life Vehicle Directive
- Landfill Directive
- Municipal Waste Incineration Directive.

The figure below shows the complexity of the issue:



Source: DG-ENV (2005)

Generally, more data are available for the waste area compared to the other environmental areas included in this analysis. Collection and treatment of a given waste stream is also fairly similar and therefore, cost differences in collection and/or treatment are more likely to be an indication of potential cost-effectiveness differences.

4.4.1 Existing indicators

The following list of indicators can be used to describe the waste sector and possibly indentify areas where potentials for cost-effectiveness improvements exist.

- Existence of CEA requirements in legislation
- Use of market-based instruments.
- Prices and costs of waste management activities:
  - Cost and unit cost for collection
  - Cost and unit cost for different waste treatment.
- Expenditure on waste management.

Mandatory CEAs
Requirements to undertake a CEA as part of legislation do not appear in the waste legislation. The overall principle is the waste management hierarchy: (a) prevention, (b) preparation for re-use, (c) recycling, (d) other recovery and (e) disposal. There are no requirements make a cost-effectiveness analysis as part of attaining the overall objectives.

This indicator therefore points to the existence of CE differences given that there are many alternative ways to implement waste management, and without undertaking CEAs as part of the implementation, it is likely that cost-effectiveness improvement potentials exist.

Use of economic instruments
User charges or fees apply to most waste management operations. There are no comparable data on cost-recovery rates across Member States. In most cases, waste generation by households are not directly measured so households either pay a fixed price or pay by the number of bins etc. It means that the incentive to reduce the generation of waste is limited. It is technically complicated to measure the actual amount of waste, and it is difficult to prevent illegal dumping of waste. Some Member States apply economic instruments such as a tax on certain packaging waste items in order to reduce the amount of packaging waste.

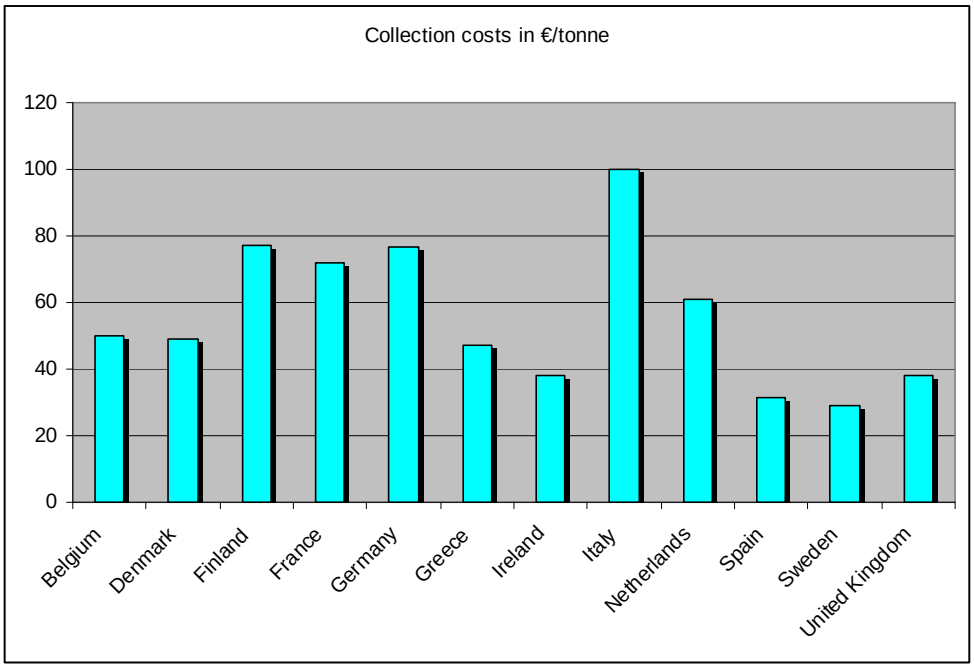
Price and unit costs
By comparing the price and unit costs of various waste management operations, some indication of cost-effectiveness differences can be found.

The data available on the cost of waste can be divided into two overall groups. One group comprises general expenditure on waste by sector while the other group includes detailed cost information on collection, sorting and treatment of different waste fractions.

Cost of collecting waste in general

The cost of collecting waste has been analysed in (DG-ENV (2005)). In Figure 4-13, the average cost estimate for the Member States is presented. The cost varies from around €30 to 100/tonne.

Figure 4-13 Collection cost in €/tonnes



Source: DG-ENV (2005)

Cost variation could be due to many factors, and the reference does not provide an exhaustive explanation. There is no relationship between the total amount of waste generated and the percentage of waste recycled or recovered. Frequency of collection, distribution on rural and urban collection could have large implication on the costs. The variations of costs and the lack of an apparent explanation point to the likely existence of a cost-saving potential, see further discussion below.

Cost of collecting biowaste

There are not so many data on the cost of collecting biowaste in Member States. The available data show large variations from €40/tonne to €302/tonnes. There is similarly limited information on the causes of the difference, though data for France could shed some light on one factor. For France, data for both rural and urban collection are included. The price for collecting rural waste is three times higher than waste collection in urban areas. It could be that part of the variation can be explained by the difference between the cost in urban and rural areas.

Cost of collecting hazardous waste

The price for collecting hazardous waste is much higher than for other waste fractions. This is due to the handling, information and training of employees and specially designed sorting points and logistic centres. The data are not comparable, and a primary data collection will be necessary in order to conclude if the handling methods in the Member States are effective.

Cost of sorting waste

The costs of sorting waste could be expected to vary as there are different technologies. This also links to waste collection as sorting at an early stage could increase the cost of collection while reducing the cost of later sorting.

The data on the costs of sorting waste ERC (2001) only cover a few countries, and there are large differences in sorting costs between the included countries. The data also shows that there are significant differences in sorting various fractions. It means that one needs to compare the exact same waste fraction across MSs in order to be able to analyse possible cost-effectiveness differences. The available data do not allow for such an analysis.

Cost of recycling

The cost of recycling waste has been analysed in a number of studies. [10]The general impression from the available data is that Austria has the highest cost and that the Netherlands has much lower costs. The data are not directly comparable, and therefore it is not possible to assess possible differences in cost-effectiveness across Member States.

Cost of composting

One study has estimated and compared composting costs (Source: ERC (2001)). These costs hardly vary among the Member States, which indicates that there are few alternative technologies, and therefore costs tend to be more uniform across MSs in the range of €30 to €60 per tonne.

Cost of landfill

Also, the cost of landfills is estimated in the same study. The costs range between €6 and €154 per tonne. The Member States with the highest costs are Luxembourg and the Netherlands, whereas Poland and Greece have the lowest costs. This could be related to the price of land and the requirements relevant for constructing a landfill. The data reviewed do not provide any insight into the main parameters causing the variation in costs.

Cost of incineration

The cost of incineration also varies a lot. Similar to the case of landfills, it is not possible to identify the main reasons for the observed differences.

Intermediate conclusion

For all the data on collection and treatment of waste, comparability across Member States is low. The referred studies have not been able to account for all factors, and it is unclear which factors are accounted for. It is therefore not possible to draw far-reaching conclusions about which Member States seem more cost-effective. For waste management, the interrelationship between the activities further complicates the comparison. The costs of collection depend on how the waste is further handled downstream. The treatment of industrial waste influences the costs etc.

In principle, an assessment of cost-effectiveness should cover the whole waste management system in order to compare across Member States.

Cost of WEEE directive

The overall cost per unit (pieces of electronic equipment included by WEEE) sold is estimated in (Arcadis (2008)). Data are included from Belgium, Sweden, Netherlands, Ireland, Spain, Austria, France and Germany: In general, Sweden has the highest cost per unit sold, whereas the lowest cost is found in Germany. The analysis stresses that the cost per unit is strongly correlated with the number of available take-back schemes, in the sense that many take-back schemes result in lower costs.

[10] Source: ERC (2001), Pira (2005) and Cagnot, J., V. Monier and A. Le Doré (2000).

Cost of the battery directive

The cost related to the battery directive in Austria, Belgium, France, Germany and the Netherlands is analysed in (Monier V and E Labrouze (2003)). The cost includes all activities connected with the directive, e.g., collection, information and treatment. The costs in Belgium and the Netherlands are three times higher than in Germany and Austria. Part of the explanation for the high cost in Belgium could be that collection rates are more ambitious.

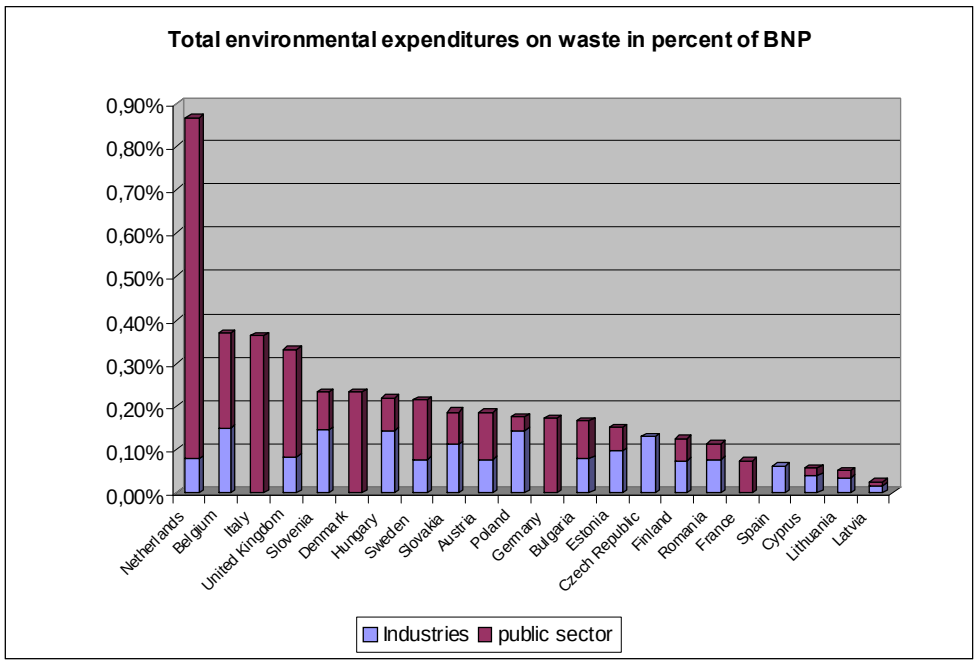
General expenditure on waste management

The last indicator for waste is based on the data from EUROSTAT on the expenditure on waste management.

Figure 4-14 shows the expenditures in percentage of GDP for both the public sector and the industries. Total expenditure varies greatly among the Member States. There is no explanation for the very high expenditure borne by the Netherlands; it could simply be a result of more comprehensive reporting of all waste expenditure rather than a difference in the actual level of expenditure.

Furthermore, the figure illustrates the split between the expenditure in the public sector and the industries (for some countries, only data from one sector are included so the real value should be higher).

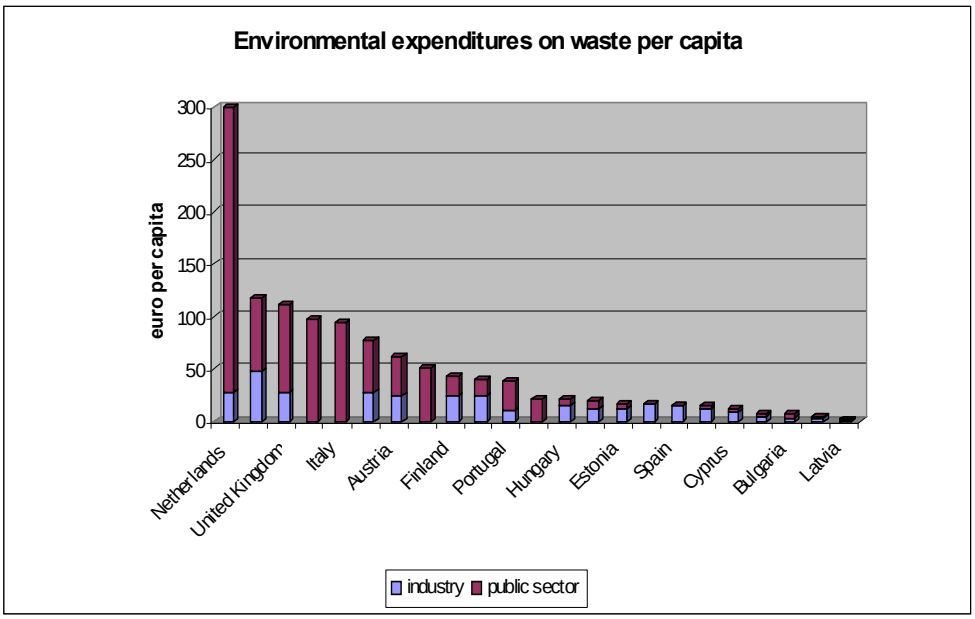
Figure 4-14 Total environmental expenditures on waste in percentage of GDP



Source: EUROSTAT

In Figure 4-15, the same data are shown, but as per capita instead of as a percentage of GDP. This changes the order a bit, but the expenditure borne by the Netherlands still looks very high compared to the rest of the Member States.

Figure 4-15 Total environmental expenditures on waste per capita



Source: EUROSTAT

4.4.2 Summary and scoring of indicators

The indicators of waste legislation are summarised in the below table. The legislation is aggregated into the Waste Framework Directive, hazardous waste legislation and legislation on special waste streams. Though differences across the legislation within the two aggregated categories are possible, a general trend can be described.

Table 4-6 Indicators of waste legislation

Directive	CEA required as part of directive?	Use of market-based instrument in MS as part of implementation?	Ex-ante CEAs exist and show differences between the CE of alternative measures?	Prices or user charges of specific activities show CE differences?	General ex-post expenditure data show differences in costs?
Waste Framework Directive	No	Yes	Yes. Ex-ante cost estimates show some difference between technologies	Yes, user charges show differences	Yes, but they cover all waste related expenditure, not any specific directive.
Hazardous waste legislation	No	No	Ex-ante cost estimates of alternative measures	Yes, user charges show differences	Yes, but they cover all waste related expenditure, not any specific directive.
Specific waste stream legislation	No	Yes	Ex-ante cost estimates of alternative measures	Yes, user charges show differences	Yes, but they cover all waste related expenditure, not any specific directive.

The scoring is subjective, but overall the indicators point to a high likelihood of cost-effectiveness differences across Member States.

As discussed, the complexity of the waste management system means that a fair comparison of cost-effectiveness requires that the whole system is taken into account. Such an assessment might not be very feasible. What could be further investigated for waste management is the operational efficiency of each activity: collection, landfills, incineration, and management of special waste streams.

Table 4-7 Application of cost-effectiveness indicators - illustrative example of simple scoring of indicators

Directive	CEA required as part of directive?	Use of market based instrument in MS as part of implementation?	Ex-ante CEAs exist and show differences between the CE of alternative measures?	Prices or user charges of specific activities show CE differences?	General ex-post expenditure data show differences in costs?	*Overall*
Waste Framework Directive	#	#	#	#	NA	**#**
Hazardous waste legislation	#	≠	#	#	NA	**#**
Specific waste stream legislation	#	#	#	#	NA	**#**

#: Significant differences in CE across MSs
≠: Some difference in CE across MSs
≈: Limited difference in CE across MSs

4.5 Review of biodiversity indicators

The main legislation in relation to biodiversity includes:

- Habitat Directive
- Birds Directive
- Marine Framework Directive.

The sites being designated under the Habitat and Birds Directives are referred to as Natura 2000 sites. The Marine Framework Directive aimed at protecting biodiversity of the marine environment is currently being implemented in the Member States.

Biological diversity or biodiversity means "…the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this

includes diversity within species, between species and of ecosystems.[11]" Biological resources include genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity.

4.5.1 Existing indicators

Given the upcoming year 2010, when progress towards the 2010 biodiversity target is to be assessed, it is necessary to have relevant and feasible indicators of European biodiversity.

In a recent report[12] from the EEA, sets of indicators are presented for European biodiversity aiming at evaluating the 2010-target. These indicators do not capture cost-effectiveness of biodiversity and conservation policies, but rather focus purely on the issue of capturing the state of biodiversity in various ecosystems. Some of these indicators require a great deal of effort and time to gather information on while others are less resource-intensive and therefore more cost-effective to collect. Problems of establishing indicators of biodiversity were considered during an expert consultation amongst 20 different countries[13]. Major hurdles included:

- lack of overall conceptual approach
- lack of presentation of the whole Drivers, Pressures, States, Impacts Responses (DPSIR) chain;
- indicators show fragmented picture on biodiversity on EU level
- too generic
- at least 19 indicators immature in methodological sense
- problems with harmonisation on the specific space level and in methodological context
- data are not available and expensive to obtain.

Of the indicators tested, data problems were encountered with 13 of the indicators; definition problems with 19 of the indicators, while only five proxy indicators were proposed. As these indicators were designed to capture levels of biodiversity, it becomes evident difficult it would be combining data to compile cost-effectiveness indicators.

[11] Article II, CBD, 1992.

[12] EEA Technical report No 11/2007; Halting the loss of biodiversity by 2010: proposal for a first set of indicators to monitor progress in Europe. ISSN: 1725–2237

[13] Consultation process facilitated by the EEA (2007)

Attempts to add the cost-effectiveness of biodiversity policies to the indicator mix will requires considerable effort and are more likely to capture either (a) (partial) biodiversity levels only, or (b) cost-levels across different zones, but it is unlikely to say much of (a) and (b) at the same time. This has simply to do with the complexity of the information which the indicator attempts to capture and present. The problem of establishing cost-effectiveness proxies is even more difficult for biodiversity than for example in the case of water, as generally biodiversity is not priced, and the supply of biodiversity cannot easily be valued. Society is currently trying to develop markets for ecosystem services such as biodiversity provision, which will enable one to come up with a better idea of the value of biodiversity (and so have a better idea about cost-effectiveness proxies), but currently most values of biodiversity are reliant on economic valuation techniques centring mostly on the 'willingness-to-pay' for biodiversity, which is inherently complex and often overestimates values due to the lack of a marginal utility curves of biodiversity provision, i.e. that these valuation capture methods are not based on incremental increases or decreases in biodiversity, but are rather based on an absolute level of diversity provision.

In addition, biodiversity conservation is usually a process that occurs at a myriad of different scales, with the overall policy goal of halting biodiversity decline, being implemented at a supra-national level, while it may be a farmer, landowner or another individual at the ground level that actually takes actions that can influence biodiversity levels (with a range of actors and stakeholders in-between).

In terms of conservation of biodiversity, the policy route usually goes down two avenues: one is to use public funds to preserve natural areas and create national parks or conservation areas, while the other is to pay landowners and farmers to create suitable habitats on private land to encourage wildlife and a diversity of species in the area: so-called agri-environment schemes. The range of measures taken to implement these two approaches obviously varies from Member State to Member State, but in essence these two avenues are the most prescribed policy interventions in terms of achieving dedicated biodiversity improvement goals.

Biodiversity policy expenditure bench-marking
Cost-effectiveness of public spending on biodiversity
Estimating the expenditure between different countries and specifically how much each country in the EU spends on biodiversity policy per capita, and comparing that to rates of change in biodiversity levels is an approach that can be considered as a proxy. If one was to combine indicators of biodiversity losses/gains in these different countries, then, in theory, it would be possible to draw some conclusions on the expenditure compared to the reduction in biodiversity loss over time. There would be no way, however, to prove that the actual expenditure had resulted in an associated reduction in biodiversity loss.

Another issue is the issue of where funding comes from. For example, financing from the EU, if included in the analysis, means that the total figures for spending on a Member States' biodiversity is independent of where the money came from. This could have implications further down the line when looking to

make comparisons between Member States, as the indicator captures funding to biodiversity as opposed to expenditure on biodiversity, but each country's stance on this issue would need to be looked at individually.
Establishing a methodology to calculate the correct expenditure levels in each Member State is also problematic and time-consuming. Direct conservation consists of activities that directly protect and promote variety among living organisms. However, direct action is often ineffective unless supported by a range of other activities such as research and development, education and publicity, or even simply administration. Sources of information may not always distinguish between these elements, and it is necessary to exercise judgement as to when a cost item should be included or not, or whether the relevant component relating to direct action should be estimated by expert judgement or by reference to other information. Expenditure -and costs - might simply not be known in some instances. For example, it is unlikely that expenditure on badger tunnels under roadways is identifiable within the totality of expenditure on roads, whilst the additional costs of diverting roads around particular wildlife sites may not be readily available. Hence, in order to make a meaningful comparison across Europe, it would be necessary to employ the same methodology in each Member State, which would be extremely unlikely to be feasible given the unique characteristics of each country's expenditure mechanisms.

Cost effectiveness of agri-environment schemes
The same process of proxy formation could be considered for agri-environment schemes (AES), whereby the expenditure on subsidies for farmers that conserve biodiversity with on-farm measures is compared across Member States and, in turn, is compared to associated increases of biodiversity. On this topic of agri-environment schemes, however, it has become recognized that there is a need for ecological information on the impacts of schemes on associated biodiversity. Although it has been widely acknowledged that there is sufficient ecological insight and geographical information to identify the objectives, outcomes and targeting for potential AES prescriptions, ecological insights have often been lacking for spatial scale effects and for temporal and ecosystem service effects (i.e. those services such as the provision of biodiversity). One suggestion to improve this situation is to link wide-scale ecological evaluations to specific case studies on the causes of effectiveness of agri-environmental schemes (or lack thereof), which could, in some cases, reveal specific situations that deserved subsidies. In general, it is agreed that there are a few main areas where research is needed to improve the cost-effectiveness of such agri-environment schemes, namely the development of decision support tools for designing cost effective agri-environmental schemes, comparative research identifying best practice, and research to investigate how institutions and governance structures have to be designed to ensure that the available money is spent in the interest of conservation. Specifically, in an article by Merckx et al. (2009)[14] it was shown that by using larger moths as bio indicators of landscape-scale quality, improvements to the cost-effectiveness of Agri-environment schemes could be achieved, firstly, by providing more appropriate financial re-

[14] Optimizing the biodiversity gain from agri-environment schemes, Agriculture, Ecosystems and Environment 130 (2009) 177–182

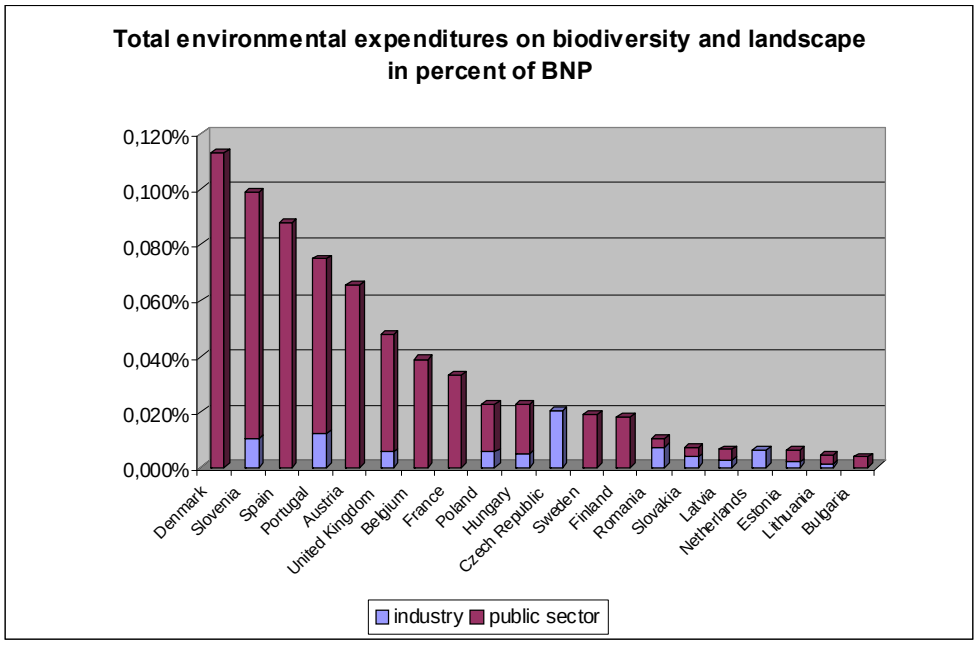
wards to farmers for different landscape features, and secondly, through landscape-scale targeting of farmers to encourage participation in AES.

Expenditure

Figure 4-16 shows the expenditures in percentage of GDP for the public sector as well as for the industries. First of all, it can be seen that there is a large variation between the Member States regarding the total expenditures. The variation is more than a factor 10.

Furthermore, it illustrates the division between the expenditures in the public sector and the industries. (For some countries, there are only data from one of the sectors so the real value should be higher). Only a few countries have expenses for the industries related to biodiversity and landscape which is probably because nature in most Member States is managed by the public sector.

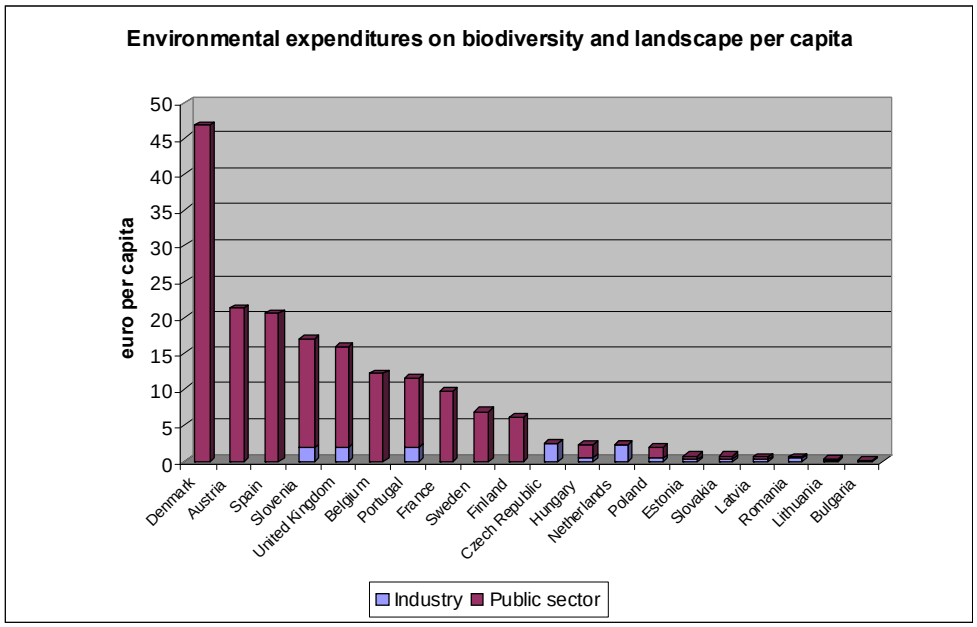
Figure 4-16 Total environmental expenditures on biodiversity and landscape in percent of GDP



Source: EUROSTAT

In Figure 4-17 the same data is shown but per capita instead of as a percentage of GDP. It changes the order a bit but not the variation between the Member States.

Figure 4-17 Total environmental expenditures on biodiversity and landscape per capita



Source: EUROSTAT

4.5.2 Summary and scoring of indicators

For the Habitat and the Birds Directives, the objectives are not to be measured in simple set of targets, and it therefore not possible to determine the cost-effectiveness of the directives as such.

4.6 Review of chemical sector indicators

The main policies and directives within chemicals include:

- REACH
- Pesticides:
  - Directive on Biocides
  - Directive on Plant protection.

The main legislation is REACH which covers most of the chemicals areas. REACH is implemented in harmonised way where the registrations of chemicals are made to the European Chemicals Agency (ECHA). There is therefore no issue of differentiation between Member States, and it is implemented with the same level of cost-effectiveness across the EU. Only the pesticide legislation is covered in this section.

4.6.1 Existing indicators

The set of indicators used for the other environmental areas does not apply to the chemicals area.

For the pesticides regulation, the requirement is for manufacturers and importers to register and have the substance and products authorised. To do so, they have to pay for the evaluation of the active substance in the product and for the registration and authorisation.

For the biocides, experience has shown quite different implementation across Member States. The EC is now reviewing the directive and the objective is to reach a much more harmonised implementation.

An example from the biocides regulation is the fee companies have to pay for evaluation of the active substance. Data show variation from about €50,000 to €350,000. The study on the impact of the revised directive does not reveal a detailed explanation of the factors behind the differences, but it is clearly not a case of actual differences in real costs of the evaluation of active substances. The factors are different degrees of cost-recovery and accounting for costs, different evaluation procedures and possibly different cost/price levels in different Member States.

It is therefore largely a question of the evaluation being made more vigorously in one Member State than in another and that the degrees of cost-recovery are different so leading to the significant difference in what the applicant needs to pay. These significant differences are being considered in the review of the directive which is likely to lead to a more harmonised system.

To the extent that the evaluation and authorisation procedures for chemicals differ among MS and costs vary accordingly, it is not a question of cost-effectiveness rather of cost-benefit. A more detailed evaluation could mean that protection level is higher if all risks are considered more carefully. Therefore, the health and environmental benefits will be higher as a risky substance will not be authorised.

4.7 Review of climate change indicators

Climate change policies and measures are closely related to the energy sector policies and transport policies. They cover therefore a wide range of sub-sectors and activities.

Previously introduced directives on energy efficiency and energy taxation have contributed to greenhouse gas reductions though they might have been introduced with other objectives; for example related to energy supply and security.

Currently, the main policies include:

- The Climate action and renewable energy package:

- EU Emission Trading Scheme (EU ETS); and
- Renewables Target.

As these are relatively new, there is little ex-post evidence to support any assessment of cost-effectiveness. It is, however, possible to discuss the policy based on the design and ex-ante assessments.

Other climate change policies and measures will be closely related to the energy sector policies and transport policies. In order to find indicators of the climate change component of these sector policies, all aspects need to be included, and broad policy indicators are unlikely to be feasible.

4.7.1 Existing indicators

Requirement of ex-ante CEA and MBI

The climate change policies do not require ex-ante CEA as part of their implementation. For the EU ETS this is also not very relevant. This directive has already been reviewed with respect to its effectiveness. In the future, there will be a more harmonised process regarding the issuing of trading permits and as the instrument itself is a market-based instrument, there are limited additional potentials for cost-effectiveness improvements. The directive should in principle be cost-effective compared to other instruments and it will be similarly cost-effective across Member States with the harmonised implementation as the price of the ETS allowances will be the same across all Member States.

For the other parts of the climate change package, the situation is different. The package will require all the non-ETS sectors to achieve certain reduction targets. These reduction targets vary across the Member States based on the wealth of each Member States. This is very unlikely to achieve the same level of cost-effectiveness across Member States.

Ex-ante CE data

Many ex-ante assessments have been made, all indicating that the cost-effectiveness of alternative measures vary significantly. It will therefore require careful assessments to secure that the implementation of the climate change package for the non-ETS sectors becomes cost-effective. As discussed above, cost-effectiveness can be achieved within each Member States while there are bound to be differences between Member States due the different reduction targets.

Expenditure data

Again, there are no expenditure data at this stage of the implementation. Given that the climate change policies affect the energy demand in all sectors, it is likely to have substantial impact.

4.7.2 Summary and scoring of indicators

The assessment of the climate change policies is summarised below. As it is at an early stage of the implementation, ex-post assessments are not available and feasible.

Overall, the main policy - the EU ETS - is being implemented in a cost-effective way across Member States and is likely to be an example of where there is little difference between Member States.

Table 4-8 Indicators for climate legislation

Directive	CEA required as part of directive?	Use of market-based instruments in MS as part of implementation?	Ex-ante CEAs exist and show differences between the CE of alternative measures?	Prices or user charges of specific activities show CE differences?	General ex-post expenditure data show differences in costs?
EU ETS	Not relevant	Yes in all MS	Being an MBI, the marginal reduction costs will be the same in across sectors and MS.	Not relevant	No data available
Renewable obligation	No	No	Ex-ante cost estimates of alternative measures show differences	Not relevant	No data available.

The other part of the policy package, the differentiated reduction targets by Member States based on the wealth of each Member State is almost by definition not cost-effective across Member States. This shows how other - equally valid - concerns play a role, and political feasibility can mean that cost-effectiveness across Member States cannot be realised.

It should be noted that one thing is that cost-effectiveness vary across Member States. The question whether each Member State achieves its given reduction target in a cost-effective manner is another question. It is possible and maybe even likely that most Member States will implement the policy relatively cost-effectively given that it entails significant overall costs to each Member State.

5 Findings

The review of the literature and the indicators have created an understanding of what is known about possible differences in cost-effectiveness across the EU Member States regarding implementation of environmental legislation. It has also illustrated some of the challenges of assessing cost-effectiveness of policy implementation and making comparisons across Member States.

The key findings are summarised with respect to:

- Status on cost-effectiveness by environment areas
- Understanding of main factors explaining cost-effectiveness differences
- Status on understanding differences in CE between Member States
- Challenges in assessing ex-post cost effectiveness
- Ways forward to improve the overall level of cost-effectiveness in implementation of environmental policies.

5.1 Status on Cost-effectiveness by environmental area

The indicator analyses of each of the seven environmental areas are summarised below.

Table 5-1 Status by environmental area

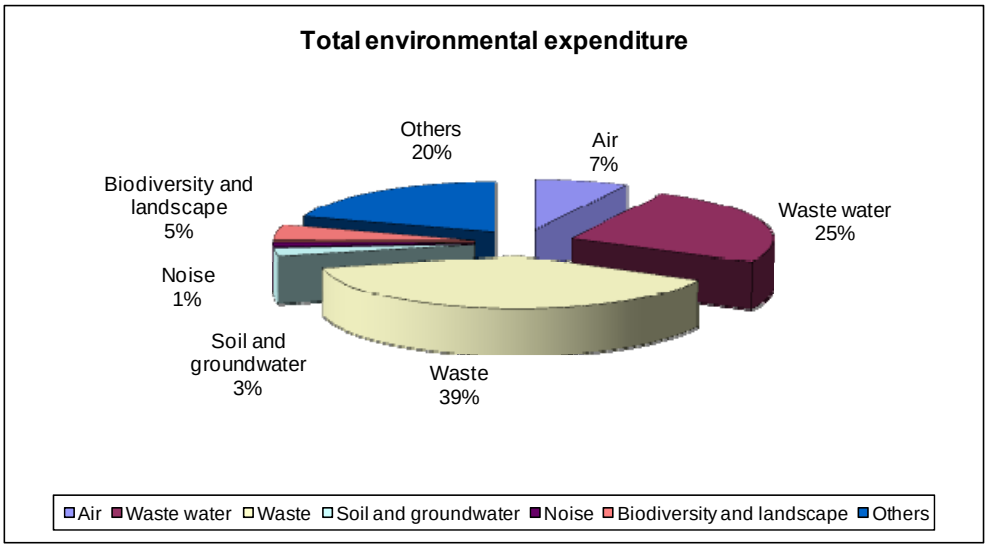
Area	Overall level of expenditure	Indicator analysis	Comments and future prospective
Water	High	Indications of cost-effectiveness differences	The main legislation, the WFD, requires CEAs to be undertaken, so improvement is in pipeline
Waste	High	Indications of cost-effectiveness differences	CEAs have been used to develop parts of the waste legislation.

Area	Overall level of expenditure	Indicator analysis	Comments and future prospective
Air	Medium	Indications of cost-effectiveness differences	The overall air quality targets have been introduced based on CEA and CBA analyses.
Integrated	Low/Medium	Lack of indicator assessment prevents assessment	IPPC has been reviewed and some improvements identified
Climate change	Possibly high in the future	Too early for ex-post analysis.	CEAs have been used to develop the policies. EU ETS is an MBI with harmonised implementation
Biodiversity	Low/medium	Indications of cost-effectiveness differences	Includes many different types of legislation, no clear trend in the use of CEA. For certain activities such as monitoring, operational efficiency could be analysed.
Chemicals	Low	Overall, few indications of CE differences.	REACH as main policy has common implementation and includes CEA requirements.
Cross-cutting (administrative activities: monitoring, permitting, inspection etc)	Low/medium	Indications of improvement potential	The operational efficiency of administrative activities could be increased

The total expenditure on waste, water and air protection is substantial and thus, even small improvements would result in notable savings.

The total expenditure on environmental is about €60 billion per year as reported to Eurostat. It means that a 1 per cent saving caused by improving overall cost-effectiveness would amount to M€600 million per year.

Figure 5-1 Total environmental expenditure in EU 27[15]



Source: Eurostat (data are based on averages for the period 2000 to 2007).

The total environmental expenditure figures for EU27 on the main categories for which data are collected show that waste related expenditure comprises 40 per cent of total expenditure. The second largest item is wastewater related expenditure accounting for about 25 per cent of the total environmental expenditure.

The environmental areas that currently account for large expenditure are also those with the clearest indications of CE differences across EU27.

5.2 Factors explaining CE differences

Many of the differences in costs or expenditure that can be observed are due to differences in the environmental standards and quality achieved.

Based on the indicator assessment, some cost differences are unlikely to be caused only by the environmental quality achieved.

The review provides some examples that can be used to look at the key policy factors and their possible influence on the level of cost-effectiveness. Each of the elements on the list of policy factors presented in Table 2.1 is described in the following sections.

5.2.1 Organisation and incentives

For wastewater and waste management, the issue of sector organisation with respect to ownership and incentives is important.

[15] The category of "Others" could include expenditure on the named categories, since for some member states, only data for "Others" have been reported.

In the water sector, the majority of Member States have publicly owned utilities that typically deal with both water supply and wastewater treatment. Only in England and Wales has the sector been privatised. Other Member States have considered whether further liberalisation would be beneficial.

The available data on costs of wastewater treatment do not point to lower costs in England and Wales compared to other EU Member States. Water supply and wastewater treatment are activities where real competition is difficult to create, so what is more important is the incentive to improve operational efficiency. If costs can be passed on directly to the customers, these utilities might have few incentives to reduce costs.

For waste management, the situation is different. Here, liberalisation could be an option. A study is available on possible efficiency gains from liberalisation of the Danish waste sector. The study also identified operational efficiency gains, for example from optimising transport of waste to incineration plants. The assessment is ex-ante, but it nevertheless points to the importance of considering the organisation of the waste management sector.

5.2.2 Use of market-based instruments

There are numerous studies highlighting the advantages of market-based instruments (MBI). When it comes to ex-post documentation of the advantages of the use of MBI, there are few examples. MBIs have only been used in limited situations where comparison to other instruments is possible.

Most Member States have used energy taxes for a long time. The impact is documented in terms of reducing the demand for fuels, but it is not easy to compare that to a situation where the use has been restricted using a different approach.

There are a few examples; for example, the use of NO_x charges and trading and the pricing of industrial wastewater effluents show advantages of using MBIs. There is probably a potential for cost-effectiveness improvements by increased use of MBI (including incentive pricing as an MBI).

Water:
The use of the proper incentive pricing can reduce the total water demand which, in turn, will have some effect on the total expenditure on wastewater treatment. Such incentive pricing is called for in the WFD, but remains far from being implemented across the EU.

Waste
It is not clear whether it is more cost-effective to introduce incentives for waste reduction apart from certain waste fractions. In many cases, illegal disposal of waste could be the reaction if for example households were to pay according the amount of waste they dispose of. It will require more detailed and local specific analysis to determine what kind of MBI will be effective.

Air
This area features examples of the use of NO_x charges and trading schemes. There is a likely potential for more use of MBI to reduce overall compliance costs. However, it needs to be carefully investigated on a case-by-case basis.

5.2.3 Choice of technology

It is very difficult to assess the choice of technology as a parameter causing cost-effectiveness differences. The choice of technology is often a result of the use of policy instruments and thereby the mechanism for either achieving a cost-effective outcome or not.

5.2.4 Operational efficiency

There are many indications that operational efficiency could be improved. This is mainly the case for well-defined operations such as wastewater collection and treatment, waste management activities as well as monitoring, permitting, inspection and enforcement activities.

If there are no incentives to reduce costs and optimise the activity, then it is unlikely to happen.

5.2.5 Summary of policy factors

For the main environmental areas, the assessment of which policy design factors could impact on cost-effectiveness is summarised in the below table.

Table 5-2 Overview of factors influencing cost-effectiveness

Area	Organisation of sector	Policy instrument choice	Operational efficiency including incentives to optimise	Comments
Water	Low	High	High	More incentive pricing and benchmarking of operations could improve CE
Waste	Medium/ high	Medium	High	Organisational setup of the sector and the benchmarking of individual management operations could improve CE
Air	Low	High	Low	There is likely to be some potential in increasing the use of MBI.

It is a subjective scoring based on the literature review and indicator assessment.

5.3 CE differences between Member States

The study has not been able to identify specific differences between Member States nor point to the Member States which have inefficient in policy implementation practices.

The indicator assessment points to the environmental areas which are likely to hold such potentials. The lack of comparable data and complex causal relationships in most areas prevent this scoping study from naming certain Member States. Without more well-founded evidence, it would not be reasonable to suggest who currently implements best practice and who does not.

5.4 Challenges in assessing CE

The interest in cost-effectiveness has motivated a number of studies which focus on reviewing the existing knowledge about cost-effectiveness.

In 2005, the EEA commissioned a comprehensive survey of existing literature on ex-post cost effectiveness analysis and two specific pilot studies on effectiveness including cost-effectiveness. The results of the survey study on the empirical evidence of ex-post cost-effectiveness are summarised below (EEA, 2005a):

- On an EU level, there is little experience of undertaking CEAs and even less of using the feedback in the policy implementation. Few environmental directives explicitly require the regulation of the directives' performance. It is recommended that the ex-post CEAs of European directives be better integrated with the process of impact assessments that are made for all major European directives.

- On the Member State level, experiences of undertaking ex-post CEAs are largely confined to the UK and the Netherlands. In these two countries, the process of ex-post policy performance evaluations is institutionalised based on legal requirements.

- The knowledge required for conducting ex-post CEA exists. However, a range of issues were not adequately dealt with in the existing literature, among other things:

    - The existing guidelines were not quite clear about which types of costs to include. The type of costs ranged from financial costs related to specific, locally implemented measures to public expenditure costs, and general equilibrium estimates of wider economic impact. The study called on better guidance on what costs to consider in which cases and how to compute them.

    - The gathering of the necessary data constitutes a general problem for the use of ex-post CEAs. If objectives, indicators and monitoring requirements are not specified before a policy measure is implemented,

the collection of the data necessary to conduct CEA analysis can be very expensive (EEA, 2005: pp. 4-5).

Out of three detailed case studies commissioned by the EEA with the aim of carrying out ex-post policy evaluations, including cost-effectiveness, two of the studies have not been able to assess cost-effectiveness due to a lack of comparable data[16].

5.5 Improving cost-effectiveness

Section 2.2 includes a discussion of how ex-post CEA and ex-ante CEA interacts. It concludes that in order to improve CE, the key requirement is to do ex-ante CEAs. For such ex-ante CEAs to actually help improve cost-effectiveness in both policy development and in implementation, a certain practice needs to exist:

- Careful and innovative thinking about relevant alternative options
- A systematic assessment and comparison of the relevant alternative options.

The EU Impact Assessment guidelines provide support to the process of option assessment including CEA considerations. The IA guidance exemplifies that guidance is available. To what extent such guidance is being used depends on whether it is required to do so, the level of 'enforcement' of the requirement, but also on the 'tradition' and attitude of the responsible organisations.

The role of ex-post CEAs is to motivate and improve preparation of the ex-ante CEA and includes:

- Identification of areas for improvement, e.g.:
  - Where do CE differences exist
  - Best practices on policy instrument design.
- Improvement of the estimation of costs and/or effects of measures.

This means that the following options could be considered as a means to improve the cost-effectiveness of environmental policies:

- Options within the mandate of EC:
  - Improving the cost-effectiveness analysis undertaken as part of policy development (IA or ex-ante evaluations are already mandatory for new EU policies)

[16] EEA 2005c, EEA 2008.

- Including a requirement to make a cost-effectiveness analysis as part of any policy implementation

- Including requirements in new polices to develop ex-post indicators that can be used to understand the efficiency of the actual policies as they have been implemented.

• Voluntary initiatives

- Support of the use of cost-effectiveness as part of Member States' implementation of any new policy

- Support of the use of best practice sharing, including more benchmark analyses and indicators.

Some of this is already happening, and it is therefore more a question of supporting existing initiatives.

It is already required that impact assessments or ex-ante evaluations of new EU policies be undertaken. The impact assessment guidelines have just been updated and part of the guidance is the so-called IQ tools which include tools for how to do quantitative analysis.

In terms of undertaking CEAs at policy implementation in the Member States, there is still room for improvement.

Ex-ante types of cost-effectiveness analyses are also made in several Member States as part of their policy implementation process. The following overview is taken from COM 2005 (97): Better Regulation for growth and jobs. It shows that 13 out of EU25 have an obligatory requirement to perform impact assessments as part of policy implementation. Though this does not necessarily imply that they carry out cost-effectiveness analyses, it is a clear indication.

Table 5-3 Ex-ante impact assessments in Member States

	IA obligatory	Alternative instruments considered	IA guidance available
Belgium	**(Y)**	**N.A.**	**(Y)**
Czech Republic	**N**	**Y**	**Y**
Denmark	**Y**	**Y**	**Y**
Germany	**N.A.**	**N.A.**	**N.A.**
Estonia	**Y**	**Y**	**Y**
Ireland	**N**	**(Y)**	**(Y)**
Greece	**N**	**N**	**N**
Spain	**Y**	**Y**	**Y**
France	**N.A.**	**N.A.**	**N.A.**
Italy	**N**	**(Y)**	**Y**
Cyprus	**N**	**N**	**N**

	IA obligatory	Alternative instruments considered	IA guidance available
Latvia	**Y**	**Y**	**Y**
Lithuania	**Y**	**Y**	**Y**
Luxembourg	**Y**	**Y**	**N.A.**
Hungary	**Y**	**N**	**N**
Malta	**N.A.**	**N.A.**	**N.A.**
Netherlands	**N.A.**	**Y**	**Y**
Austria	**Y**	**Y**	**Y**
Poland	**Y**	**Y**	**Y**
Portugal	**N**	**N**	**N**
Slovenia	**N.A.**	**N.A.**	**N.A.**
Slovakia	**N.A.**	**N.A.**	**N.A.**
Finland	**Y**	**Y**	**Y**
Sweden	**Y**	**Y**	**Y**
United Kingdom	**Y**	**Y**	**Y**
Total Yes	**13**	**15**	**15**

Source: COM 2005 (97)

Note (Y) = planned or only partly.

Expanding the list to include all Member States is one step towards improving the use of ex-ante cost-effectiveness analyses. Improving the quality of CEAs will be the next step. The proposals for further studies include suggestions on how to support this improvement in the use of ex-ante CEAs.

Best practices sharing includes the IMPEL network. The IMPEL network has improved efficiency in monitoring, permitting and enforcing environmental legislation as its main objectives.

The next section includes proposals on how to further support the use of CEAs in the policy implementation process.

6 Proposed studies

This section includes suggestions for additional studies that can support the improvement of the cost-effectiveness of environmental policy implementation.

The findings from the literature review and the assessment of indicators point to likely differences in cost-effectiveness across Member States. Though it has not been possible to document such differences in detail, the indicators point to potentials within all main environmental areas.

The available data do not support a detailed mapping of where cost-effectiveness differences exist. Though it would have been useful to have such mapping, one should realise that in a dynamic world, the objective of achieving cost-effectiveness requires an ongoing effort. Even if it was possible to document either the existence or the absence of CE differences at any given point in time, this would not mean that the situation could not be different in the future.

Documentation of existing CE differences could be an incentive to increase focus on the cost-effectiveness aspects of policy implementation, but only through proper use of ex-ante CEAs as a continuous element of policy development and implementation can cost-effectiveness be achieved.

On this basis, criteria for selecting future studies have been developed and used to identify the specific studies.

6.1 Criteria for selecting future studies

The cost-effectiveness of EU environmental policies can be improved through the following types of processes:

Provide more ex-post assessment and evidence:

- Sharing of benchmark or best practice information among Member States
- Benchmark and performance reviews of existing policies or specific activities including ex-post cost-effectiveness analysis

Improve the use of ex-ante cost-effectiveness analysis:

- Best practice sharing of ex-ante CEA in policy implementation

- Inclusion of CEAs as part of standard procedure when developing and implementing new policies.

The key requirement for improving the level of cost-effectiveness is to undertake proper ex-ante CEAs as part of all stages of policy development and implementation. As illustrated in Figure 2.1, ex-post evidence supports that by either identifying certain options or practices that have a potential for increasing the level of cost-effectiveness or by improving the assessment of costs and/or effects to increase quality of the ex-ante assessments.

Introducing requirements to undertake both ex-ante and ex-post assessments are more an issue of policy initiatives and processes than about undertaking additional studies and providing more data.

More harmonisation will lead to more equal levels of cost-effectiveness across Member States but depending on how it is achieved the overall level of cost-effectiveness might not increase. Political feasibility could be obstacle to more harmonisation.

There are three main routes of supporting cost-effectiveness in policy implementation by providing more information and data through new studies.

Table 6-1 Approaches and routes to improving CE in policy implementation

	Feasibility	Expected impact on CE	Rank (Impact/ resources)
Information and best practice sharing	High	Low	2
Benchmarking of well-defined activities to improve operational efficiency	Medium	High	1
Ex-post benchmarking at directive/policy level	Low	Medium	3

Feasibility

Feasibility is assessed by considering how difficult and resource demanding it is to define and make each approach operational. Sharing of information and best practice takes place already, and there should be few barriers to further sharing of cost-effectiveness information. The resource needs will also be limited.

Benchmark of specific, well-defined operations has been done so it is technically feasible to do. It requires some resources in data collection and analysis.

For the third approach, the review of indicators has shown that there are currently no high quality ex-post indicators, and the difficulties in defining the relevant indicators and collecting data are also evident from the review. Collection of data for ex-post CE indicators will be quite expensive. The current data on expenditure that are collected on behalf of Eurostat do not allow for ex-post

cost-effectiveness comparison. It is therefore going to be resource intensive to develop and implement such data collection.

Impact on CE

The impact on cost-effectiveness is defined as the expected impacts on the actual degree of cost-effectiveness in the policy implementation across Member States.

Sharing of best practice can motivate Member States to improve practice and thereby improve CE. Benchmarking of specific activities will provide quantified and more specific information about where and what to change in order to achieve improved operational efficiency. It will therefore have larger impact on overall cost-effectiveness of the policies. The only drawback is that it is restricted to environmental areas where there are well-defined activities or services.

Better ex-post cost-effectiveness information could also act as motivation to improve practices, and it could potentially point to better estimates of costs and effects and thereby improve ex-ante CEAs - given that they are undertaken for that policy area.

Combining the assessment of feasibility and impacts, the three approaches or routes to improved CE in policy implementation have been ranked. Development of benchmarks for activities obtains the highest score, while information and best practice sharing comes in second.

Political and institutional feasibility

One constraint on further improving CE across EU Member States is the lack of incentives for Member States to do so. Firstly, there is the issue of who should take the initiative to improve CE. Secondly, improvements will require the relevant Member State authorities to invest in change before the benefits are achieved. The benefits might fall on other parties or on the population at large. Additional studies could support the process, but without an institutional anchoring of the process, limited progress can be expected.

6.2 Suggestions for new studies

Based on the above considerations the following project ideas have been developed.

Table 6-2 Proposal for new studies

Title	Environmental area	Budget
Use of benchmarking applying Data Enveloping Analysis (DEA) or similar to improve operational efficiency of environmental services	General	Medium
Benchmark study of waste management operations to compare operational efficiency	Waste	Medium/ Large
Benchmark study of wastewater treatment to compare operational efficiency	Water	Medium
Assessment of how to support existing or new best practice sharing of efficient implementation of environmental policies.	General	Small
Development of sector indicators.	Waste	Medium
Development of scoreboard for cost-effective implementation of environmental policies	General	Medium/ large

Each project idea is further described in the subsequent sections.

6.2.1 Study 1: Use of benchmarking applying DEA or similar to improve operational efficiency of environmental services.

Background

The scoping study has identified that there are potential operational efficiency improvements in delivery of environmental services.

Delivery of environmental services such as collection, sorting and disposal of waste, treatment of wastewater are relatively well-defined activities where the outcome is measures, and the costs are recorded by the companies/utilities performing the services.

There are techniques that can be used to benchmark the operational efficiency of such activities. One technique is Data Envelopment Analysis (DEA). It is a linear programming methodology measuring the efficiency in situations where the production process presents a structure of multiple inputs and outputs. Some of the benefits of DEA are that there is no need to explicitly specify a mathematical form for the production function, and DEA is capable of handling multiple inputs and outputs which will be the case for most environmental services.

Objective

The objective is to assess the opportunity for using benchmark techniques such as DEA to assess the potential for operational efficiencies. The assessment should cover waste management, wastewater treatment and identify other activities that could be covered.

Tasks

List of tasks:

- Review alternative benchmarking techniques and tools such as DEA with respect to:
  - Data requirements, uncertainties, output format etc.
- Assess waste management and water sector activities with respect to data availability, cost of collecting data etc.
- Review existing benchmark and indicator analysis being done in Member States or by industry associations;
- Map benchmark tools and environmental services to identify the most prospective for detailed pilot studies;
- Develop detailed terms of reference for pilot studies.

Output: The output will be assessment of the potential for detailed quantitative benchmark assessments with environmental service and policy implementation. ToR for two-three detailed case studies.

Budget: A tentative budget is 100k to 150k EUR.

6.2.2 Study 2: Benchmarking analysis of the waste sector (using DEA or similar tool) to identify operational efficiency improvement potentials

Background: Same as for study 1.

Objective: The objective is to undertake a pilot benchmark assessment of waste sector operations. The benchmark assessment should identify the potential for increasing operational efficiency in the benchmarked companies.

Tasks: List of tasks:

- Define which waste management operations should be included (collection, sorting, landfills, incineration, and special waste streams)
- Select the utilities/companies to be part of the pilot study. They should represent all types of Member States (about 10 countries)
- Collect data from all participants
- Analyse data and estimate efficiency improvement potentials
- Organise workshop for participants and other relevant stakeholders to present and discuss results
- Develop programme for how to repeat the benchmark exercise (depending on the conclusions from the pilot study and the workshop).

Output The output will be assessment of the potential for detailed quantitative benchmark assessments with environmental service and policy implementation. ToR for two-three detailed case studies.

Budget A tentative budget is 200k to 300k EUR.

6.2.3 Study 3: Benchmarking analysis of the wastewater sector (using DEA or similar to tool) to identify operational efficiency improvement potentials

Background Same as for study 1.

Objective The objective is to undertake a pilot benchmark assessment of wastewater sector operations. The benchmark assessment should identify the potential for increasing operational efficiency in the benchmarked companies.

Tasks List of tasks:

- Define which wastewater management operations should be included (collection, sorting, landfills, incineration, and special waste streams)
- Select the utilities/companies to be part of the pilot study. They should represent all types of Member States (about 10 countries)
- Collect data from all participants
- Analyse data and estimate efficiency improvement potentials
- Organise workshop for participants and other relevant stakeholders to present and discuss results
- Develop programme for how to repeat the benchmark exercise (depending of the conclusion from the pilot and the workshop).

Output The output will be assessment of the potential for detailed quantitative benchmark assessments with environmental service and policy implementation. ToR for two-three detailed case studies.

Budget A tentative budget is 200k to 300k EUR.

6.2.4 Study 4: Study on how to support sharing of best practices of implementation (existing and new initiatives)

Background The IMPEL network is about improving the implementation of environmental policies for sharing information and good practices between Member States. The study "Lean data collection for ex-post assessments" AEA (2007) developed recommendations for how to take the process forward. It concluded that one organisation needs to be responsible in order to anchor the process.

Objective	To assess how IMPEL and other initiatives can be supported in improving CE across Member States.
Tasks	List of tasks: • Identify any other initiatives such as the IMPEL • Review existing initiatives • Assess through consultation with existing initiatives ways of improving their results • Assess whether there could be any additional initiative to sharing best practice that would be useful • Develop list of actions for improving existing initiatives or establishing new.
Output	The output is an action plan for improving existing initiatives or establishing new.
Budget	A tentative budget is 50k to 100k EUR.

6.2.5 Study 5: Pilot study on waste sector of developing ex-post indicators

Background	The scoping study has confirmed that there are very few ex-post CE data available The indicators that have been used give some assessment of the situation. By recording and reporting more ex-post data, it might be possible to develop better indicators. Also, the existing data could be used to define better and more precise indicators than what were feasible within this scoping study. The idea is to take the indicator perspective beyond what has been done in the present study and to develop better indicators for measuring CE and allow for comparisons across Member States.
Objective	The objective is to undertake a study on developing the specific indicators and to collect primary data to test the feasibility of the indicator.
Task	List of tasks: • Define ex-post indicators for the sector • Collect data to test the indicators • Assess the cost of collection and future reporting of the data • Estimate costs and benefits of alternative indicators • Rate the indicators and select the preferred option

- Collect primary data to test one indicator in detail
- Develop specific action plan for how to implement the indicator.

Output: An action plan for how to implement an indicator that has been tested, and a test report showing the results of using the indicator.

Budget: A tentative budget is 100 to 150k EUR.

6.2.6 Study 6: Development of cost-effectiveness scoreboard

Background: The scoping study has confirmed that there are no ex-post CE data. The indicators that have been used give some assessment of the situation.

A scoreboard comprises a set of indicators. By recording and reporting more ex-post data or using existing data, it could be possible to define better and more precise indicators than what were feasible within this scoping study.

By defining a comprehensive set of data for the implementation of environmental policies a scoreboard could be developed and used to monitor progress. The scoreboard could cover more or less environmental areas or a list of defined directives. By including more environmental areas, the scoreboard could account for interlinks and synergies between policy areas with respect to achieving environmental targets and in the implementation.

Objective: The objective is to investigate the feasibility of developing a scoreboard and to make pilot scoreboard.

Task: List of tasks:

- Review experience with scoreboards
- Define requirements for alternative definitions of a cost-effectiveness scoreboard
- Define the list of indicators to be included in the preferred scoreboard alternative
- Collect data to define all the indicators
- Compile and assess the scoreboards
- Organise workshop with relevant stakeholders to review the pilot scoreboard
- Revise scoreboards and finish reporting.

Output: An assessment of the feasibility or scoreboard for cost-effective policy implementation and pilot scoreboard.

Budget: A tentative budget is 300k to 500k EUR.

7 Literature

AEA Energy & Environment (2007): Scoping Study for the Development of Lean Methods for the More Systematic Collection of Information on Ex-Post Environmental Abatement Costs. European Commission DG ENV

Beamount, N. and R. Tinch (2004): Cost Effective Reduction of Copper Pollution in the Humber Estuary. CSERGE Working Paper ECM 03-04

EEB (2001): Water Pricing in EU Review. Publication Number 2001/002

EEA (2001): Reporting on environmental measures: Are we being effective?, EEA Environmental Issue report, No. 25, November 2001

EEA (2003): Water Prices: Indicator Fact Sheet for EU, WQ05

EEA (2005a): Cost-effectiveness of environmental policies - an inventory of applied ex-post evaluation studies with a focus on methodologies, guidelines and good practice, Ecologic & EFTEC, April 2005

EEA (2005b): Effectiveness of urban wastewater treatment policies in selected countries: an EEA pilot study. European Environmental Agency, EEA Report No 2/2005

EEA (2005c): Effectiveness of packaging waste management systems in selected countries: an EEA pilot study. EEA Report, No 3/2005

EEA (2006): Using the market for cost-effective environmental policy - market-based instruments in Europe, EEA report, no.1/2006, Copenhagen

EEA (2007): Halting the loss of biodiversity by 2010: proposal for a first set of indicators to monitor progress in Europe. Technical report No 11/2007, Copenhagen

EEA (2008a): Effectiveness of environmental taxes and charges for managing sand, gravel, and rock extraction in selected EU countries, EEA report, no. 2/2008, Copenhagen

EEA (2008b): Territorial Cohesion – analysis of environmental aspects of EU regional policy. Task 1: Evaluate ex post the effectiveness, efficiency and effects of implementing the Structural and Cohesion Funds in environment. Final Report. European Environmental Agency

Entec (2005): National Emission Ceiling Directive Review. Task 1 - In depth analysis of the NEC national programmes. Final Report. Entec UK Limited

Entec (2007a): Assessment of the Implementation by the Member States of the IPPC Directive. Final Report. Entec 2007a

Entec (2007b): Assessment of the Environmental Impacts and Costs Arising from Implementation of the LCP and IPPC Directives for Combustion Installations with Multiple Boiler Units.

Entec (2008): Monitoring of Permitting Progress for New and Existing IPPC Installations. ENTEC. http://circa.europa.eu/Public/irc/env/ippc_rev/library?l=/permitting_progress/monitoring_permitting/_EN_1.0_&a=d

ERC (2001): Costs for Municipal Waste Management in the EU. Final Report. Eunomia Research & Consulting Ltd.

Eureval C3E (2006) Study on the Use of Cost-effectiveness Analysis in EC's Evaluations, Study for DG Budget by Centre for European Evaluation Expertise 2006,

Federal Statistical Office (2008): Environmental Statistics and Accounts – Air Emissions in the EU. Federal Statistical Office, Germany, Eurostat contract number: 71401.2005.001-2005.291

Harrington, W. and R:D: Morgenstern (2004): Evaluating Regulatory Impact Analyses. Resources for the Future, Discussion Paper 04-04

Henze, M. et al. (2002): Wastewater Treatment: Biological and Chemical Processes. Springer: Berlin

Hildén, Mikael, Jukka Lepola, Per Mickwitz, Aard Mulders, Marika Palosaari, Jukka Similä, Stefan Sjöblom and Evert Vedung (2002): Evaluation of environmental policy instruments - a case study of the Finnish pulp & paper and chemical industries. Monographs of the Boreal Environment Research, No. 21

Hitchens, D., F. Farrell, J. Lindblom and U. Triebswetter (2001): The impact of Best Available Techniques (BAT) on the Competiveness of European Industry. Institute for Prospective Technological Studies.

IVM (2006): Ex ante and ex post costs of implementing the Nitrates Directive Case study in the framework of the project 'Ex post estimates of costs to business of EU environmental policies'. Contract No ENV.G.1/FRA/2004/0081. Amsterdam

IEEP (2004): Better and Simpler, Simplification of Regulation for a More Competitive Europe. Institute for European Environmental Policy, Draft Conference Background Report

Ifo (2006): Assessment of different approaches to implementation of the IPPC Directive and their impacts on competitiveness. Final Report. Ifo Institute

IIASA (2005): Target Setting Approaches for Cost-effective Reductions of Population Exposure to Fine Particulate Matter in Europe. CAFE Scenario Analysis Report Nr. 4, Background paper for the meeting of the CAFE Working Group on Target Setting and Policy Advice, Extended Version for the CAFE Steering Group, February 13, 2005

IIASA (2007b): Analysis of Policy Measures to Reduce Ship Emissions in the Context of the Revision of the National Emissions Ceilings Directive. Final report. Contract No 070501/2005/419589/MAR/C1

IIASA (2008): National Emission Ceilings for 2020 based on the 2008 Climate & Energy Package. NEC Scenario Analysis Report Nr. 6

Kohler, N. and E. Perry (2005) Implementation of the Landfill Directive in the 15 Member States of the European Union. Golder Europe EEIG

Monier, V. and E. Labrouze (2001) Critical Review of Existing Studies and Life Cycle Analysis on the Regeneration and Incineration of Waste oils. Taylor Nelson Sofres Consulting and BIO Intelligence Service.

OFWAT (2007), International comparison of water and sewerage service- Covering the Period of 2004-2005, UK

Oosterhuis et al. (2006): Ex-post estimates of costs to business of EU environmental regulation. Institute for Environmental Studies

RPA (2008): Assessing the Impact of the Revision of Directive 98/8/EC concerning the Placing of Biocidal Products on the Market - Note on Issues and policy Options. Prepared for European Commission DG Environment

SEMIDE (2008): Water pricing in some EU countries. Euro-Mediterranean Information System on know-how in the Water sector: International portal. Available online at: http://www.emwis.net/topics/waterpricing/water-pricing-some-eu-countries

SPRU (2000): The Large Combustion Plant Directive (88/609/EEC): An Effective Instrument For Pollution Abatement? Science and Technology Policy Research.

Vercaemst, P. et al. (2007): Sectoral Costs of Environmental Policy. Final report. VITO

7.1 Internet

Organisation	Website	Date
Eurostat	http://ec.europa.eu/eurostat/	March 2009
DG ENV	http://ec.europa.eu/environment/air/quality/legislation/reporting.htm	March 2009

Appendix A Literature review

The results of the literature review are listed in the following tables organised by environmental area. The column "Remarks" includes an indication of whether the study is primarily ex-ante or ex-post.

Air quality

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Air Quality Policies	2004	AEA (2004) Cost and environmental effectiveness options for reducing air pollution from small scale combustion installations, AEA Technology Environment, AEAT/ED48256/Final report Issue 2	Ex-ante
CAFE - Clean Air For Europe program	2005	AEA (2005) CAFE CBA: Baseline Analysis 2000 to 2020, AEA Technology Environment, AEAT/ED51014/Baseline Scenarios, Issue 5	Ex-ante
CAFE - Clean Air For Europe program	2005	AEA (2005) Cost-Benefit Analysis of Policy Option Scenarios for the Clean Air For Europe Programme, AEA Technology Environment, AEAT/ED48763001/CBA-CAFE ABC scenarios	Ex-ante
CAFE - Clean Air For Europe program	2005	AEA (2005) Cost-Benefit Analysis of the Thematic Strategy on Air Pollution, AEA Technology Environment, AEAT/ED48763001/Thematic Strategy	Ex-ante
Air Quality Policies	2006	AEA (2006) Assessing the air pollution benefit of further climate measures in the EU up to 2020, AEA Technology Environment, AEAT/ED48763001/Climate policy co-benefit, Issue 6	Ex-ante
IPPC-directive	2007	AEA (2007) Evaluation of the costs and benefits of the implementation of the IPPC Directive on Large Combustion Plants, AEA Energy & Environment, Issue number 3	Ex-ante
Air Quality Policies	?	AEA (Date Unknown) Economic Evaluation of Air Quality targets for CO and Benzene.	Cost-benefit analysis. Comparison between three European cities.
National Emission Ceiling Directive	2008	AEA (2008): Evaluation of national plans submitted under the National Emission Ceilings Directive 2001/81/EC. Issue Number 3 (Final). AEA Energy & Environment	Ex ante
thematic EU-strategy on air pollution	2006	Based on Danish models and data the Danish Environmental Research Institute has evaluated an EU-impact assessment for the thematic strategy on air pollution. http://www2.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/FR586.pdf	
thematic EU-strategy on air pollution	2006	Based on Danish models and data the Danish Environmental Research Institute has evaluated an EU-impact assessment for the thematic strategy on air pollution. http://www2.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/FR586.pdf	Ex-ante
Large Combustion Plants Directive	2006	BIS (2006) Study on ex-post estimates of costs to business of selected pieces of EU environmental legislation - Case study on the Large Combustion Plants Directive. Bio Intelligence Service.	Ex-post
National Policies	2005	Brink, C., E. van Lerland, L. Hordijk and C. Kroeze (2004) Cost-effective emission abatement in agriculture in the presence of interrelations: cases for the Netherlands and Europe. *Ecological Economics*, Vol. 63, Issue 1, pp. 59-74	Primarily evaluation of national policies. Not in possession of the paper.
NEC-directive	2006	Danish EPA (2006). Analyse af Danmarks muligheder for at reducere emissionerne af NOx i 2010. http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk/Udgiv/publikationer/2006/87-7052-139-5/html/default.htm	The objective of this report is to form a technical and economic basis for decisions as to how Denmark in a cost effective manner can fulfil the target of 127,000 tonnes NOx in 2010.
National Policies	1996	De Jager, D. and K. Blok (1996) Cost-effectiveness of emission-reduction measures for methane in the Netherlands. *Energy Conversion and Management*, Vol. 37, Issue 6, pp.1181-1186	Some ex-post data bot only includes Netherlands. Not in possession of the paper.
IPPC-directive	2002	DG Enterprise (2002) The economic Consequences of the IPPC Directive. Workshop.16 May 2002	Ex-post evaluation of BAT but without economic figures
Directive on Petrol and diesel quality	2001	DG ENV (2001) The costs and benefits of Lowering the Sulphur Content of petrol & diesel to less than 10 ppm	Ex-ante
National Policies	2003	EAI (2003) An economic Assessment of Particles Filters. Environmental Assessment Institute.	Ex-ante
Large Combustion Plants Directive	2000	SPRU (2000) The Large Combustion Plant Directive (88/609/EEC): An Effective Instrument For Pollution Abatement? Science and Technology Policy Research.	Ex-post

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Large Combustion Plants Directive	2001	Eames, M. (2001) The Large Combustion Plant Directive (88/609/EEA): An Effective Instrument for SO2 Pollution Abatement?. In: Implementing European Environmental Policy: the impacts of the Directives in Member States, M., Glachant (ed.), Edward Elgar	Not in possession of the paper
Auto-Oil Programme	1999	EC (1999) Auto-Oil II Cost-effectiveness Study. Part I: Introduction and Overview. European Commission, Standard & Poor's DRI and K.U.Leuven. Draft final Report.	Ex-post
Ambient air Quality Assessment and Management	2001	Entec (2001) Economic Evaluation of Air Quality Targets for Heavy Metals. Entec UK Limited.	Ex-ante
IPPC-directive	2007	Entec (2007) Assessment of options to streamline legislation on industrial emissions. Final Report - Main Report.	Ex-post evaluation of effects of marked based instruments
IPPC-directive	2007	Entec (2007) Assessment of the Environmental Impacts and Cost Arising from Implementation of the LCP and IPPC Directives for Combustion Installations with Multiple Boiler Units.	Ex-ante
Large Combustion Plants Directive	2007	Entec (2007b) Assessment of the Environmental Impacts and Costs Arising from Implementation of the LCP and IPPC Directives for Combustion Installations with Multiple Boiler Units.	Ex-ante
IPPC-directive	2008	Entec (2008) Monitoring of Permitting Progress for New and Existing IPPC Installations. ENTEC. http://circa.europa.eu/Public/irc/env/ippc_rev/library?l=/permitting_progress/monitoring_permitting/_EN_1.0_&a=d	
CAFE - Clean Air For Europe program	2005	DG ENV (2005): Annex to: The Communication on Thematic Strategy on Air Pollution and The Directive on "Ambient Air Quality and Cleaner Air for Europe". Impact Assessment. Commission Staff Working Paper, SEC(2005) 1133	Ex ante
Air Quality Policies	2008	Federal Statistical Office (2008): Environmental Statistics and Accounts – Air Emissions in the EU. Federal Statistical Office, Germany, Eurostat contract number: 71401.2005.001-2005.291	Ex post
IPPC-directive	2001	Hitchens, D., F. Farrell, J. Lindblom and U. Triebswetter (2001) The impact of Best Available Techniques (BAT) on the Competiveness of European Industry. Institute for Prospective Technological Studies.	Ex-post
IPPC-directive	2004	IEEP (2004) Better and Simpler, Simplification of Regulation for a More Competitive Europe. Institute for European Environmental Policy, Draft Conference Background Report	Ex-ante
IPPC-directive	2006	Ifo (2006) Assessment of different approaches to implementation of the IPPC Directive and their impacts on competitiveness. Final Report. Ifo Institute	Ex post comparison across MS
RAINS - Regional Air Pollution Information and simulation	1998	IIASA (1998) Economic Evaluation of Air Quality Targets for Trospospheric Ozone. Part B: Methodology and Databases. International Institute for Applied Systems Analysis.	It seems like some of the data is ex-post although it relies on models
National Emission Ceiling Directive	1999	IIASA (1999) Economic Evaluation of a Directive on National Emission Ceilings for Certain Atmospheric Pollutant. Part A: Cost-effectiveness Analysis. International Institute for Applied Systems Analysis.	Ex-ante
National Emission Ceiling Directive	1999	IIASA (1999) Economic Evaluation of a Directive on National Emission Ceilings for Certain Atmospheric Pollutant. Part B: Cost-benefit Analysis. International Institute for Applied Systems Analysis.	CBA ex-ante
National Emission Ceiling Directive	2000	IIASA (2000) Cost-effective Control of Acidification and Ground-level Ozone: Further Analysis. Eight Interim Report – Part 1.	Some ex-post data is included
CAFE - Clean Air For Europe program	2005	IIASA (2005) A final set of scenarios for the Clean Air For Europe (CAFE) programme. International Institute for Applied Systems Analysis.	Ex-ante
CAFE - Clean Air For Europe program	2005	IIASA (2005) Target Setting Approaches for Cost-effective Reductions of Population Exposure to Fine Particulate Matter in Europe. CAFE Scenario Analysis Report Nr. 4, Background paper for the meeting of the CAFE Working Group on Target Setting and Policy Advice, Extended Version for the CAFE Steering Group, February 13, 2005	Some baseline data is ex-post
National Emission Ceiling Directive	2007	IIASA (2007) Analysis of Policy Measures to Reduce Ship Emissions in the context of the Revision of the National Emissions Ceiling Directive. IIASA Contract No. 06-107	Ex-ante
National Emission Ceiling Directive	2007	IIASA (2007) Analysis of Policy Measures to Reduce Ship Emissions in the Context of the Revision of the National Emissions Ceiling Directive. International Institute for Applied Systems Analysis.	Their seems to be some ex-ante cost evaluations
Air Quality Policies	2007	IIASA (2007) Cost-optimized reductions of air pollutant emissions in the Eu Member States to address the environmental objectives of the Thematic Strategy on Air Pollution. NEC Scenario Analysis Report Nr. 3. International Institute for Applied Systems Analysis.	Their might be some interesting aspects of cost-curves
National Emission Ceiling Directive	2007	IIASA (2007): Analysis of Policy Measures to Reduce Ship Emissions in the Context of the Revision of the National Emissions Ceilings Directive. Final report. Contract No 070501/2005/419589/MAR/C1	Ex ante
National Emission Ceiling	2008	IIASA (2008): National Emission Ceilings for 2020 based on the 2008 Climate & Energy Package. NEC Scenario Analysis Report Nr. 6	Ex ante

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Directive			
Acidification	1999	Krewitt, W., M. Holland, A. Trukenmuller, T. Heck and R. Friedrich (1999) Comparing Costs and Environmental Benefits of Strategies to Combat Acidification and Ozone in Europe	Not in possession of the paper
Air Quality Policies	2004	Milieu (2004) Assessment of the Effectiveness of European Air Quality Policies and Measures, Milieu Ltd., Final Report, B-43040/2003/365967/MAR/C1	Ex-post. Comparing Eu-15 with US
Air Quality Policies	2000	Netcen (2000) Estimates of the marginal external costs of air pollution in Europe.	Includes some data on costs of air pollution in European countries
National Policies	2004	RIVM (2004) Beoordeling van de Uitvoeringsnotitie Emissieplafonds verzuring en grootschalige luchtverontreniging 2003. RIVM rapport 500037003/2004	
Reduction of Air Pollution from Existing Municipal Waste Incineration Plants - Directive	2001	Schlucht, S., A. Bültmann, M. Eames, and K. Lulofs (2001) Implementation of the European Municipal Waste Incineration Directive (89/429/EEC): Lessons From Four Member States. *European Environment*, Vol. 11, Issue 5.	Ex-post. Not in possession of the paper. Includes four Member states.
Ozone Depleting Substances	2006	Vanner, R. (2006) Ex-post estimates of costs to business of EU environmental policies: A case study looking at Ozone Depleting Substances. Policy Studies Institute	Ex-post
IPPC-directive	2005	Vercaemst, P., D. Huybrechts and E. Meynaerts (2005) Ex-post estimates of costs to businesses in the context of BAT and IPPC. Final report. VITO	Ex-post
CAFE - Clean Air For Europe program	2005	DG ENV (2005) The Communication on Thematic Strategy on Air Pollution and The Directive on 'Ambient Air Quality and Cleaner Air for Europe'. Impact Assessment. SEC (2005) 1133	Ex ante
IPPC-directive	2007	DG ENV (2007a) Directive of the European Parliament and the Council on industrial emissions (integrated pollution prevention and control) (recast). Impact Assessment. Commission Staff Working Document. SEC(2007) 1679	
IPPC-directive	2007	DG ENV (2007b) Summary of the Impact Assessment accompanying document to the proposal for a of the European Parliament and the Council on industrial emissions (integrated pollution prevention and control) (Recast). Commission Staff Working Document. SEC(2007) 1682	
Large Combustion Plants Directive	2005	Entec (2005) Preparation of the review relating to the Large Combustion Plant Directive. Draft Final Report. Entec UK Limited	Ex post
National Emission Ceiling Directive	2005	Entec (2005) National Emission Ceiling Directive Review. Task 1 - In depth analysis of the NEC national programmes. Final Report. Entec UK Limited	Ex post
IPPC-directive	2007	Entec (2007a) Asseessment of the Implementation by the Member States of the IPPC Directive. Final Report. Entec 2007a	Ex post

Biodiversity

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Habitats directive	2006	Ante D. Lerouxa and John Creedy (2006) Optimal land conversion and growth with uncertain biodiversity costs, Ecological Economics Vol.61 (2-3)	The aim of this paper is to characterise the trade-offs between economic growth and natural resource conservation by determining the optimal rate of conversion of a natural reserve of land
Habitats directive	2007	Cristina Marta-Pedrosoa, Tiago Domingos, Helena Freitasa and Rudolf S. de Groot (2007) Cost–benefit analysis of the Zonal Program of Castro Verde (Portugal): Highlighting the trade-off between biodiversity and soil conservation; Soil and Tillage Research Volume 97, Issue 1, November 2007, Pages 79-90	CBA study. Conclusion of thios paper is that soil erosion has reduced the cost-efficiency of public expenditure in local biodiversity conservation
Habitats directive	2001	Drechsler, M., Watzold, F (2001) "The importance of economic costs in the development of guidelines for spatial conservation management". Biological Conservation Vol.97, pp.51-59	

Biodiversity trading schemes	2008	Drechslera, M. and Wätzoldb, F. (2008) Applying tradable permits to biodiversity conservation: Effects of space-dependent conservation benefits and cost heterogeneity on habitat allocation	Cost-effective allocation of habitat for species under spatiotemporally heterogeneous economic development
Natura 2000	2008	Elena Cantarello and Adrian C. Newton (2008) "Identifying cost-effective indicators to assess the conservation status of forested habitats in Natura 2000 sites" Forest Ecology and Management Vol. 256 pp.815–826	Ecological in scope, little on cost-effectiveness of policy.
Agri-environment measures	2009	Nilsson, F.O.L. (2009) Biodiversity on Swedish pastures: Estimating biodiversity production costs	Biodiversity cost-function modelling
Natura 2000	2001	OECD, 2001. Working Party on Economic and Environmental Policy Integration – Working Group on Economic Aspects of Biodiversity: Direct Payments for Biodiversity provided by Swiss Farmers: An Economic Interpretation of Direct Democratic Decision, Paris	
Natura 2000	2000	Strijker, D., Sijtsma, F.J., Wiersma, D., 2000. Evaluation of nature conservation. An Application to the Dutch Ecological Network. Environmental and Resource Economics 16, 363–378.	Evaluation-based methodology
Agri-environment measures	2008	Ulbrich, K., Drechsler, M., Watzold, F., Johst, K., Settele, J., "A software tool for designing cost-effective compensation payments for conservation measures"., Environmental Modelling & Software 23 122-123	By comparing the effects of different mowing regimes on butterfly populations for a given budget, the user can identify the cost-effective mowing regime and the corresponding compensation payments for that budget
Agri-environment measures	2008	Ulbrich, K., Drechsler, M., Watzold, F., Johst, K., Settele, J., Estimating optimal conservation in the context of agri-environmental schemes, Ecological Economics, Vol.68 pp.295-305	Determination of the amount of financial resources that should be allocated towards a particular aim such as the conservation of an endangered species. Economists can contribute to an answer by estimating the 'optimal level of species conservation'. This requires an assessment of the supply and the demand curve for conservation and a comparison of the two curves to identify the optimal conservation level
Habitats directive	2005	Watzold, F. and Schwerdtner, S. (2005) "Why be wasteful when preserving a valuable resource? A review article on the cost-effectiveness of European biodiversity conservation policy". Biological Conservation Vol. 123, pp.327-338.	focuses on reserves and compensation payments for conservation measures as the two most relevant conservation policy instruments in Europe

Chemicals

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
National Policies	2004	Beamount, N. and R. Tinch (2004) Cost Effective Reduction of Copper Pollution in the Humber Estuary. CSERGE Working Paper ECM 03-04	Ex-post
Thematic Strategy on the Sustainable Use of Pesticides	2004	BiPRO (2004): "Assessing economic impacts of the specific measures to be part of the Thematic Strategy on the Sustainable Use of Pesticides - Final Report", Prepared for The European Commission	Ex-ante, very substantial

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Chemical policies	2007	DG ENV (2007): "Accompanying document to the Proposal for a Regulation of the European Parliament and of the Council on Classification, labelling and packaging of substances and mixtures, and amending Directive 67/548/EEC and Regulation (EC) No. 1907/2006 - Impact Assessment", Working dokument	Ex-ante, short, cost and benefits. Referrers to the probably more interesting: "Impact Assessment of Implementing the GHS" (May, 2006), but this assessment study is not available due to an error on the homepage
Chemical policies	2002	EC (2002) Study of Cost-Effectiveness of the Proposed EU Chemicals Policy. EC Paper, July 15	Ex-ante
REACH-regulation	2003	EC (2003) Commission Staff Working Paper. COM(2003)644 final	Ex-ante, Policy preparing paper
Seveso II Directive	2008	EU-Vri (2008): "Study of the effectiveness of the Seveso II Directive"	Ex-post, cost are found but it is also pointed out that there are not many estimates on costs.
National Policies	2002	Hildén, Mikael, Jukka Lepola, Per Mickwitz, Aard Mulders, Marika Palosaari, Jukka Similä, Stefan Sjöblom and Evert Vedung (2002) Evaluation of environmental policy instruments - a case study of the Finnish pulp & paper and chemical industries. Monographs of the Boreal Environment Research, No. 21.	Ex-post
National Policies	2004	IFM (2004) Pesticide stop på offentlige arealer. Institut for Miljøvurdering	Ex-post
Directive concerning the placing of Biocidal Products on the Market	2008	RPA (2008): "Assessing the Impact of the Revision of Directive 98/8/EC concerning the Placing of Biocidal Products on the Market - Note on Issues and policy Options", Prepared for European Commission DG Environment	Ex-ante, economic impact and administrative burdens are assessed

Climate change

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Air Quality Policies	2006	AEA (2006) Assessing the air pollution benefit of further climate measures in the EU up to 2020, AEA Technology Environment, AEAT/ED48763001/Climate policy co-benefit, Issue 6	Ex-ante
The Kyoto Protocol	2003	C. Brink (2003) Modelling cost-effectiveness of interrelated emission reduction strategies the case of agriculture in Europe	Ex ante
EU 2 degree celcius target	2007	CEC (2007) Communication from the Commission to the European Parliament and Council on the review of the Community strategy to reduce CO2 emissions and improve fuel efficiency from passengers cars and light-commercial vehicles. SEC (2007) 61	Ex-ante
GHG emissions	2006	CEPS (2006) Revisiting EU Policy Options for tackling Climate Change. A social Cost-Benefit Analysis of GHG emission reduction strategies	CBA
EU ETS	2008	CEU (2008) Communication from the Commission to the European Parliament and Council on the review of the Community strategy to reduce CO2 emissions and improve fuel efficiency from passenger cars and light-commercial vehicles. Impact Assessment. SEC (2007) 61.	Ex post
EU ETS	2005	DIW Berlin (2005) The Environmental and Economic Effects of European Emissions Trading. Discussion Papers 533.	Ex ante

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
EU ETS	2008	EEA (2008) Greenhouse gas emission trends and projections in Europe 2008. Tracking progress towards Kyoto targets. No 5/2008.	Some interesting data. (EU-27 country profile)
ECCP	2008	EEA (2008) Success stories within the road transport sector on reducing greenhouse gas emission and producing ancillary benefits. No 2/2008.	Cost-effectiveness analysis of some special cases
GHG emissions	2007	FEE (2007) A Review of Recent Studies on Cost Effectiveness of GHG Mitigation Measures in the European Agro-Forestry Sector.	Analysis in the European Agro-Forestry sector
The Kyoto Protocol	2007	FEE (2007) The Kyoto Protocol and the Effect of Existing and Planned Measures in the Agricultural and Forestry Sector in the EU25.	
EU ETS	2005	Ilex Energy Consulting (2005) The Environmental Effectiveness of the EU ETS: Analysis of CAPS.	Ex-ante
The Kyoto Protocol	2002	IMV (2002) Danmarks omkostninger ved reduktion af CO2.	Ex ante
EU ETS	2006	McKinsey & Company ;Ecofys (2006) EU ETS Review. Report on International Competitiveness.	Ex ante. Analysis for a limited number of sectors in Europe.
EU ETS	2007	N. Anger et al. (2007) Competitiveness Effects of Trading Emissions and Fostering Technologies to Meet the EU Kyoto Targets: A Quantitative Economic Assessment. Industrial Policy and Economic Reforms Papers No.4	Competitiveness effects of the EU ETS; ex post and ex ante.
The Kyoto Protocol	2005	NEAA (2005) Meeting the EU 2 C climate target: Global and regional emission implications. Report 728001031/2005	Ex ante
Environmental Taxes	2004	P. Agnolucci (2004) Ex post evaluations of CO2-based taxes: a survey. Tyndall working paper 52.	Ex-post
1998 agreement btw the EU and the motor industry on CO2 emissions	2005	P. Kågeson (2005) Reducing CO2 Emissions from New Cars. A progress report on the car industry's voluntary agreement and an assessment of the need for policy instruments.	Some interesting data.
EU ETS	2008	RILE (2008) Assessing the European Emissions Trading Scheme Effectiveness in Reaching the Kyoto Target: An Analysis of the Cap Stringency. No. 2008/14.	Looks at the consequences of permits over-allocation.
EU ETS	2007	Sato et al. (2007) Differentiation and Dynamics of Competitiveness Impacts from the EU ETS. CWPE 0712 and EPRG 0704.	Industrial competitiveness impact of the EU ETS.
Reduce CO2 emissions from passenger cars	2006	TNO Science and Industry (2006) Review and analysis of the reduction potential and costs of technological and other measures to reduce CO2-emissions from passenger cars. Contract nr. SI2.408212.	Ex ante
The Climate Change Bill	2007	UKERC (2007) The cost-effectiveness of carbon abatement in the transport sector.	Ex ante

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
The Kyoto Protocol	1999	VTT Energy (1999) Integrated cost-effectiveness analysis of greenhouse gas emssion abatement. The case of Finland.	Ex ante
EU ETS	2006	ZEW (2006) The Impacts of the European Union Emissions Trading Scheme on Competitiveness in Europe. Discussion Paper No. 06-051.	Ex ante
EU ETS	2005	Öko-Institut (2005) The environmental effectiveness and economic efficiency of the European Union Emissions Trading Scheme: Structural aspects of allocation.	Ex ante

Integrated

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Environmental Liability	2000	EC (2000) White Paper on Environmental Liability. European Commission	Ex-ante
Sustainable Development Strategy	2007	EC (2007) Progress Report on the Sustainable Development Strategy 2007. COM(2007) 642 final	Some few ex-post data
Energy-using Products	2005	Kemna, R. (2005) MEEUP Methodology Report. Final Report. VHK	Ex-post evaluation of effectiveness. Some limited cost data
National Policies	2006	Webb, J., M. Ryan, S.G. Anthony, A. Brewer, J. Laws, M.F. Aller and T.H. Misselbrook (2006) Cost-effective means of reducing ammonia from UK agriculture using NARSES model	Ex-ante
Environmental Health	2000	WHO (2000) Considerations in evaluating the cost-effectiveness of environmental health interventions. WHO/SDE/WSH/00.10	Ex-post. Uncertain abourt the extent of European data included

Others

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Environmental Taxes	2005	Bach, S. (2005), Be- und Entlasttungswirkungen der Ökologischen Steuerreform nach Produktionsbereichen. DIW Berlin	Ex-post evaluation of effects on env, Employment and innovation. Data only from Germany
Administrative burdens		COMMISSION OF THE EUROPEAN COMMUNITIES (2006), Measuring administrative costs and reducing administrative burdens in the European Union. Commission Working Document, Brussels.	It provides a detailed presentation of the building blocks of the EU-wide strategy for measuring administrative costs and reducing administrative burdens which are proposed in the Strategic Review.

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Regulatory Burdens for Business	2007	CSES (2007), Study on Environment Related Regulatory Burdens for SMEs. Centre for Strategy & Evaluation Services LLP	Data on regulatory burden
Administrative burdens	2006	Defra (2006), Administrative Burdens: Measurement Exercise. Final Report	The report presents the administrative costs for the regulation in scope for Defra.
Administrative burdens	2007	Defra (2007), Administrative burdens in European agriculture: an evidence base. Final Report. Crown, London 2007	Presents administrative burdens in agricultural sector across Europe
National Policies	2002	DORS (2002), Evaluation of Danish Environmental and Energy Policy in the nineties: Kapitel III: Vurdering af 90'ernes Miljø og Energipolitik	Ex-post, but very broad
Environmental Taxes	1996	EEA (1996), Environmental Taxes. Implementation and Environmental Effectiveness.	Ex-post
Environmental Policy	2005	EEA (2005), Cost-effectiveness of environmental policies: An inventory of applied ex-post evaluation studies with a focus on methodologies, guidelines and good practice. Final report. 3475/B2004.EEA. European Environmental Agency. Copenhagen	Ex-post
Environmental Taxes	2006	EEA (2006), Using the market for cost-effective environmental policy. EEA Report, No 1/2006	Ex-post
Environmental Taxes	2008	EEA (2008), Effectiveness of environmental taxes and charges for manageing sand, gravel and rock extraction in selected EU countries. EEA Report, No 2/2008	Ex-post
Environmental Expenditures	2008	Eurostat (2008), Environmental Protection Expenditure by Industry in the European Union 1997-2004. http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-08-093/EN/KS-SF-08-093-EN.PDF	Statistics environmental expenditures on EU
Broad Cost-effectiveness Analysis	2000	Glachant, M. (2000), How can the Implementation of EU Environmental Policy be more Effective and Efficient? Lessons from Implementation Studies. CERNA, Research Report 2000-B-7	Ex-post
Broad Cost-effectiveness Analysis	2005	Görlach, B. and E. Interwies (2005), Cost-effectiveness of environmental policies. EEA	Ex-post
Broad Cost-effectiveness Analysis	2006	Görlach, B., E. Interwies and J. Newcombe (2006) How are we performing? The Role of ex-post Cost-Effectiveness-Analysis in European Environmental Policies	Ex-post

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Broad Cost-effectiveness Analysis	2007	Görlach, B., E. Interwies and J. Newcombe (2007), Evaluating the Cost-Effectiveness of Environmental Policies: Theoretical Aspirations and Lessons from European Practice for Global Governance	Ex-post
Administrative burdens		Hampton, P., (2005), Reducing administrative burdens: effective inspection and enforcement. HM Treasury. Crown. London	Administrative burden of regulation on businesses that can be reduced
Road Transport	2006	Jantzen, J. and H. van der Woerd (2006), Ex-post Estimates of Costs to Business of EU Environmental Policies. Case study Road Transport. Institute for Applied Environmental Economics	Ex-post
Environmental Taxes	2005	Knigge, M. and B. Görlach (2005), Effects of Germany's Ecological Tax Reforms on the Environment, Employment and Technological Innovation. Ecologic	Ex-post evaluation of effects on env, Employment and innovation. Data only from Germany
Environmental Taxes	2005	Kohlhaas, M. (2005), Gesamtwirtschaftliche Effecte der Ökologischen Steuerreform. DIW Berlin	Ex-post. Macroeconomic effects
Administrative burdens	2005	Ministry of Finance and Ministry of Transport in Netherlands, UKIE (2005), Benchmark Transport EU Legislation, Poland - The Netherlands	This report highlights the benchmark process, the practical experiences and recommendations carried out by Poland and the Netherlands
Administrative burdens	2005	Ministry of Finance, the Netherlands, Danish Commerce and Companies Agency, Ministry of Trade and Industry, Norway, Swedish Business Development Agency (2005), International comparison of measurements of administrative burdens related to VAT in the Netherlands, Denmark, Norway and Sweden.	The comparison identifies differences in administrative burdens regarding VAT regulation among certain countries.
National Policies	2006	Netherlands Environmental Assessment Agency (2006): Cost of Policy Inaction, in association with IEEP, GHK, Vrije Universiteit Amsterdam and Ecologic	
Administrative burdens		Network of Heads of European Environment Protection Agencies (2008), Improving the Effectiveness of EU Environmental Regulation – A Future Vision	Developing an agreed vision for environmental policy and regulation in Europe.
Administrative burdens	2008	OECD (2008), Programs to Reduce the Administrative Burden of Tax Regulations in Selected Countries. Forum on Tax Administration: Taxpayers Services Sub-Group. Available online at: http://www.oecd.org/dataoecd/39/6/39947998.pdf	Information note on administrative burdens from Centre for Tax Policy and Administration

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Regulatory Burdens for Business	2006	Ooserhuis et al. (2006) Ex-post estimates of costs to business of Eu environmental regulation. Institute for Environmental Studies	Ex-post
Administrative burdens		Rambøll Management (2006), International benchmark of administrative burdens related to selected EC Directives in The Netherlands, Germany, Denmark - Methodological Findings. Final Report. Hamburg, Germany	comparison of administrative burdens covered The Netherlands, Germany, Denmark
National Policies	2000	RIVM (2000), Kosteneffectiviteit van milieumaatreglen. RIVM rapport 773008002.	Ex-post
Environmental Taxes	1999	RPAL (1999), Induced and Opportunity Cost and Benefit Pattern in the Context of Cost-Benefit Analysis in the Field of Environment. Final Report. Risk & Policy Analysts Limited	Ex-post
National Policies	2003	The Danish Government (2003), Making markets work for environmental policies - achieving cost-effective solutions	Ex-post, but without in-depth cost analysis
Environmental Taxes	2000	WRc (2000), Study on Investment and Employment related to EU Policy on Air, Water and Waste.	Ex-post

Waste

Directive/policy	**Year**	**References (Name, Year, Title, Publisher)**	**Remarks**
RoHS-directive	2008	ARCADIS (2008) Study on RoHS and WEEE Directives. 06/11925/AL. ARCADIS and RPA.	Comprehensive data on administrative burdens and other costs
WEEE-directive	2008	ARCADIS (2008) Study on RoHS and WEEE Directives. 06/11925/AL. ARCADIS and RPA.	Comprehensive data on administrative burdens and other costs
Packaging and Packaging Waste directive	2000	Cagnot, J., V. Monier and A. Le Doré (2000) Cost-Efficiency of Packaging Recovery Systems - The Case of France, Germany, The Netherlands and the United Kingdom. Final Report. Contract n°ETD/98/502038. Taylor Nelson Sofres Consulting	Ex-post
Landfill Disposal Management	2000	COWI (2000) A Study on the Economic Valuation of Environmental Externalities from Landfill Disposal and Incineration of Waste. Final Main Report	CBA, apparently including ex-post data
Biodegradable Waste Management	2004	COWI (2004) Preliminary Impact Assessment for an Initiative on the Biological Treatment of Biodegradable Waste. Final Report	Limited data on existing practice
Thematic Strategy on the Sustainable Use of Pesticides	2005	DG-ENV (2005), SEC(2005) 1681, Impact assessment on the Thematic Strategy on the prevention and recycling of waste and the immediate implementing measures	Ex-ante
Package Waste Management	2005	EEA (2005) Effectiveness of packaging waste management systems in selected countries: an EEA pilot study. EEA Report, No 3/2005	Ex-post

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Package Waste Management	2005	EEA (2005) Policy effectiveness evaluation. The effectiveness of urban wastewater treatment and packageing waste management systems. European Environmental Agency.	Discussion based on former EEA reports.
Municipal Waste Management	2001	ERC (2001) Costs for Municipal Waste Management in the EU. Final Report. Eunomia Research & Consulting Ltd.	Ex-post data
Municipal Waste Management	?	Eunomia (Year Unknown) Economic Analysis of Options for Managing Biodegradable Municipal Waste. Final Report. Eunomia and Ecotec	CBA ex-post of existing systems
End of Life Vehicle -directive	2006	GHK (2006) A study to examine the benefits of the End of Life Vehicles Directive and the costs and benefits of a revision of the 2015 targets for recycling, re-use and recovery under ELV Directive. GHK and Gio Intelligence Service	CBA, including ex-post data
Packaging and Packaging Waste directive	2006	GHK (2006) Costs of compliance case study: Packaging & Packaging Waste Directive 94/62/EC. Final report, June 2006	Ex-post
WEEE-directive	2006	IPTS (2006) Implementation of Waste Electric and Electronic Equipment Directive in EU 25. Institute for Prospective Technological Studies	Some data on administrative costs and costs for industry
Municipal Waste Management	2007	JRC (2007) Environmental Assessment of Municipal Waste Management Scenarios: Part II - Detailed Life Cycle Assessments. JRC Scientific and Technical Reports. EUR 23021 EN/2 - 2007.	Comparison between costs in Krakow and Malta
Landfill-directive	2005	Kohler, N. and E. Perry (2005) Implementation of the Landfill Directive in the 15 Member States of the European Union. Golder Europe EEIG	Data on costs for EU-15 MS
Municipal Waste Incineration Directive	2000	Lulofs, K. (2000) The implementation of the Municipal Waste Incineration Directives, CERNA, Research Paper 2000-B-8	Ex-post
Regeneration and Incineration of Waste Oils	2001	Monier, V. and E. Labrouze (2001) Critical Review of Existing Studies and Life Cycle Analysis on the Regeneration and Incineration of Waste oils. Taylor Nelson Sofres Consulting and BIO Intelligence Service.	Some costs analysis and data on taxes
Batteries directive	2003	Monier, V. and E. Labrouze (2003) Impact assessment on Selected Policy Options for Revision of the Battery Directive. Final Report. BIO Intelligence Service.	Some cost data is included but it is not CEA

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Packaging and Packaging Waste directive	2005	PIRA (2005) Study on the Implementation of Directive 94/62/EC on Packaging and Packaging Waste and Options to Strengthen Prevention and Re-use of Packaging. Final Report, 21 February 2005, 03/07884/AL. PIRA and ECOLAS	CBA, broad cost-estimates. Some ex-post data.
Packaging and Packaging Waste directive	2003	RDC (2003) Evaluation of costs and benefits for the achievement of reuse and recycling targets for the different packaging materials in the frame of the packaging and packaging waste directive 94/62/EC. Final Consolidated Report, March 2003. Research Development & Consulting and PIRA	CBA partly ex-post
WEEE-directive	2007	UNU (2007) 2008 Review of Directive 2002/96 on Waste Electrical and Electronic Equipment (WEEE). Final Report. United Nations University.	Data on aggregated EU level on implementation of the directive
	2003	Van Zele, L. and P. Leroy (2003) Gemeenten en de Uitcouw van de infrastructuur voor afvalwaterzuivering. UIA	
	2001	Vroonhof, J.T.W., G.C. Berhsma and A.M.M. Ansems (2001) Verwerking kunststof verpakkingsafval uit huishoudens. CE and TNO	

Water

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Groundwater Daughter Directive	2002	BRGM, Ecologic (2002) Economic assessment of groundwater protection - Executive summary. ENV.A.1/2002/0019	Ex-ante
Water Framework Directive	2006	Dworak, Thomas, Britta Pielen (2006), Selecting cost effective measures under the EU Water Framework Directive - The issue of scale, Leipzig University, Ecologic and University of natural Resources and Applied Life Science	Ex-ante
Water Prices	1998	Ecologic (1998), Comparison of Water Prices in Europe	Ex-post
River Basin Management	2003	Ecologic (2003), The Economic Analysis according to the Water Framework Directive in the Danube River Basin - A Cross-Country Assessment of Implementation Capacities and Priority Gaps.	Ex-ante
Water Framework Directive	2004	Ecologic (2004), Assessing Environmental and Resource Costs in the Water Framework Directive: The case of Germany.	Ex-ante
Water Framework Directive	2007	Ecologic (2007) Cost-effectiveness groundwater protection: the Thülsfelde Water Protection Area. Slides.	Ex-ante
Water Framework Directive	2007	Ecologic (2007) Cost-Effectiveness-Considerations in River Basin Management - Optimisation and selection of measures. Slides	Ex-ante
Water Framework Directive	2007	Ecologic, ACTeon, NTUA and Universidad de Cordoba (2007) EU Water saving potential (Part 1 - Report). ENV.D.2/ETU/2007/0001r	Ex-ante

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Water Framework Directive	2007	Ecologic, ACTeon, NTUA and Universidad de Cordoba (2007) EU Water saving potential (Part 2 - Case studies). ENV.D.2/ETU/2007/0001r	Ex-ante
Water Prices	2004	Ecologic, Kassel University (2004), Basic principles for selecting the most cost-effective combinations of measures for inclusion in the programme of measures as described in Article 11 of the WFD: HANDBOOK , Research Report 202 21 210, UBA-FB 000563/E	Ex-Ante
Water Framework Directive	2008	Ecologic, UBA, Vienna University of Technology (2008) Cost Effective Measures to Minimise Nutrient Pollution - Case study on calculating cost-effective measures to tackle nutrient pollution from the agricultural, municipal and industrial sectors in the Black Sea.	Ex-post
Water Prices	2001	EEA (2001), Household water use and price of water in Hungary. European Environmental Agency. Copenhagen. Available online at: http://dataservice.eea.europa.eu/atlas/viewdata/viewpub.asp?id=523	Ex-post
Water Prices	2003	EEA (2003), Water Prices: Indicator Fact Sheet for EU, WQ05	Ex-post
Urban Water	2003	EEA (2003), Water Use in Urban Areas: Indicator Fact Sheet for EU, WQ02e	Ex-post
Urban Waste Water Treatment Directive	2005	EEA (2005), The effectiveness of urban wastewater treatment policies in selected countries - an EEA pilot study. European Environmental Agency.	Examines the effectiveness of wastewater policies and measures in six Member States
Water Prices	2001	EEB (2001), Water Pricing in EU Review, Publication Number 2001/002	Ex-post
Water sector liberalization and privatization	2002	EEB (2002), A Review of Water Services in the EU under liberalisation and privatisation pressures. Publication Number: 2002/012, Brussels	Ex-post
Water Framework Directive	2000	Elofsson, K. (2000), Cost efficient reductions of stochastic nutrient loads to the Baltic Sea	Ex-ante
Water Prices	2001	European Parliament (2001), Effluent charging system in the EU member states, Working Paper, ENVI 104 EN	Ex-post
Water resources management	2003	Gerasidi A., et al (2003), CEA for Water Management in the islands of Paros, Greece, National Technical University of Athens. 8th International Conference on Environmental Science and Technology Lemnos Island, Greece, September 2003.	Ex-post
Water Framework Directive	2007	ICF International (2007), "Preliminary Cost Effectiveness Analysis of the Water Framework Directive - Revised after stakeholder review"	Ex-ante
the Danish Action Plan for the Aquatic Environment. (Nitrate Directive)	2004	In this report, the total costs and the cost efficiency of each measure has been calculated. Furthermore, the yearly payments in the period 1998-2003 have been estimated. The difference between the two calculation methods is related to forestry and wetlands as they are based on one off payments. http://www.foi.life.ku.dk/Publikationer/Rapporter/~/media/migration%20folder/upload/foi/docs/publikationer/rapporter/nummererede%20rapporter/160-169/169.pdf.ashx	Ex post
Water Framework Directive	2006	IVM (2006), Ex ante and ex post costs of implementing the Nitrates Directive Case study in the framework of the project 'Ex post estimates of costs to business of EU environmental policies'. Contract No ENV.G.1/FRA/2004/0081. Amsterdam	Ex-post, ex ante

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Water Framework Directive	2005	Kessler, P. (2005) Abwasserabgabe und Wasserrahmenrichtlinie - Was gibt die Richtlinie vor? Slides	
WFD	2005	LNV (2005), Allocation of costs and benefits in the Water Framework Directive A Dutch exploration. Ministry of Agriculture, Nature and Food Quality (LNV), The Hague	Ex-ante
Water Framework Directive	2005	Ministerie van Verkeer en Waterstaat (2005), In pursuit of optimal measure packages - Dutch handbook on cost effectiveness analysis for the EU Water Framework Directive, Netherlands	Ex-ante
Water Framework Directive	2006	NERI (2006), Modelling Cost-efficient Reductions of Nutrient Loads to the Baltic Sea - Concept, Data and Cost Functions for the Cost Minimisation Model, Ministry of the Environment, Denmark	Cost function modelling
Water Prices	2002	OECD (2002), Transition to full-cost pricing of irrigation water for agriculture in OECD countries, COM/ENV/EPOC/AGR/CA(2001)62/FINAL	Ex-post
Water Framework Directive	2005	OECD (2005), Allocation of Costs and Benefits in the Water Framework Directive - A Dutch Exploration	Ex-ante
Water Framework Directive	2007	OECD (2007), Health costs of inaction with respect to water pollution in the OECD countries, 1ENV/EPOC/WPNEP(2007)9/FINAL	Ex-post
Water Prices	2003	OECD Observer (2003), Pricing Water, No. 236. Available online at: http://www.oecdobserver.org	Ex-post
Water Prices	2006	OECD Observer (2006). Water and farms: Towards sustainable use. No. 254. Available online at: http://www.oecdobserver.org/news/fullstory.php/aid/1801/Water_and_farms:_Towards_sustainable_use.html	Ex-post
Water Industry	2007	OFWAT (2007), International comparison of water and sewerage service- Covering the Period of 2004-2005, UK	Ex-post
Water Framework Directive	2000	RPA (2000), Socio-Economic Impacts of the Identification of Priority Hazardous Substances under the WFD: Final Report - J347/WFD. Risk & Policy Analysts Limited, London.	Ex-ante
Water Framework Directive	2005	RPA, MWH, SISTECH (2005), Development of a Methodology to Determine the Cost-Effectiveness of Measures and Combination of Measures for the WFD: Executive Summary	Methodology
Water Prices	2008	SEMIDE (2008), Water pricing in some EU countries. Euro-Mediterranean Information System on know-how in the Water sector: International portal. Available online at: http://www.emwis.net/topics/waterpricing/water-pricing-some-eu-countries	Ex-post
Water resources management	2005	SNIFFER (2005), The Case for Valuation Studies in the Water Framework Directive, Project WFD55	Ex-ante
Water framework directive	2007	The Report analyses options for a cost effective implementation of the water framework directive. http://www.fm.dk/Publikationer/2007/Fagligt%20udredningsarbejde%20om%20virkemidler%20i%20forhold%20til%20implementering%20af%20vandrammedirektivet/~/media/Files/Publikationer/2008/Download/Web_Fagligt_udredningsarbejde_om_vandrammedirektivet.ashx	Ex ante

Directive/policy	Year	References (Name, Year, Title, Publisher)	Remarks
Water Framework Directive	2007	VITO (2007), Costs and Benefits associated with the implementation of the WFD, with a special focus on agriculture: Final Report (Annex: Overview of the number of studies on costs and/or benefits of the Water Framework Directive), 2007/IMS/N91B4/WFD-annex	Ex-ante
Water Framework Directive	2007	VITO, Ecologic and Time (2007) Costs and Benefits associated with the implementation of the Water Framework Directive, with a special focus on agriculture: Final Report. 2007/IMS/N91B4/WFD	Ex-ante
Groundwater Daughter Directive	2007	Water Cost (2007), Highlights from the Final Seminar held in Assen "Taking the Results Forward"	Ex-post
Water Framework Directive	2007	WaterCost (2007), Application of CEA to the Upper Slea Catchment, slides	Ex-ante
Water Framework Directive	2007	Watercost (2007), Watercost findings from Lower Saxony	Ex-post
Water Industry	2002	WRc, Ecologic (2002), Study on the application of the competition rules to the water sector in the European Community: Final Report. Report N. UC6064, WRC PLS, UK	Ex-post