Cost-effectiveness of environmental policies

An inventory of applied ex-post evaluation studies with a focus on methodologies, guidelines and good practice

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0 Executive Summary

Economic analysis for ex-post policy appraisal addresses the question whether a policy objective has been achieved in the most cost-effective way. This question can be answered with the help of a cost-effectiveness analysis (CEA), which relates the costs of a measure to the physical effects that have been achieved (i.e. Euro per ton of CO_2 emissions reduced or per river km restored). The current study has investigated the use of ex-post CEAs to assess the efficiency of environmental policy measures in Europe, the existing guidelines and manuals for this purpose, and the instances where European environmental legislation where ex-post CEA has to be conducted. In addition, ex-ante CEAs were considered where they provided additional insights. Detailed summaries of case studies, guidelines and legal requirements can be found in the web-based PANACEA database created for this project.

Although a few European countries have undertaken a number of ex-post CEAs of environmental policy measures in the last years, ex-post evaluation of environmental policy performance in general remains a relatively recent phenomenon and experience with it is still limited.

- At the EU level, there is little experience with carrying out such assessments, and even less with using their results to feed back into policy implementation. While several environmental Directives require the regular evaluation of the Directive's performance, few of these explicitly require an assessment of their cost-effectiveness. Of the environmental acquis, only four Directives explicitly mandate that the cost-effectiveness be assessed ex-post (Directives 2001/77 on renewable energy, 2001/81 on national emission ceilings, 2003/30 on biofuels and 2004/8 on cogeneration). This report argues that ex-post cost-effectiveness assessments of European Directives need to be better integrated with the process of impact assessments that are carried out for all major European Directives. These ex-ante impact assessments should already formulate the research questions for an ex-post CEA, and identify the data required for it.
- At the level of the EU Member States, the experience with undertaking ex-post CEA of environmental policies is largely confined to the UK and the Netherlands, with occasional studies from other countries. In these two countries, the process of ex-post policy performance evaluation (including cost-effectiveness) is most institutionalised on the basis of legal or other requirements and national guidance documents. Outside the EU, some good examples of applied ex-post CEA, as well as some fairly developed guidance documents, can be found in the US.

In terms of the environmental issues addressed, the case studies reviewed during this study cover a wide range of environmental problems, including acidification, air quality, biodiversity, climate change, chemicals, waste and water. Occasional studies have addressed noise and ozone depletion.

While the study identified several thorough and elaborated case studies, there was no showcase example of a study that included all aspects suggested in the guidance. Instead, a common finding was that many case studies would apply simplifications and shortcuts to the proposed methodologies, or omit parts of the analysis altogether. While the case studies themselves are not very transparent in explaining why such simplifications were made, one main reason is presumably the difficulty of obtaining the necessary data. Indeed, some guidance documents argue that finding ex-post data on costs and effects will often be more problematic than forecasting costs and effects ex-ante. An option to remedy this is to clearly state the objective of a policy measure up front, along with time-bound targets and indicators, and to require reporting on the public and private costs of achieving the targets.

Turning to the guidelines surveyed in this project, the picture that emerges is that guidance exists on how to conduct a thorough ex-post CEA of environmental policies, including on the dangers and pitfalls of such an evaluation and ways of overcoming them. However, the available knowledge is distributed across different documents, none of which comprises all the necessary elements. Thus,

- Guidelines on economic assessment often devote more attention to cost-benefit analysis than to cost-effectiveness analysis;
- Guidance documents for cost-effectiveness analysis are generally written with ex-ante analysis in mind, treating ex-post analysis as a special case, and in far less detail;
- Guidance documents that are specifically geared towards ex-post policy appraisal often say little about cost-effectiveness and how to measure it, but rather address evaluation more generally.

In order to provide adequate and user-friendly guidance for performing ex-post CEA of environmental policies, it is proposed to develop a clearly structured guidance document with appendices for different policy areas. This guidance should focus first on those Directives where an ex-post CEA or some other ex-post evaluation is required. There is an obvious yet unavoidable trade-off involved in specifying the level of detail expected in a guidance document. Parts of a CEA will necessarily be complex and technical, at the same time guidance should be practice-oriented and accessible to non-economists practitioners who carry out or oversee such assessments. A simplified guidance will therefore need to skip some technical aspects, move them to an annex or to a separate, more detailed manual. The guidance document should provide clear pointers to other documents, where further information can be obtained on certain steps of the process. For example, the US EPA's work on cost definitions and measurement and the Dutch, EU and UNESCO guidance on ex-post evaluation can provide many useful insights. The document should also make reference to case studies where particular aspects have been addressed in an exemplary way. To this end, a web-based implementation with links to good practice examples and in-depth guidance would provide a useful companion to a written report. The web-based PANACEA database developed for this project could serve as a starting point for this.

Thus, most of the knowledge required for conducting ex-post CEAs already exists. However, there is still a need for further research to address issues that are not adequately dealt with in the literature:

- There is an issue whether some form of discounting should be applied to the effectiveness term of a CEA. Discounting is routinely applied to compare monetary sums at different points in time, but it is not normally done for physical units such as reduced emissions. However, to ensure the comparability of different options, discounting the effects might also be considered.
- Also, the guidance is not quite clear about which types of costs should be considered. These range from financial costs associated with specific, locally implemented measures (i.e. investment and operational costs) to public expenditure costs, and general equilibrium estimates of the wider economic impacts including foregone producer and consumer surplus. Clearer guidance on which costs to consider in which cases, and how to compute them, would therefore be helpful.
- A general problem for the use of ex-post CEA is gathering the necessary data. Unless objectives, indicators and monitoring requirements have been specified before a policy measure is implemented, it can be very costly and time-consuming to collect the data for an ex-post CEA. Therefore, a targeted and proportional approach for CEA is necessary, whereby the complexity of the analysis (and thus data requirements) is adjusted to the complexity of the decision. Here, more insights are needed on how shortcuts can be applied in a methodologically sound way.

This project provides a useful first step in the process of applying the CEA tool effectively in the ex-post evaluation of European environmental policy measures. By providing a snapshot of the state of play with detailed analysis of a range of existing case studies and guidance documents, the need for a more focussed approach has become clear. A first step in taking this work forward could be a consultation exercise with practitioners and those in charge of commissioning studies that would lead to a more tailored and prescriptive web-based tool for conducting consistent cost effectiveness analyses in the future. Such efforts should be accompanied by increased recognition of the data needs for all future analyses of both effectiveness and cost-effectiveness research.

1 Introduction

1.1 Ex-post Cost-Effectiveness Analysis: What is it and how can it be used?

Economic analysis for policy appraisal is generally interested in answering two questions: 'is a given policy objective worth achieving?' and 'If so, has the policy objective been achieved in the most cost-effective way?'. While the first question is addressed in a cost-benefit analysis (CBA), the second question can be answered with the help of a cost-effectiveness analysis (CEA). The two methods are briefly described in the box below.

Box: Cost-benefit analysis and cost-effectiveness analysis

Cost-benefit analysis (CBA) is carried out in order to compare the economic efficiency implications of alternative actions. The benefits from an action are contrasted with the associated costs (including the opportunity costs) within a common analytical framework. To allow comparison of these costs and benefits related to a wide range of scarce productive resources, measured in widely differing units, a common numeraire is employed: money. This is where most problems usually start for economic policy or project appraisal since some resources, especially environmental ones, are difficult to price in money terms. Many of the goods and services provided by ecosystems – such as amenity, clean air, biodiversity sustenance – are not traded on a market, hence no market price is available which reflects their economic value. Such prices need to be estimated instead through the use of valuation studies, e.g. eliciting people's willingness to pay for a particular environmental good. By comparing costs and benefits in monetary terms, a CBA provides an assessment of whether a policy option is worth implementing (i.e. whether the benefits outweigh the costs). The comparison can either be done by diving benefits by costs (where a benefit-cost ratio larger than one means that the option is worth implementing), or by subtracting net costs from net benefits (where a positive sum indicates a beneficial option).

A **cost-effectiveness analysis** (CEA) seeks to find the best alternative activity, process, or intervention that minimises resource use to achieve a desired result. An ex-ante CEA is performed when the objectives of the public policy have been identified and an analyst or an agency has to find the least cost-option of achieving these objectives. An ex-post CEA addresses the question in how far objectives have been achieved, and at what cost. In either case, the cost-effectiveness of a policy option is calculated by dividing the annualised costs of the option by a quantified measure of the physical effect, such as animal or plant species recovered, tons of emissions of a given pollutant reduced, kilometres of river length restored, etc. In this context, the effects of a policy can be both reduced pressures (e.g. the least-cost option to reduce CO2-emissions), or avoided impacts (e.g. the cheapest way to keep global warming below 2°), where the latter is usually more difficult to assess. Different options that achieve / have achieved the same effect are then compared based on their cost. CEA, therefore, does not ask, nor attempts to answer, the question whether the policy is justified, in the first place, in the sense that its benefits to society will exceed its costs to society. CEA is sometimes used as a second-best option when a full-blown CBA would be desirable, but many effects cannot be captured in monetary form.

Cost-effectiveness analysis can be applied both as an ex-ante appraisal and as an ex-post evaluation tool. If applied ex-ante, a CEA will help to determine the most cost-effective way of achieving a given target, assisting policy makers to allocate resources and realise policy objectives in efficiently.

The focus of this report is on ex-post CEAs. Where it is applied ex-post, a CEA may help to assess whether a policy measure has been effective in addressing the problem it was designed for, and at what cost. It can take the form of an ex-ante / ex-post comparison, assessing whether expected effects were realised in the projected cost; it can consist of a cross-country comparison (benchmarking), or, if ex-post CEAs are carried out repeatedly, it can determine whether efficiency has increased over time.

Although some European countries have moved ahead in this respect in the last years, ex-post evaluation of environmental policy performance remains a relatively recent phenomenon and is not widely applied. At the European level, there is little experience with carrying out such assessments, and even less with using their results to feed back into policy implementation.

1.2 Critical Issues in ex-post Cost-Effectiveness Analysis

Whether at the European level or at the level of Member States, similar problems are encountered in ex-post assessments.

- The main challenge is to establish the **causality** between observed effects and influencing factors, thereby disentangling the different effects of policies and relating them to individual policy measures, and separating out the influence of other factors.
- A related problem is that of **data gathering**: unless specifically tailored monitoring requirements have been specified up front, it is often difficult to find the data that measures the impact a policy has had. For this reason, data gathering ex-post can easily become very costly and time-consuming.
- Another main issue relates to the **scale of the analysis** – traditionally, CEAs were mainly applied at the local level, in order to evaluate individual, well-defined measures. Upscaling the analysis to assess the cost-effectiveness of strategies or policies at national or European level necessarily increases the uncertainty of relating observed impacts to a particular action.

Next to these practical problems, there are also some theoretical issues that merit further discussion, but which are only touched upon in passing in the available literature:

- There is some discussion on which **types of costs** should be considered in a CEA, ranging from the purely financial private costs (i.e. investment and operational costs) of specific measures to general equilibrium-estimates of costs to the wider economy, including efficiency losses (foregone producer and consumer surplus). At least one guidance document argues that changes in producer and consumer surplus should be included, however none of the case studies identified actually calculated these cost components.
- Regarding the **treatment of effectiveness**, there is an interesting issue of whether measures of effectiveness should be discounted even though they are in non-monetary terms. Discounting of costs is a standard procedure in most CEAs, and is called for in all guidance documents. Regarding the temporal dimension of effectiveness, there is no guidance on whether some type of discounting should be applied as well. For example, in a comparison of two measures that achieve the same objective at the same cost, but where one takes two years to reach the objective, while for the other costs are stretched out over five years, the latter would appear more cost-effective.
- Other issues include the distinction between **intermediate goals and final goals** of a policy intervention, which are often confused. Thus, the effectiveness term in a cost-effectiveness analysis can either capture a pressure (i.e. tons of emissions reduced) or an impact (avoided damage or improvements in environmental quality). Which of the two is applicable depends on the original goal of the policy measure. In practice, most assessments tend to focus on pressures, since

they are more easy to measure and since the causality between measures and effects is more easy to establish.

1.3 Scope of this Report

This document summarises and interprets the main results of the project "Cost-effectiveness of environmental policies", carried out by Ecologic, eftec and IVM on behalf of the European Environment Agency. It is mainly structured along the work packages identified for this project:

I. Overview of legal requirements for ex-post CEA in European Environmental Policy

II. Overview of guidance documents and manuals for carrying out ex-post CEAs

III. Selected case studies of applied ex-post CEA for environmental policy measures.

Due to the prevalence of ex-ante over ex-post CEA, work package III also included selected examples of ex-ante CEA. For work package II, it emerged that while there are some guidelines that provide insight on the processes and techniques of ex-post evaluation, and some that would discuss the application of CEA to ex-post analysis, there were no guidelines and manuals specifically geared towards ex-post CEA.

While this document provides a summary and conclusion of the work package results, the detailed results (including summaries of legal requirements, guidelines and case studies) are documented in a web based database, the Pan-European database for applied ex-post Cost-Effectiveness Analyses (PANACEA). The database includes detailed summaries for the most relevant studies and guidelines, as well as bibliographic references and links for the less relevant cases.

The gathering of information and literature involved the following steps:

- Consultation with members of the network of economists in the framework contract;
- Consultation with the EEA project steering group;
- Consultation with EEA national focal points;[1]
- A detailed web-search, including on-line resources of major research institutes, international bodies, relevant national Government departments and European Commission DGs;
- Consultation with in-country contacts in ministries;
- Searches in relevant academic journals.

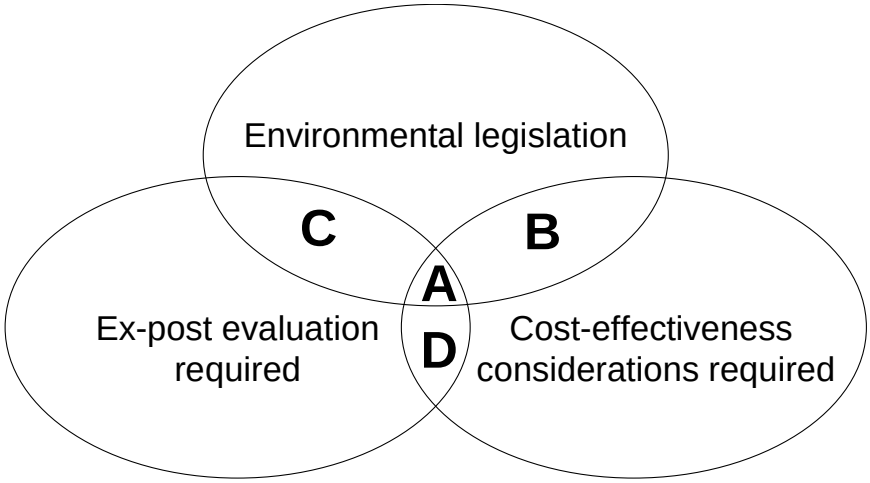
[1] Regarding the consultations with the EEA national focus points and subsequent contacts, the authors would like to thank the following people for their support: Jan Voet (Belgium), Tapani Saynatkari and Marjukka Porvari (Finland), Denise Juin (France), David Lee (UK), Gerard O'Leary (Ireland), Bernt Rondell and Per Magdalinski (Sweden) and Eric Debrabanter (Luxembourg). The authors would also like to thank Friedrich Hinterberger (SERI), Anneke Klasing (Ecologic), Frans Oosterhuis (IVM), David Pearce (UCL) and Hans Vos (EEA) for reviewing and commenting on this paper. The summary and overview of legal requirements upon which chapter 2.1 draws was compiled by Frans Oosterhuis and Harro van Asselt (IVM).

2 Summary of the Results

2.1 Legal Requirements for ex-post CEAs

In 2001, the EEA noted that "very few items of EU environmental legislation request information on policy effectiveness … even though some EU measures are very costly to implement and should be subject to some kind of cost-effectiveness scrutiny" (EEA, 2001, p. 14). This observation still seems to be valid, although a (small) number of recent Directives do include a requirement to perform an ex-post cost-effectiveness analysis.

This project identified 18 legislative items that require some type of evaluation, and can be related to environmental policy. In the figure below, these items are visualised by grouping them in four categories. As the analysis shows, only a small subset (A) indeed meets all three requirements: (i) environmental legislation that (ii) mandates a cost-effectiveness analysis (iii) to be carried out ex-post. If any of these three criteria are relaxed, the scope of relevant items can be expanded. This means that the 18 general items covered in this project can be subdivided as follows:



A - Environmental legislation that requires an ex-post evaluation of cost-effectiveness, at least as one of several factors to be considered in a wider evaluation framework. The current study has identified four items in this category: Directives on cogeneration, biofuels, renewable energy and emission ceilings (see below).

B - Environmental legislation that requires an ex-ante evaluation / analysis of cost-effectiveness, or at least consideration of cost-effectiveness as one of several factors. In this category, six items have been identified. The cost-effectiveness requirements in this category may take different forms: e.g. in the case of the Water Framework Directive (WFD), it is not so much the cost-effectiveness of the Directive as such that is considered, but rather the cost-effectiveness of combinations of measures mandated by the Directive. Several Directives (e.g. large combustion plants, ozone and benzene in ambient air) require that experiences with the implementation of the Directive be taken into account when deciding on the cost-effectiveness of stricter standards, thus connecting ex-post evaluation and ex-ante CEA.

C - Environmental legislation that requires an ex-post evaluation, but not (necessarily) the analysis of cost-effectiveness. Four items have been identified that fall into this category, including Directives on marine and air pollution. While none requires explicitly the consideration of cost-effectiveness,

some items refer to the overall efficiency or the effectiveness of the regulations, implying at least a contributing function for cost-effectiveness.

D - Legislation and regulations requiring ex-post CEA that is not strictly environmental, but has a significant impact on the environment. This category comprises four items related to funding instruments of the Community regional policy (Cohesion Fund, Structural Funds, the Instrument for Structural Policies for Pre-Accession (ISPA) and the Financial Instrument for the Environment (LIFE)). It should be noted that this list is not exhaustive. Depending on which policies are regarded as having a significant impact on the environment, more could be included in this category.

This means that while there are several more Directives that involve effectiveness assessments in one way or another, the set of environmental Directives calling for an ex-post evaluation of cost-effectiveness is limited to four Directives:

- **Directive 2001/77 (Electricity from renewable energy sources).** Article 4.2 of the Directive demands that "[t]he Commission shall, not later than 27 October 2005, present a well-documented report on experience gained with the application and coexistence of the different mechanisms [...]. The report shall assess the success, including cost-effectiveness, of the support systems [...] in promoting the consumption of electricity produced from renewable energy sources." The reporting may include a proposal for a framework for Community activities with regard to support schemes for Community activities. This framework should "promote the use of renewable energy sources in an effective way, and be simple and, at the same time, as efficient as possible, particularly in terms of cost".
- **Directive 2001/81 (National Emission Ceilings).** Article 9.1 of the Directive demands that "in 2004 and 2008, the Commission shall report to the European Parliament and the Council on progress on the implementation of the national emission ceilings", and on the extent to which the objectives of the Directive are likely to be met. The reports shall include "an economic assessment, including cost-effectiveness, benefits, an assessment of marginal costs and benefits and the socioeconomic impact of the implementation of the national emission ceilings on particular Member States and sectors.
- **Directive 2003/30 (Promotion of biofuels and other renewable fuels).** Article 4.2 of the Directive states that "by 31 December 2006 at the latest, and every two years thereafter, the Commission shall draw up an evaluation report [...] on the progress made in the use of biofuels and other renewable fuels in the Member States." The report shall assess "the cost-effectiveness of the measures taken by Member States in order to promote the use of biofuels and other renewable fuels", as well as "the economic aspects and the environmental impact of further increasing the share of biofuels and other renewable fuels".
- **Directive 2004/8 (Cogeneration).** Article 7.3 of the Directive demands that the Commission should provide "a well-documented analysis on experience gained with the application and coexistence of the different support mechanisms" in order to "assess the success, including cost-effectiveness, of the support systems in promoting the use of high-efficiency cogeneration."

All of these Directives have entered into force in 2001 or later. Consequently, they are still in their first reporting cycle. The first assessments of the Directives' performance was expected for the end of 2004 (for the National Emission Ceilings Directive), but has not been published at the time of writing. Most of the assessments will be repeated at intervals of two or four years.

A further question is how the evaluation of cost-effectiveness should be conducted. For the four Directives that require an ex-post CEA, neither guidelines nor standards are provided regarding the content or the methodology to be applied. For some of the other Directives and regulations, more

guidance exists. The guidance is most developed in the case of the Water Framework Directive, Article 11 / Annex III of which requires an ex-ante appraisal of the most cost-effective combination of measures to achieve good ecological status. To support the selection of measures, the European working group WATECO (established under the WFD Common Implementation Strategy) has produced an extensive guidance document. In addition, some Member States have come up with handbooks and guidance documents for the national implementation (see also the results of WP 2).

Box: National-level requirements in the Member States

While the focus of this study was on requirements for ex-post effectiveness in European environmental legislation, it also became evident that the legal requirements for ex-post-evaluation on the level of the Member States differs markedly. Considerable experience with such assessments exists in the NL and the UK, where requirements are in place to evaluate policies and their impacts, including their (cost-)effectiveness.

- In the Netherlands, Article 20 of the Government Accounts Act (Comptabiliteitswet) states that Ministers shall be responsible for the effectiveness and efficiency of the policy underlying their budgets. This includes conducting regular audits of the effectiveness and efficiency of the policy, and reporting back to the Ministry of Finance. Guidance for this requirement is presented inter alia in the draft "guidance for ex post evaluation research" (Concept wegwijzer evaluatieonderzoek ex-post [G44]).
- For the UK, the Green Book on appraisal and evaluation in central government (G8 below) states that "all new policies, programmes and projects, whether revenue, capital or regulatory, should be subject to comprehensive but proportionate assessment, wherever it is practicable, so as best to promote the public interest." In this context, the Green Book mentions cost-effectiveness analysis as one possible assessment method.

2.2 Guidance Documents

There is a large number of textbooks on the use of economic appraisal, most of which focus on cost-benefit analysis but also sometimes cover cost-effectiveness analysis. This abundance in the domain of academic publications does not seem to be reflected in the publication of practical guidelines. In addition, cost-effectiveness analysis is dealt with to a greater extent in the health sector than in the environmental sector. Textbooks on cost-benefit analysis in the environmental sector typically only mention cost-effectiveness in passing.

For the selection of the guidance documents covered in this study, emphasis was placed on providing a range of the best examples, in order to make an overall assessment of the state of play and thereby to assess the need for a new, specific guidance document to be authored for the EEA's purposes. For selecting guidance documents, the criteria for selection were:

- That the guidance was up-to-date (thus only the latest Government guidance from one issuing body is presented);
- That the guidance is focused on the analysis of environmental policies (or explicitly mentions them as one of a number of policies to be assessed);
- That the guidance is issued by or directed at EU Member States (except where other country-level guidance offers additional insights, as is the case with the USA); and
- Public sector guidance is preferred.

Forty-four potential guidance documents, mostly guidelines from various national and international public sector bodies, but also academic papers and books, were identified during the course of this project, of which twenty-four were deemed to be relevant for the purposes of this study. Of these, fifteen are summarised in the PANACEA database. The relevant guidance documents are summarised in the table below (a grey "(X)" in the ex post or ex ante column indicates that the document is relevant, but does not explicitly address ex post/ex ante evaluation; a question mark indicates that we were informed of the document's existence, but were either unable to obtain a copy or it is in a language we were unable to translate):

No.	Title	Policy Area	Country	Author/client	Type of analysis	Ex post	Ex ante	Summary
G2	*CEA and Developing a Methodology for Assessing Disproportionate Costs* (2004)	WFD	UK	Risk and Policy Analysts Ltd / DEFRA and UK Environment Agency	CEA & CBA		X	X
G3	*Guidelines for Defining and Documenting Data on Costs of Possible Environmental Protection Measures* (1999)	Environment general	EU	European Environment Agency / no client	Neither			X
G8	*The Green Book: Appraisal and Evaluation in Central Government* (2003)	General	UK	UK Treasury / no client	CBA & CEA	X	X	X
G9	*Guidelines for Preparing Economic Analyses* (2000)	Environment general	USA	US Environment Protection Agency. / no client	CBA & CEA	(X)	X	X
G12	*Basic Principles for Selecting the most Cost-Effective Combinations of Measures as Described in Article 11 of the Water Framework Directive HANDBOOK* (2004)	WFD	Germany	Ecologic / German Federal Environment Agency	CEA		X	X
G14	*Economics and the Environment: the Implementation Challenge of the Water Framework Directive, Guidance Document* (2003)	WFD	EU	WATECO / no client	CEA		X	X
G18	*What Constitutes a Good Agri-Environmental Policy Evaluation?* (2004)	Agriculture	OECD	Pearce, David / no client	CEA & CBA	(X)	(X)	X
G20	*Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* (1992)	General	USA	US Office of Management and Budget / no client	CBA & CEA		X	X
G21	*Guidelines for the Economic Analysis of Projects* (1997)	Development projects	Asian countries	Asian Development Bank / no client	CBA & CEA		X	X
G22	*Opportunities Envelope Guidelines for Proposals* (2004)	Climate Change	Canada	Government of Canada / no client	CEA		X	X
G24	*PEEM Guidelines 3 - Guidelines for cost-effectiveness analysis of*	Vector-borne diseases	Inter-national	Panel of Experts on Environmental Management for	CEA	X	X	X

No.	Title	Policy Area	Country	Author/client	Type of analysis	Ex post	Ex ante	Summary
	vector control. (1993)			Vector Control (PEEM), WHO / no client				
G25	*Review of Technical Guidance on Environmental Appraisal* (1999)	Environment general	UK	eftec / former UK DETR	CBA & CEA	X	X	X
G27	*Guide to Cost-Benefit Analysis of Investment Projects*	General	EU	Evaluation Unit, DG Regional Policy, EC / no client	CBA & CEA		X	
G29	*Cost-Effectiveness Analysis a Tool for UNESCO*	General	Inter-national	SPM consultants / UNESCO	CEA	X	X	X
G30	*DTLR Multi-Criteria Analysis Manual*	General	UK	former UK DETR/ no client	CBA, CEA & MCA		X	
G32	*Making Choices in Health: WHO Guide to Cost Effectiveness Analysis*	Health	Inter-national	World Health Organisation / no client	CEA		X	
G33	*A Handbook for Impact Assessment in the Commission: How to do an Impact Assessment*	General	EU	Strategic Planning and Programming unit, Secretariat-General, European Commission / no client	CBA, CEA & MCA	(X)	X	
G34	*Samfundsøkonomisk vurdering af miljøprojekter.*	Environment general	Denmark	Danish National Environmental Research Institute / no client	?	?	?	
G35	*Kosten en baten in het milieubeleid, definities en berekeningsmethoden*	Environment general	Netherlands	Dutch Ministry for Spatial Planning, Housing and the Environment (VROM) / no client	?	?	?	
G36	*Evaluating EU Activities*	General	EU	European Commission DG Budget / no client	CBA & CEA	X	X	
G37	*A Framework for Evaluating Environmental Policy Instruments*	Environment general	Finland	Mickwitz, Per / no client	CBA & CEA	X	X	
G38	*Kosteneffectiviteit natuurbeleid: Methodiekontwikkeling*	Environment general	Netherlands	Rijksinstitut voor Volksgezondheid en Milieu (RIVM) / no client	CEA	X		
G39	*Evaluating EU expenditure programmes: A guide: ex post and intermediate evaluation*	General	EU	European Commission DG Budget / no client	CBA & CEA	X		
G40	*Ex-ante Evaluation: a Practical Guide for Preparing Proposals for Expenditure Programmes*	General	EU	European Commission DG Budget / no client	CBA & CEA		X	X
G43	*Ympäristöpolitiikan Taloudellisten Vaikutusten Arviointi (Economic*	Environment general	Finland	Porvari, M. and Hildén, M. (Finnish Environment Institute)	?	?	?	

No.	Title	Policy Area	Country	Author/client	Type of analysis	Ex post	Ex ante	Summary
	Assessment of Environmental Policy)			/ no client				
G44	*Wegwijzer Evaluatieonderzoek ex post*	General	Netherlands	Dutch Ministry for Spatial Planning, Housing and the Environment (VROM) / no client	Neither	X		X

Of the fifteen guidelines summarised, there are:

- Three documents dealing with cost-effectiveness analysis for implementing the Water Framework Directive (G2, G12, G14);
- Six government or international body-issued guidance documents for the public sector in general (G8, G20, G24; G 29; G40; G44);
- Two government-issued guidance documents for evaluation of environmental policies (G9, G25);
- Two guidelines on using cost-effectiveness for project appraisal (G21, G22);
- One document primarily concerned with data collection and management as a prerequisite for cost-effectiveness analysis (G3); and
- One academic background paper on cost-effectiveness analysis of agri-environment schemes (G18).

The guidance documents and manuals identified in the study vary substantially in the level of detail they provide about how to undertake cost-effectiveness analysis, especially with regards to technical issues such as discounting, distributional impacts, effects on competitiveness, and so on. However, the basic descriptions of the core stages of the cost-effectiveness analysis differ only a little.

As discussed in greater detail in chapter 3 below, the overall picture that emerges is that many useful elements are present in the different documents, which together provide good insights on how to conduct an ex-post cost-effectiveness analysis. However, there is not one single document that would combine all of these elements into one volume.

Regarding the distribution and the focus of the documents, the following observations can be made:

- There is a bias in the guidance towards ex-ante analysis. There are, however, some guidelines that provide insight in the processes and techniques of ex-post evaluation, including ex-post CEA. These are the Commission's Guide on Evaluating EU Expenditure Programmes (G39), and Evaluating EU Activities: A practical guide for the Commission Services (G36); the Dutch Wegwijzer Evaluatieonderzoek ex post (G44), and the HM Treasury Green Book: Appraisal and Evaluation in Central Government (G8). While these documents give insights on ex-post evaluation in general, the treatment of cost-effectiveness analysis in these documents is rather superficial. Thus, HM Treasury Green Book (G8) mentions cost-effectiveness on three occasions only (p. 4, 37, 38) and defines CEA in one short sentence only (p. 4). Annex E of the EU guide on evaluating EU Activities (G36) lists several evaluation techniques including CBA and MCA, however CEA is not included in this annex (p. 89, 90), but is only briefly defined in the glossary (p. 103). The Commission's Guide on Evaluating EU Expenditure Programmes (G39) provides comprehensive guidance on how to frame, set up and conduct an ex-post evaluation, e.g. in terms

of establishing causality between measures and outcomes, and singling out the effects of a particular policy measure. Cost-effectiveness analysis is briefly discussed and compared to other evaluation tools (p. 58), but on a rather abstract level. The Dutch Wegwijzer Evaluatieonderzoek ex post (G44) discusses the distinction between efficiency, effectiveness and cost-effectiveness in some detail, but does not provide guidance on which costs to consider or how to measure them.

- In many cases, guidance documents will generally be written with ex-ante analysis in mind, treating ex-post analysis as a special case, and in far less detail (see e.g. HM Treasury Green Book (G8) or the Handbook for Impact Assessment in the European Commission (G33) as well as the DETR Review of Technical Guidance on Environmental Appraisal (G25)). As also documented in the survey of legal requirements (see chapter 2.1), there are more cases where undertaking an ex-ante analysis is a legal obligation. Where organisations are not legally required to perform ex-post analysis, the need for guidance will be less pressing and the focus of the guidance less clear-cut.
- In terms of spatial distribution of national-level guidance documents, good examples can be found in three countries in particular: the UK (G 2, 8, 25), the US (G 9, 20) and the Netherlands (G 35, 38, 44).
- The documents relating to the Water Framework Directive (G 2, 12, 13, 14) contain a large amount of WFD-specific supplementary details and are of limited value as general guidance documents. Also, in line with the requirements for CEA established by the WFD, they focus on ex-ante analysis only.
- The general guidance documents issued by governments or their agencies or international bodies are for the most part not specifically related to the analysis of environmental policy, but have a much broader scope. In this way, e.g. HM Treasury Green Book (G8), the Guide to Cost-Benefit Analysis of Investment Projects issued by the European Commission, DG Regions (G27) or the Dutch guidance on ex-post policy evaluation (G44) do provide general guidelines for assessing the cost-effectiveness of policies, but pay less attention to the specific needs of evaluating environmental policies, such as the valuation of environmental goods and services, or the incorporation of long-term effects and irreversible damages. The HM Treasury Green Book provides examples of data sources for a range of impacts, including environmental impacts, with an entire annex devoted to the valuation of non-market goods. However, this type of data is more commonly used in a CBA than a CEA.
- In G29, a paper on the potential role of CEA within UNESCO, the authors make the observation that making CEA a permanent feature and an accepted tool within the organisation it will be necessary to modify the culture of the organisation, ‘which is very sceptical of what is seen as limited "economistic" methods’. The paper makes the case for introducing incentives to ensure that this evaluation tool is streamlined within the activities of UNESCO.
- At the same time, several guidance documents focus specifically on the evaluation of environmental policy, including e.g. the OECD guide on evaluating economic instruments for environmental policy (G7), the US EPA guidelines for preparing economic analyses (G9, ex-ante only), the eftec / DETR study on Review of Technical Guidance on Environmental Appraisal (G25), the Danish Economic assessment of environmental projects (Samfundsøkonomisk vurdering af miljøprojekter, G34) or the Dutch guidance on costs and benefits in environmental policy (Kosten en baten in het milieubeleid, G35).
- An explicit distinction between financial and economic costs is made in most of the guidance documents. The documents use different terms to make this distinction, and sometimes the same terms are used to mean different things. In some cases, the terms ‘direct’ and ‘indirect’ costs are used instead of ‘financial’ and ‘economic’, in other cases ‘social welfare losses’ are used to mean

economic costs. The US EPA guidelines (G9) are the most detailed in this respect, differentiating between compliance costs, government regulatory costs, social welfare losses, transitional costs, and indirect costs. However, environmental costs are not always explicitly mentioned. The focus of some of the guidelines are on the social costs of the options assessed, while others are more interested in the costs to industry of proposed environmental regulation.

- At least one of the documents (HM Treasury Green Book (G8)) recommends cost-benefit analysis over cost-effectiveness analysis. A similar tendency to regard CEA as a simpler but inferior alternative to a CBA can also be discerned in the UK Water Framework Directive Guidance (G2). Other documents note that cost-effectiveness analysis should be performed when there are substantial doubts about the theoretical basis of the monetisation of benefits, or if environmental targets are set politically without a cost-benefit analysis.
- Some of the guidelines (G 2, 8, 44) point out that performing the cost-effectiveness analysis or the evaluation itself can be a significant drain on resources, and the effort put into the analysis should be commensurate with the proposed program or policy.

2.3 Case Studies of applied ex-post Cost-Effectiveness Analyses

This part of the project has reviewed applications of cost-effectiveness analysis in the evaluation of environmental policies, with a strong focus on European studies and on ex-post analyses. To this end, more than 70 potential case studies were identified, 18 of which passed the selection criteria and were thus summarised and treated in greater detail. The project did not attempt to give a comprehensive overview of ex-post CEA in Europe, due to language limitations an emphasis was placed on studies that are published in English, French, German or Dutch. To identify a broad scope of potential studies, consultations were carried out with some national authorities as well as with the EEA's network of focal points, as described in chapter 1. The following table presents a selection of the total case studies, listing only those that were pre-selected for further analysis.

No.	Author	Year	Title	Country	Policy area	Timing	Summ
CS1	NERA	2002	Fleetwide Emissions and Cost-Effectiveness of the Consent Decree Pull-Ahead Requirements for Heavy-Duty Diesel Engines	USA	Air quality	ex ante	
CS2	Wright et al.	2001	The Cost-Effectiveness of Reductions in Dioxin Emissions to Air from Selected Sources	New Zealand	Air quality	ex ante	
CS8	Standard & Poor's DRI	1999	The Auto-Oil II Cost-Effectiveness Study	FI, F, D, EL, IRL, I, NL, E, UK	Air quality	ex post	
CS11	IVM	2000	Cost-effectiveness of Dutch water policies	NL	Water	ex ante	X
CS12	RIVM	2000	Cost effectiveness of environmental measures	NL	Acidification	ex ante	X
CS13	RIVM	2004	Environmental costs of energy measures 1990-2010	NL	Energy, Climate	ex ante / ex post	X
CS15	RIVM	2003	Evaluation of the Implementation memorandum for emission ceilings, acidification and large-scale air pollution 2003	NL	Air quality	ex ante	X
CS19	CE Delft	2001	Treatment of plastic packaging waste from	NL	Waste	ex-ante	

No.	Author	Year	Title	Country	Policy area	Timing	Summ
			households				
CS20	CE Delft	2000	Accelerated introduction of cleaner petrol and diesel engines in the Netherlands	NL	Air quality	ex-ante	
CS26	Resources for the Future	1999	The Enhanced I/M Program in Arizona: Costs, Effectiveness, and a Comparison with Pre-regulatory Estimates	USA	Air quality	ex post	X
CS30	Harvard School of Public Health	2000	Are the Costs of Proposed Environmental Regulations Overestimated? Evidence from the CFC phaseout	USA	Ozone	ex post	X
CS31	Swedish University of Agricultural Sciences	2000	Cost efficient reductions of stochastic nutrient loads to the Baltic Sea	Baltic Sea countries	Water	ex ante	
CS47	Macaulay Land Use Research Institute	2002	The cost-effectiveness of biodiversity management: a comparison of farm types in extensively farmed areas of Scotland	UK	Biodiversity	ex post	X
CS49	Beamount, N. and Tinch, R.	2003	Cost Effective Reduction of Copper Pollution in the Humber Estuary	UK	Water	ex post	X
CS51	IIASA	1999	Economic Evaluation of a Directive on National Emission Ceilings for Certain Atmospheric Pollutants. Part A Cost-Effectiveness Analysis	EU	Air quality	ex ante	X
CS52	VTT	1999	Integrated cost-effectiveness analysis of greenhouse gas emission abatement: the case of Finland	FI	Climate change	ex ante	X
CS53	AEA Technology	1998	Options to Reduce Nitrous Oxide Emissions	EU	Climate change	ex post	X
CS54	AEA Technology	1998	Options to Reduce Methane Emissions	EU	Climate change	ex ante	
CS56	WRc	Unknown	Examination of Existing Policy Options ... to Implement Directive 76/464/EEC	EU	Water	ex post	
CS57	eftec	2001	The Potential Cost and Effectiveness of Voluntary Measures in Reducing the Environmental Impact of Pesticides	UK	Agriculture	ex ante	
CS63	Entec	2004	Review of the Large Combustion Plant Directive	EU	Air quality	ex ante	
CS69	Tyndall Centre	2004	Ex post evaluations of CO2-based taxes: a survey	DK, FI, D, NL, NO, S, UK	Climate change	ex post	X
CS70	DMU	2004	Effectiveness of waste water policies in selected countries – an EEA pilot study	DK, NL, F, E, PL, EE	Water	ex post	X
CS71	European Topic Centre	2004	Analysis of effectiveness of implementing packaging	AT, DK, IRL, I, UK	Waste	ex post	X

No.	Author	Year	Title	Country	Policy area	Timing	Summ
	on Waste and Material Flows		waste management systems				
CS73	SPRU	2000	The Large Combustion Plant Directive (88/609/EEC): An Effective Instrument For Pollution Abatement? (IMPOL)	F, D, NL, UK	Air quality	ex post	X
CS74	CERNA	2000	The Implementation of the Municipal Waste Incineration Directives (IMPOL)	F, D, NL, UK	Air quality	ex post	X
CS75	SPRU	2000	The Implementation of EMAS in Europe: a case of competition between standards for environmental management systems (IMPOL)	F, D, NL, UK	Population & Economy	ex post	X
CS86	RIVM	2004	Evaluation of the Dutch Manure and Fertiliser Policy, 1998-2002	NL	Agriculture	ex post	X

It emerged that the practical experience with ex-post cost-effectiveness evaluations is unevenly distributed in Europe, with much evidence coming from the Netherlands and the UK. The finding that these countries have a long tradition for such assessments is in line with the results of a 1998 study for the European Commission, which surveyed the use of economic evaluation methods for environmental policies in several European countries (Virani 1998).

In general, there is a limited awareness of the precise concept of cost-effectiveness, both by consultants conducting the analyses and by the officials administrating them. Reports promising discussions of cost-effectiveness sometimes turn out instead to be cost-benefit analyses (e.g., CS75) discussions on whether static or dynamic efficiency are being achieved (especially with respect to market-based instruments) (e.g., CS69), or aggregations of cost estimates unrelated to the outcomes achieved (case studies not summarised). Few studies were strict methodical cost-effectiveness analyses of the type outlined in guidance documents (the most complete example of which was the US EPA guidance G9). Where cost-effectiveness ratios are actually calculated, they are sometimes not clearly defined (e.g. in the IMPOL studies CS73 and CS74).

- As stated in EEA (2001) and by Agnolucci (2004, CS69), environmental effect and environmental effectiveness should be treated as distinct concepts. The former is the physical outcome of the intervention, while the latter is a measure of this effect in comparison with what was expected or with what other interventions have achieved. This distinction is not made in all case studies.
- Many of the aspects of cost-effectiveness analysis recommended by guidance documents are not carried out in practice in the studies, presumably because of the difficulties of reconciling theoretical correctness with time, data, resource and skill constraints.[2] For example, none of the studies reviewed included lost consumer or producer surplus in their costs, as recommended by the US EPA guidelines (G9). Furthermore, discounting, although recommended in almost all guidance documents, was not applied in most studies. This was particularly noticeable in CS52, which discussed greenhouse gas abatement costs in Finland far into the future without the use of

[2] Unfortunately, few of the studies are transparent about which aspects were omitted out and why, which difficulties and constraints were encountered, and how they were addressed.

discounting. As one exception, a study on energy measures in the Netherlands (CS13) not only applied discounting, but also investigated the impact of choosing a social or a private interest rate.

- With regard to the choice of a baseline or reference scenario, business-as-usual baselines representing "the world without the intervention" are found less often than baselines which use a single year as a reference point. The latter implies that without the intervention, environmental outcomes would have stayed constant at the level of the base year. This can lead to a large underestimation of the actual effect that an intervention has had.
- Some of the studies reviewed discussed the marginal abatement costs of emission reductions. However, it should be remembered that marginal abatement cost is only a proxy for cost-effectiveness, and becomes a less accurate proxy the more marginal abatement costs vary for different emission levels. This is because the cost-effectiveness ratio should use the total cost of a measure,[3] whereas the marginal abatement cost is the cost per unit reduction *at a particular stage* of abatement, and ignores the fact that costs at an earlier stage may very well have been lower.[4] Therefore, the marginal abatement cost is only an exact measure of cost-effectiveness if marginal abatement cost is constant across all emission levels, which would be a brave assumption.
- The most widely used sources of information were surveys of regulated business units (CS26, CS47, CS53, CS73, CS75), academic studies (CS12, CS30, CS47, CS51, CS52, CS75), firms' environmental reports (CS12, CS49, CS75), official national statistics (CS51, CS52), data transmitted to the regulatory agency as part of the regulatory obligation (CS26, CS49, CS70, CS71), including data submitted to international bodies such as the IPCC or CORINAIR database (CS52, CS53). The latter included three studies where data was supposed to be reported to Eurostat or other (CS70, CS71, CS73). Strikingly, some of these studies were conducted in those cases where there least data was available. Other sources were realised using market prices from trade journals and newspapers (CS30), consultation with technical experts (CS30, CS75), and government information on subsidy amounts (CS47).
- Some case studies addressed lack of data as a restriction for the analysis. One case study (CS53) noted that commercial sensitivity restricted the availability of data; another (CS69) noted that a lack of data on the marginal costs of abating carbon dioxide make attempts to perform CEA problematic. Other problems with data sourcing were noted in CS70 – i.e. insufficient data provided by Eurostat – and CS71, which found that it takes a long time for data to become publicly available. However, none of the studies explicitly discussed the cost of conducting the analysis itself, or of the data gathering in particular
- Methodological considerations, such as the treatment of confounding factors and sensitivity testing, are variably applied and are sometimes buried in the text rather than explicitly introduced as important parts of the cost-effectiveness analysis. CS12 is a notable exception in this regard, providing a comprehensive set of sensitivity tests that control for variations in the interest rate, depreciation period applied, indirect costs, effect of interactions between measures, timing of different measures and the impacts of relative price changes. Other case studies reflect uncertainty by using different weightings for different parts of environmental effectiveness (CS26), different assumptions about baselines (CS30), different lifetimes for abatement measures (CS49), to wider influences like reform of the Common Agricultural Policy (CS51) and economic growth (CS52).

[3] Note that total costs here refer only to the additional costs associated with the measure itself, and not the total costs of achieving the environmental outcome.

[4] A more formal mathematical explanation would describe this by showing that the total cost of emissions reductions is the integral of the marginal abatement cost between two different emissions levels.

3 Interpretation of the Results

The current project addressed the extent to which cost-effective considerations are taken up in the evaluation of environmental policy in Europe, and where they are, whether the analysis is consistent with existing guidelines. In other words, is the current practice of ex-post cost-effectiveness analysis making best use of available advice to quantify the effectiveness of policies and relate it to the costs encountered?

For environmental policy at the Community level, systematic ex-post assessment of cost-effectiveness is a fairly recent phenomenon. Of the total environmental acquis, only four Directives explicitly mandate that an ex-post assessment of cost-effectiveness be carried out. As these Directives all entered into force after 2000, no assessment has yet been carried out in response to the reporting obligations for these Directives.[5]

However, several ex-post cost-effectiveness assessments have been carried out to assess the performance of other earlier Directives and Community programmes, even though the Directives and regulations themselves do not mandate such assessments. This includes assessments of the EU Urban Waste Water Treatment Directive (CS70), the Directive on packaging and packaging waste (CS71), the Large Combustion Plant Directive (CS74) or the EMAS regulation (CS75). Likewise, there are a few examples where the implementation of European regulations at the Member State level has been analysed in a CEA (e.g. CS15 for the National Emissions Ceiling Directive in the Netherlands).

From the analysis of ex-post CEAs surveyed in this study, it has emerged that **the scope, level of detail and methodological focus of ex-post CEAs differ substantially**. As of yet, it is not possible to identify one "common approach" to ex-post CEA that has been applied in different countries, or to different policy questions. On the contrary, a certain tendency of reinventing the wheel can be discerned, e.g. in the case of the Water Framework Directive, where different Member States have commissioned guidelines and handbooks in addition to the guidance prepared on the European level. This is not necessarily a negative development, as different approaches to implementing one and the same Directive may be warranted by different conditions in the Member States (e.g. in terms of available data, complexity of the decision situations, available human resources etc.). Yet it means that much scope remains for policy learning and mutual exchange.

The actual implementation of the CEAs documented in this project **differs from the theoretical ideal of a CEA**, more so in some cases than in others. The real-life practice combines several different approaches, all of which include assessments of costs and outcomes of some sort, but which do not always closely resemble the textbook ideal of a CEA. Such changes are not always due to a lack of understanding, but are often necessitated by data gaps or by time and capacity constraints. To deal with these, authors will often take methodological shortcuts. For instance,

- A US study on the cost of CFC phaseout (CS30) uses marginal abatement cost as a proxy for cost-effectiveness, an EEA study on packaging waste (CS71) uses budgeted government expenditure as a proxy for costs, and the cross-country study CS74 on the implementation of the municipal waste incineration directives uses data from two German *Länder* as representative of the whole of Germany.

[5] For the National Emission Ceilings Directive (2001/81), an extensive ex-ante cost-effectiveness has been carried out in 1999 in preparation for the Directive (Amann et al. 1999). The first assessment of the implementation of the Directive is due at the end of 2004, but was not available at the time of writing. In addition, a national ex-ante CEA for the implementation of the NEC Directive has been carried out in the Netherlands (Beck et al. 2004, CS15)

- Three studies (CS 69, 70 and 71) explicitly note that the lack of data makes analysis difficult, but derive their conclusions on the limited data base available;
- Some studies will omit certain parts of the analysis and certain types of impacts, or treat them in a qualitative way. Thus, many studies do not address impacts to the national economy, such as increased expenditure, job creation etc. (this omission is explicitly noted in a study on copper pollution in the Humber estuary (CS49), but also applies to other studies). Other studies do not address secondary environmental impacts of abatement technologies used, or describe them only in qualitative terms (e.g. CS75 for the case of the EMAS scheme).
- Cost estimates are sometimes taken over from previous studies, even though these may not be recent ones (e.g. CS 15, 51).
- Confounding factors and parameters, such as economic growth, technological change, policy developments, the interactions and interdependencies between measures, the presence of side-effects, or the difficulty of relating measures to outcomes, are discussed in many studies. Most studies would either mention them, but not incorporate them into the subsequent analysis (CS 15, 30, 70, 71), or are treated in the sensitivity analysis only (CS 12, 51).
- For presenting results, a particular shortcut was applied in the IMPOL study on the large combustion plant Directive (CS73), which described the cost-effectiveness of the compared options only in qualitative terms as low, medium or high.

The variety of methodological shortcuts employed means that only a minority of case studies has actually applied the different parts of a CEA that are described in guidance documents. Thus, for example,

- A third of the summarised case studies do not consider **sensitivity testing** of any sort. While some others employ sensitivity testing or at least some type of plausibility check (e.g. by comparing results with other studies), only two provide an elaborated sensitivity analysis (CS 12, 51). In two studies, a reduced form of sensitivity analysis is applied by using different baselines (CS 30, 52).
- Only four studies (CS 12, 49, 51, 53) apply **discounting** and discuss the effect that the choice of discount rate has on the results, while other studies skip this part altogether.
- Only four studies (CS 12, 51, 52, 53) made use of **models** to estimate the cost-effectiveness of policies.
- While many studies simply applied the status quo (or the situation in a given year) as the **baseline** for the analysis, one study (CS70) did not specify a baseline for the analysis, making interpretation of the findings rather difficult.
- None of the studies provided a monetary valuation of environmentally **beneficial side-effects**, as suggested e.g. by the WFD-related guidance document G2.

The majority of these simplifications, shortcuts and omissions can be related to a lack of data, or respectively to a lack of resources for gathering the necessary data. While the reviewed case studies are not very transparent about the cost of conducting the analysis and of gathering the data, some of the guidance documents contain insights on this point. The particular difficulties of gathering ex-post data on costs and effectiveness are discussed e.g. in G44 and G29, both of which note that data gathering ex-post can be more tedious than for ex-ante analysis. For example, the UNESCO guidance on CEA (G29) notes that "Systematic C-E analysis presumes the existence of clear objectives, cost data and results indicators. Many times, however, organisations request ex-post evaluations of the effectiveness of interventions that were never designed with any of these aspects in mind." Consequently, all these steps that should have been taken up front have to be repeated ex-post.

When comparing different ex-post CEAs, it has to be considered that **not all policy initiatives are equally suited for an ex-post evaluation by means of a CEA**. The following conditions would appear most relevant for a successful ex-post CEA (see also G44):

- The objectives of the policy intervention have to be clearly identified and defined, ideally connected with a quantified target and a clear baseline.
- The policy should be connected to a fixed time period, identifying when policy targets should be achieved.

This **diversity in terms of depth and detail also can also be related to the guidelines used**. None of the guidance reviewed for this study is an "uncluttered", easily-digestible general guidance document for performing CEA with respect to environmental policies. They are either a little too comprehensive, e.g. the US EPA's Guidelines for Preparing Economic Analyses, or too general for non-economists, e.g. the UK Treasury Green Book, or too specifically-focused on one policy area, e.g. the Water Framework Directive documents. Also, while most guidelines for ex-post cost-effectiveness analyses strive to be theoretically comprehensive – which, by itself, is positive – they also need to take into account the likelihood of data gaps and other practical difficulties in conducting analysis, and make practical recommendations for dealing with these limitations.

On this point, the available guidance documents are mostly confined to a more or less concise technical description of cost-effectiveness analysis and its strengths and weaknesses. However, they give much less guidance at all on how to deal with real-life difficulties, e.g. by specifying which methodological shortcuts can be advisable or at least justifiable. The exceptions to this are the guidelines aimed at the WFD (G2, G12 and G14), which are already embedded in a specific regulatory context, the section on communicating assumptions and methods in G9, the Dutch guidance on ex-post evaluation G44, and the outlining of issues surrounding the practicalities of data reporting in G3.

- For instance, the WFD-related guidance G2 argues for a tiered approach in determining the level of detail of the analysis. Thus, it is suggested that the analysis can be limited if there is widespread agreement among stakeholders on the measures to be implemented, if different alternatives differ strongly in the results that they deliver, or if either of the alternatives delivers significant additional benefits.
- Likewise, the US EPA guidelines for preparing economic analyses (G9) recognise that some impacts may escape quantification, and provide brief guidance on which of the markets affected by a measure can be left out of the analysis.
- The Dutch guidance on ex-post evaluation (G44), by contrast, pays ample attention to the everyday problems encountered by policy makers, including scarce resources, lack of time, political pressures etc. However, the document only describes evaluation in general and provides no information on how these findings relate to conducting a CEA.
- Practical limitations of CEAs and ways of overcoming them are also sometimes touched upon in discussions of dealing with risk and uncertainty, but it is not explained how this can be related back to carrying out the assessment (see e.g. the US EPA guidelines for preparing economic analyses (G9) or the European Commission handbook for impact assessments (G33)).

The emerging picture is thus that there is a considerable amount of guidance on Cost-Effectiveness Analysis, which sheds little light on ex-post CEA, and that there is sufficient guidance on the practical aspects of ex-post policy evaluation, which does however say little about cost-effectiveness and the way it can be assessed. That is to say: **the knowledge of how to conduct an ex-post evaluation of cost-effectiveness is available, but it needs to be combined from different sources**. There is as yet not one single document which provides all the relevant guidance in a consistent way.

As noted above, **ex-ante CEAs are relatively more abundant than assessments carried out ex-post**, a fact that is also reflected in the focus of most guidance documents. Since this project focused on ex-post analyses, it was considered (i) whether ex-post assessments would deliver results that are markedly different from ex-ante CEAs, and (ii) whether experiences with ex-ante CEAs could be inferred to the practices of ex-post CEAs.

I. Regarding the first point, there are few cases where the results of an ex-post CEA were directly compared to an ex-ante analysis previously conducted for the same policy measure. The assessment by Resources for the Future of the enhanced inspection and maintenance programme in Arizona (CS26) is one of the rare examples of such comparisons, concluding that the ex-ante estimates of the costs of achieving the forecasted emission reductions were underestimated. Another assessment by James Hammitt (CS30) of the cost of CFC phase-out found mixed evidence: while some ex-ante assessments substantially overestimated the marginal costs of limiting CFC consumption, others modestly underestimated this cost.[6]

II. For the second point, the small amount of studies comparing directly the results of ex-ante and ex-post analysis prevents us from inferring specific conclusions regarding the relationship between ex-ante and ex-post CEAs. What can be said, however, is that an ex-post CEA will be much easier to perform in cases where an ex-ante assessment has been carried out:

- Certain points that are crucial for a successful ex-post CEA will have been clarified in cases where an ex-ante assessment has been carried out. This includes clearly defined and quantified targets for a policy intervention, a baseline scenario, and a timetable for achieving the targets.
- Carrying out an ex-ante assessment presents an opportunity to formulate at an early stage the questions that should later be addressed in the ex-post CEA. This means that monitoring and reporting requirements can be designed accordingly, meeting the data needs of an ex-post CEA.

[6] A 1999 study published by the Stockholm Environment Institute, "Costs and Strategies presented by Industry during the Negotiations of Environmental Regulations" (CS9), was not considered in detail in this project: while the study did compare ex-ante and ex-post estimates of costs, it did not relate to these to the effectiveness or measures or compare their cost-effectiveness.

4 Recommendations and possible follow-up Activities

One main objective of this study has been to derive recommendations for potential follow-up activities to be implemented by the EEA; these are discussed in chapter 4.3 below. In addition, policy recommendations were derived regarding the use of project results for the impact assessment procedure at the EU Commission (chapter 4.1), as well as the implementation and evaluation of existing EU environmental legislation (chapter 4.2).

4.1 Ex-post CEAs and the Commission's Impact Assessment Procedure

The results of this project have implications for the trend in European environmental policy towards more and better assessment of the impacts of policies, both ex-post and ex-ante. At the same time, policy evaluation is clearly not a goal in and of itself, but has to serve a specific purpose. Considering the time and resources that flow into evaluation exercises like an ex-post cost-effectiveness analysis, it is clear that the expenses will be justified only if the results of the analysis have a practical impact on policy making. Thus, the evaluation of policies becomes a useful tool once the results feed back into the policy process: be it for the further implementation of the same policy, or for future policy initiatives in a related field.

One of the main processes where cost-effectiveness considerations may play a role is the (Sustainability) Impact Assessment - (S)IA. At its Gothenburg summit in 2001, the European Council decided that an ex-ante sustainability impact assessment should be carried out for all major policy proposals, thereby establishing these assessments as a cornerstone for the coherent implementation of the EU Sustainable Development Strategy. With its communication (COM 2002/276). the European Commission developed a highly comprehensive approach to impact assessment. One motive behind the current initiatives in the EU is the establishment of more efficient and "leaner" decision-making procedures.

The relation between impact assessments (such as (S)IAs) and ex-post assessments (including cost-effectiveness analyses) is ambivalent. Different types of interactions can be conceived of:

- Ex-post assessments can be used to follow up on ex-ante appraisals, and to put their role into perspective. Ex-post appraisals can be employed to assess whether the predicted costs or the expected impacts have actually been incurred, or to reveal where they have been clearly under- or overstated. In the medium term, this information can be used to improve the quality of ex-ante appraisals, by revealing the crucial influence of particular assumptions or methodological choices.
- At the same time, the comparison with ex-post analyses could also help to better define the role of impact assessments in the policy making process, showing their usefulness and their limitations. Also, if it is clear from the outset that an (S)IA will be re-evaluated at a later stage, this could give an extra incentive to carry out the assessments more thoroughly, eliminating the likelihood that (S)IAs are drawn up in before a decision is taken, but never re-considered afterwards.
- It is also possible that the existence of ex-post evaluation and monitoring requirements will reduce the burden placed on ex-ante appraisals. Where it is clear from the outset that the performance and the cost-effectiveness of a policy will be re-evaluated during the implementation, the requirements for an ex-ante assessment of all expected impacts may become less strict.
- At the same time, strengthening the link between ex-ante and ex-post assessments can also make both more effective: in this sense, the ex-ante impact assessment should comprise a list of issues that should later be addressed through an ex-post assessment, including the cost-effectiveness of

measures taken.[7] This is of particular relevance for the data collection – a recurring problem for an ex-post analysis is that necessary data on impacts and expenditure is not available. An ex-ante appraisal would be well suited to identify the data needs that have to be collected during the implementation phase, as many of the questions later to be answered through the ex-post assessment will also be raised during the ex-ante appraisal. Such an initiative should consider the "Monitoring and Evaluation" requirement of (S)IAs as formulated in the guidance documents for Commission impact assessment (European Commission 2002, European Commission undated (G33)). A review conducted by the Institute for European Environmental Policy (IEEP 2004) concludes that "Almost all IAs make some reference to monitoring procedures [...]. However, few specifically address the question of what specific data is required to assess the impact of measures." Thus, (S)IAs could not only be used to already identify data needs, but ex post CEAs could also reinforce the monitoring and evaluation as required by (S)IAs.

- Better integration of ex-ante appraisal and ex-post evaluation will also mean that the ex-ante assessment may take on a different form and focus. It would be expected that the assessment could become more action-oriented, identifying weak points and bottlenecks that are crucial for the implementation, and thereby also setting the focus for an ex-post analysis. In other words, the assessment would be less of a conclusive judgement on which option is or is not worth pursuing, but would rather specify the conditions under which an option is preferable.

However, if a stronger integration between ex-ante appraisal and ex-post evaluation is pursued, two main caveats should be considered:

- Uncertainty – both ex-ante and ex-post assessment have to deal with uncertainty to a degree., where the former has the problem of predicting realistic impacts, the latter has the problem of relating the observed impacts to individual measures and initiatives. In this sense, both are limited, and it is not necessarily possible to prove the ex-ante appraisal wrong with the benefit of hindsight.
- Scaling and agency – whereas the sustainability impact assessments are carried out on the EU level and by the Commission, ex-post assessments for many Directives would be carried out on Member State level, and by national administration officials. This means that the scale of the analysis will be different, affecting also the level of detail at which information is obtained; and this means that the questions initially identified by the Commission may not be equally applicable to all Member States.

4.2 Regarding the Evaluation of existing EU Environmental Legislation

The main findings of this project – a diversity of approaches followed in real-life CEAs, and a lack of guidance targeted specifically at ex-post CEA – are clearly relevant for the implementation and evaluation of those Directives that require an ex-post evaluation, including cost-effectiveness aspects. For these four Directives identified in Chapter 2.1, the first round of evaluation is either underway or will be carried out in the coming year, highlighting the need for specific guidance and good-practice examples of ex-post CEAs.

At the same time, the findings of this project are also relevant for the implementation of other Directives identified in this study, which either provide for an ex-ante cost-effectiveness analysis or which require ex-post reporting of effectiveness in a broader sense. In both these cases, findings

[7] In fact, such a requirement exists for impact assessments conducted by the European Commission, but is not always followed up on in the assessments carried out so far.

related to the methodology and practice of ex-post CEAs, including specific guidance, can provide important inputs.

I. In policy areas where an ex-ante CEA is required: To support the learning from policy implementation, it seems advisable to re-consider the results of such an ex-ante analysis during and after the implementation, in order to see if the ex-ante analysis succeeded in assessing expected impacts, and if the judgement made regarding the most cost-effective solution was indeed correct. Such knowledge can be a valuable input for the further implementation process, or for other subsequent policy initiatives in the same field.

   The Water Framework Directive provides an example of this. The WFD requires programmes of measures to be drawn up in order to reach good ecological status in all water bodies by 2015. The selection and combination of measures shall be guided *inter alia* by cost-effectiveness considerations. It is foreseen that the programme of measures will be adapted and revised at six-year intervals, repeating the cost-effectiveness analysis for the selection of potential measures. Although there is no formal requirement to do so, it seems highly advisable to base the selection of measures after 2015 on an assessment of how far the judgements made in the first planning cycle regarding the cost-effectiveness of measures were indeed correct. To this end, an ex-post analysis would be necessary to assess the extent to which the planned objectives have actually been reached, and if not, then why not. Similar arguments can be made for other Directives that are implemented over a longer time period and with more than one implementation and reporting cycle.

II. The second possible application concerns those Directives that mandate an ex-post evaluation of the policies' performance or effectiveness, but do not explicitly require a cost-effectiveness analysis. However, even a loose evaluation that does not qualify as a CEA in the proper sense will often involve a qualitative description of cost-effectiveness, or an unrelated juxtaposition of information on costs and on effects. With some guidance and better data, such assessments could be developed further towards a CEA. Here, it needs to be assessed whether the evaluation would benefit from giving a greater weight to cost-effectiveness considerations, e.g. by making the evaluation more stringent and more coherent.

Regarding the actual ex-post assessments that will eventually be carried out – be they fully fledged ex-post CEAs or other types of evaluations involving cost-effectiveness – it should be considered that this study only provides a first scoping of the available evidence. As many of the Directives requiring an ex-post evaluation of (cost-)effectiveness are still in their first reporting period, the number of ex-post evaluations carried out both at the EU and the Member State level will increase in the near future.

This raises the question of how the assessments themselves will be assessed: what constitutes a successful assessment, and how can the value of an assessment for subsequent policy making be assessed? In this context, it also needs to be established which institutions will be responsible for reviewing assessments, and how the results of assessments will flow back into the policy making process.

As previously mentioned, there are notable differences between individual Member States when it comes to evaluating the (cost-)effectiveness of environmental and other policies. Judging by the number of case studies and guidance documents surveyed in this study, systematic and institutionalised procedures for evaluation and appraisal would appear to be furthest developed in the UK and in the Netherlands, supported by cross-cutting requirements to evaluate the performance and cost-effectiveness of major policy initiatives (see also box on p. 7). This observation is also supported by Virani (1998), who surveyed the use of economic evaluation methods for environmental policies in several European countries. For those European Directives that require Member States to report on

cost-effectiveness, it can be expected that the capacity and experience built up will also be reflected in the quality of the assessments (e.g. Directive 2000/60 (WFD), Directive 2002/30 (noise-related operating restrictions at Community airports) and Directive 2004/8 (Cogeneration)).

4.3 Possible Follow-up Activities by the European Environment Agency

Based on the findings of this study we conclude that potential further activities by the European Environment Agency in the area of ex-post CEAs should concentrate on providing appropriate guidance for their application:

- In their thematic scope, most guidance documents reviewed in this study are either too wide or too narrow – either explaining how to assess the performance of each and every policy initiative, or applicable to the implementation of one particular Directive only.
- In terms of assessment methods, there is little guidance specifically targeted at cost-effectiveness analysis. Instead, most guidance documents treat CEA as one (minor) point next to cost-benefit or multi-criteria analysis, or even present it as an inferior alternative to a CBA.
- Regarding the timing, most guidance documents are geared towards ex-ante assessments, treating ex-post analyses as a special case if at all. There are some guidance documents on ex-post evaluation in a broader sense (e.g. G 8, 36, 39, 44), which also mention cost-effectiveness as one criterion and explain the concept. However, these documents provide insights, but no hands-on guidance on how to conduct an ex-post CEA, which would lead us to conclude that there is no specific guidance for ex-post cost-effectiveness analyses.

These findings suggest that there is a need for a specific guidance document on how to conduct ex-post CEAs for environmental policy measures. Based on the outcomes of this project, such a guidance document should have the following properties:

Format of the guidance document

A **clearly structured guidance document** on performing cost-effectiveness analysis for environmental policy in the EU, with **appendices relating to different policy areas or Directives**, and with **clear pointers to further information** on certain aspects of the process if required, rather than attempting to be fully comprehensive.

For this format, a **web-based implementation** with links to good practice examples, in-depth guidance for particular aspects, downloadable checklists etc. would seem most suited.[8] The web-based PANACEA database developed for this project could serve as a starting point for such an application.

Focus of the guidance document

The guidance document should have a **clear focus on the application of CEA for the ex-post evaluation of environmental policies**. The current and future Directives requiring ex-post assessment of cost-effectiveness would clearly be a starting point, as would be the follow-up evaluation of Sustainability Impact Assessments carried out by the European Commission. In specifying the level of

[8] Some of the manuals and guidelines discussed in this report have such web-based interfaces, however with much less detail and interconnections than suggested here. This includes HM Treasury Green Book (G8) at http://greenbook.treasury.gov.uk/, the eftec/DETR Review of Technical Guidance on Environmental Appraisal (G25) at http://www.defra.gov.uk/environment/economics/rtgea/, or the DG Regional Policy Guide on Evaluation of Socio-Economic Development (G27) at http://www.evalsed.info/frame_about.asp.

detail for the proposed guidance document, there is an obvious yet unavoidable trade-off: parts of a CEA will necessarily be complex and technical, at the same time the guidance also needs to be understandable and useful for non-economists and practitioners in the administration. A practical guideline will therefore need to skip some of the more complex aspects, or move them to an annex. [9]

Approach of the guidance document

Above all, the guidance document needs to embody a **pragmatic approach**. There is sufficient guidance to explain the theoretical foundations and to elaborate the requirements for an ideal prototype CEA, the US EPA Guidelines for Preparing Economic Analyses (GS9) being the most developed guideline in this regard. However, a practice-oriented guideline should not only be theoretically comprehensive, but should also consider the likelihood of data gaps and other practical difficulties in conducting analysis, and should make practical recommendations for dealing with these limitations. Rather than describing a prototype CEA, it should also explain which simplifications and shortcuts are justifiable under which conditions, and how this will affect the quality of the results.

A guidance document of this type should also help practitioners to determine **how much effort to put into an ex-post evaluation**. Although a CEA is generally less of a strain on time and resources than other appraisal types, a fully fledged CEA can still require substantial inputs of manpower and resources, especially in order to assess the effects of the investigated measures. In order to cope with limited administrative capacities, a targeted and proportional approach may be called for, whereby the complexity of the analysis is adjusted depending on the complexity of the decision situation, e.g. through an initial screening. How this can be achieved in a methodologically sound way would need to be explained in the guidance document.

Practical impact of the guidance document

Next to providing methodological guidance, a guidance document should also provide recommendations on how the results of an ex-post cost-effectiveness analysis can feed back into the policy making process, and how the political impact of results can be enhanced.

- Above all, this concerns the **clarity, brevity and the structuring of information** for the reader's benefit. This is especially appropriate where the output of the analysis is targeted at a non-economic audience, or where it is presented as part of a public participation process. Some of the guidelines surveyed in this project contain such recommendations on how to present results, e.g. HM Treasury Green Book (G8) or the European Commission Handbook for Impact Assessments (G33). However, the majority of case studies summarised in this study are rather targeted at an academic audience, and are therefore difficult to digest for a non-specialist reader.
- Another point concerns the **optimal timing of the assessment** in the policy making process. On the one hand, the analysis has to take place long enough after the policy intervention to observe an effect, which may take several years in the case of environmental policy measures. On the other hand, it also has to take place early enough to have an influence on possible follow-up measures, or the decision on (dis-)continuing the measure. The set of case studies analysed in this study are inconclusive in this regard: while several of them were supposed to feed into a specific policy

[9] An alternative would be to develop the guidance in two parts: a summarised guidance for the administration officials commissioning the assessment, and a more detailed and technical guidance for those carrying out the actual analysis.

process, there is no indication of the actual impact these studies may have had. Other studies were written for informative purposes rather, unrelated to a specific future policy process.

Possible extensions to the guidance document

An additional feature of the guidance document would be to **introduce different types of assessment methods**, and to support the choice among these. This would take the form of a checklist, indicating in which cases cost-effectiveness analysis is the appropriate, necessary or sufficient evaluation method, and in which cases other methods (such as cost-benefit analysis, multi-criteria analysis or semi-quantitative screening methods) are preferable.[10] The impression arising from this project is that currently there is no systematic approach regarding the choice of evaluation methods for EU environmental policy. The feature of choosing between different evaluation methods would become all the more relevant if the scope of the guidance were extended to include Directives requiring an ex-post evaluation of effectiveness in general, rather than ex-post CEA only (see 4.2 above).

Another possible extension concerns the further development of the PANACEA database: first of all, PANACEA could be developed further into a portal for the guidance document as described above, linking the guidance elements to data base entries. Secondly, the PANACEA database could be updated continuously, as more ex-post assessments of European environmental policy become available. In this way, the database can be developed into a reference inventory for assessments carried out in response to EU Directives, including assessments carried out on the Member State level.

[10] Some information on this can be expected from the ongoing FP6 project "Sustainability A-Test". However, since one of the objectives of Sustainability A-Test is to support the ex-ante sustainability impact assessments carried out by the European Commission, ex-post evaluation does not feature prominently in the project.

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