

## **Cost-effectiveness of environmental policies**

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

Specific Agreement No 3475/B2004.EEA

Final Report, April 2005

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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<sub>2</sub> 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 dividing 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 CO<sub>2</sub>-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;<sup>1</sup>
- 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.

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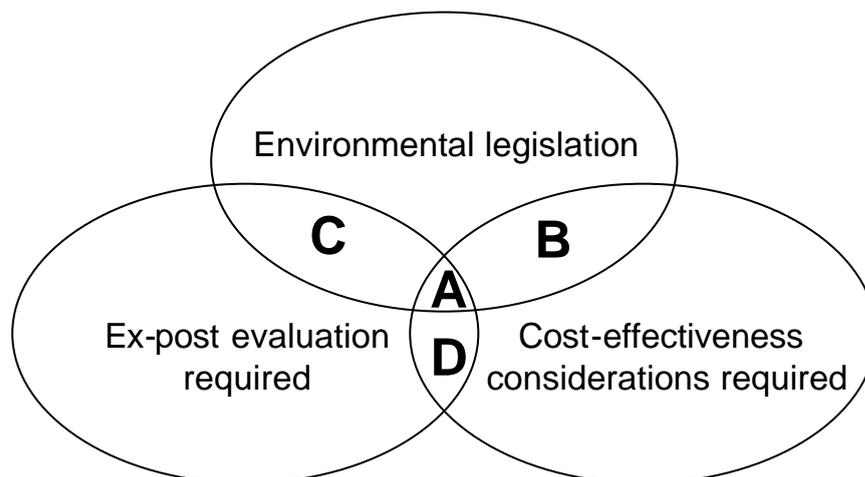
<sup>1</sup> Regarding the consultations with the EEA national focus points and subsequent contacts, the authors would like to thank the following people for their support: Jan Voet (Belgium), Tapani Saynatkari and Marjukka Porvari (Finland), Denise Juin (France), David Lee (UK), Gerard O’Leary (Ireland), 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	<i>CEA and Developing a Methodology for Assessing Disproportionate Costs</i> (2004)	WFD	UK	Risk and Policy Analysts Ltd / DEFRA and UK Environment Agency	CEA & CBA		X	X
G3	<i>Guidelines for Defining and Documenting Data on Costs of Possible Environmental Protection Measures</i> (1999)	Environment general	EU	European Environment Agency / no client	Neither			X
G8	<i>The Green Book: Appraisal and Evaluation in Central Government</i> (2003)	General	UK	UK Treasury / no client	CBA & CEA	X	X	X
G9	<i>Guidelines for Preparing Economic Analyses</i> (2000)	Environment general	USA	US Environment Protection Agency. / no client	CBA & CEA	(X)	X	X
G12	<i>Basic Principles for Selecting the most Cost-Effective Combinations of Measures as Described in Article 11 of the Water Framework Directive HANDBOOK</i> (2004)	WFD	Germany	Ecologic / German Federal Environment Agency	CEA		X	X
G14	<i>Economics and the Environment: the Implementation Challenge of the Water Framework Directive, Guidance Document</i> (2003)	WFD	EU	WATECO / no client	CEA		X	X
G18	<i>What Constitutes a Good Agri-Environmental Policy Evaluation?</i> (2004)	Agriculture	OECD	Pearce, David / no client	CEA & CBA	(X)	(X)	X
G20	<i>Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs</i> (1992)	General	USA	US Office of Management and Budget / no client	CBA & CEA		X	X
G21	<i>Guidelines for the Economic Analysis of Projects</i> (1997)	Development projects	Asian countries	Asian Development Bank / no client	CBA & CEA		X	X
G22	<i>Opportunities Envelope Guidelines for Proposals</i> (2004)	Climate Change	Canada	Government of Canada / no client	CEA		X	X
G24	<i>PEEM Guidelines 3 - Guidelines for cost-effectiveness analysis of</i>	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
	<i>vector control.</i> (1993)			Vector Control (PEEM), WHO / no client				
G25	<i>Review of Technical Guidance on Environmental Appraisal</i> (1999)	Environment general	UK	eftec / former UK DETR	CBA & CEA	X	X	X
G27	<i>Guide to Cost-Benefit Analysis of Investment Projects</i>	General	EU	Evaluation Unit, DG Regional Policy, EC / no client	CBA & CEA		X	
G29	<i>Cost-Effectiveness Analysis a Tool for UNESCO</i>	General	Inter-national	SPM consultants / UNESCO	CEA	X	X	X
G30	<i>DTLR Multi-Criteria Analysis Manual</i>	General	UK	former UK DETR/ no client	CBA, CEA & MCA		X	
G32	<i>Making Choices in Health: WHO Guide to Cost Effectiveness Analysis</i>	Health	Inter-national	World Health Organisation / no client	CEA		X	
G33	<i>A Handbook for Impact Assessment in the Commission: How to do an Impact Assessment</i>	General	EU	Strategic Planning and Programming unit, Secretariat-General, European Commission / no client	CBA, CEA & MCA	(X)	X	
G34	<i>Samfundsøkonomisk vurdering af miljøprojekter.</i>	Environment general	Denmark	Danish National Environmental Research Institute / no client	?	?	?	
G35	<i>Kosten en baten in het milieubeleid, definities en berekeningsmethoden</i>	Environment general	Netherlands	Dutch Ministry for Spatial Planning, Housing and the Environment (VROM) / no client	?	?	?	
G36	<i>Evaluating EU Activities</i>	General	EU	European Commission DG Budget / no client	CBA & CEA	X	X	
G37	<i>A Framework for Evaluating Environmental Policy Instruments</i>	Environment general	Finland	Mickwitz, Per / no client	CBA & CEA	X	X	
G38	<i>Kosteneffectiviteit natuurbeleid: Methodiekontwikkeling</i>	Environment general	Netherlands	Rijksinstituut voor Volksgezondheid en Milieu (RIVM) / no client	CEA	X		
G39	<i>Evaluating EU expenditure programmes: A guide: ex post and intermediate evaluation</i>	General	EU	European Commission DG Budget / no client	CBA & CEA	X		
G40	<i>Ex-ante Evaluation: a Practical Guide for Preparing Proposals for Expenditure Programmes</i>	General	EU	European Commission DG Budget / no client	CBA & CEA		X	X
G43	<i>Ympäristöpolitiikan Taloudellisten Vaikutusten Arviointi (Economic</i>	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
	<i>Assessment of Environmental Policy)</i>			/ no client				
G44	<i>Wegwijzer Evaluatieonderzoek ex post</i>	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 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	Beamont, 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 CO <sub>2</sub> -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.<sup>2</sup> 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

<sup>2</sup> 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,<sup>3</sup> 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.<sup>4</sup> 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).

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<sup>3</sup> 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.

<sup>4</sup> 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.<sup>5</sup>

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.

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<sup>5</sup> 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.<sup>6</sup>
- 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.

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<sup>6</sup> 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.<sup>7</sup> 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

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<sup>7</sup> 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.<sup>8</sup> 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

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<sup>8</sup> 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 etec/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.evaled.info/frame\\_about.asp](http://www.evaled.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.<sup>9</sup>

### **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

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<sup>9</sup> 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.<sup>10</sup> 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.

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<sup>10</sup> 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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## Annex 1 Overview: CEA and ex-post evaluation in EU legislation

<i>Legislative item</i>	<i>Article</i>	<i>Requirement</i>	<i>Addressee and deadline</i>	<i>Ex-post</i>	<i>Remarks</i>	<i>Guidance documents</i>	<i>Assessments carried out</i>
Regulation 1164/94 (Cohesion Fund)	13	Evaluate the manner in which projects have been carried out and the potential and actual impact of their implementation in order to assess whether the original objectives can be, or have been, achieved. This evaluation shall, inter alia, address the environmental impact of the projects. Detailed rules for monitoring and evaluation shall be laid down in the decisions approving projects.	Commission and beneficiary Member States, during implementation of projects and after completion	Yes	No explicit mentioning of cost-effectiveness	Guide to cost-benefit analysis of investment projects	See Cohesion Fund Annual Report 2002 (COM(2003)697)
Directive 98/69 (Air pollution by emissions from motor vehicles)	3.3	Evaluate the provisions of the Directive, examination of the contribution to cost-effectiveness, including an evaluation of the benefits and availability of enhanced technology	Commission, no specific date provided				Although it is not directly aimed at the provision of the Directive, the CEA of the Auto-Oil II programme is of relevance.
Regulation 1260/1999 (General provisions on the Structural Funds)	43	Ex-post evaluation covering the utilisation of resources and the effectiveness and efficiency of the assistance and its impact	Commission, in collaboration with the Member State and the managing authority, 31.12.2009	Yes		Guide to cost-benefit analysis of investment projects	See <a href="http://europa.eu.int/comm/regional_policy/sources/docgener/evaluation/evaluation_en.htm">http://europa.eu.int/comm/regional_policy/sources/docgener/evaluation/evaluation_en.htm</a>
Regulation 1267/1999	Annex	Evaluate (ex-post) the utilisation of resources and the	Commission and beneficiary	Yes		Guide to cost-benefit analysis of	Evaluation report on ISPA's predecessor



<b>Legislative item</b>	<b>Article</b>	<b>Requirement</b>	<b>Addressee and deadline</b>	<b>Ex-post</b>	<b>Remarks</b>	<b>Guidance documents</b>	<b>Assessments carried out</b>
(Instrument for Structural Policies for Pre-Accession (ISPA))	IV	effectiveness and efficiency of assistance and its impact. The evaluation will, inter alia, address the contribution made by measures to the implementation of Community policies on the environment or to the contribution of trans-European networks and common transport policies, and they will also assess the environmental impact of the measures.	countries, after completion of the measures			investment projects	Phare is available
Directive 2000/60 (Water Framework Directive, WFD)	Article 11 and Annex III	In the economic analysis, judgements need to be made about the most cost-effective combination of measures in respect of water uses to be included in the programme of measures under Article 11 based on estimates of the potential costs of such measures	Member States, Programme of measures by 2009, revised in 2015 and 2021			Common Implementation Strategy for the WFD, Guidance Document No. 1 (Economics and the Environment).	No
Directive 2000/69 (Benzene and carbon monoxide in ambient air)	8.2	Report on the experience acquired in the application of the Directive, taking into account (a.o.) the cost-effectiveness of making further reductions to polluting emissions	Commission, 31.12.2004			No	No
Regulation 1655/2000 (Financial Instrument for	12	Report on the implementation of the Regulation, its contribution to the development of Community environmental policy, and the use	Commission, 30.09.2003	Yes	No specific requirement to evaluate cost-effectiveness	No	Mid-term review, November 2003 (COM(2003)668)



<b>Legislative item</b>	<b>Article</b>	<b>Requirement</b>	<b>Addressee and deadline</b>	<b>Ex-post</b>	<b>Remarks</b>	<b>Guidance documents</b>	<b>Assessments carried out</b>
the Environment (LIFE))		made of the appropriations					
Decision 2850/2000 (Community framework for cooperation in the field of marine pollution)	5	Evaluate the implementation of the framework for cooperation	Commission, 28.12.2003 and 28.12.2006	Yes	No specific requirement to evaluate cost-effectiveness	No	An evaluation has been carried out, which does not contain an explicit CEA
Directive 2001/77 (Promotion of electricity produced from renewable energy sources in the internal electricity market)	4.2	Report on experience gained with the application and coexistence of the different support mechanisms, taking into account (a.o.) their cost-effectiveness	Commission, 27.10.2005	Yes		No	No
Directive 2001/80 (Large combustion plants)	4.7(c)	Report on cost-effectiveness and costs and advantages of further emission reductions in the combustion plants sector in Member States compared to other sectors	Commission; 31.12.2004			No	Interim report of the preparation for the review of June 2004
Directive 2001/81 (National Emission)	9.1	Report on the implementation of the national emission ceilings, including (a.o.) cost-effectiveness	Commission; 2004 and 2008	Yes		No	Ex ante CEA has been conducted



<b>Legislative item</b>	<b>Article</b>	<b>Requirement</b>	<b>Addressee and deadline</b>	<b>Ex-post</b>	<b>Remarks</b>	<b>Guidance documents</b>	<b>Assessments carried out</b>
Ceilings)							
Directive 2002/3 (Ozone in ambient air)	11.2(a)	Report on the application of the Directive, taking into account the broad scope for making further reductions in polluting emissions across all relevant sources, taking account of technical feasibility and cost-effectiveness	Commission, 31.12.2004			No	No
Directive 2002/30 (Rules and procedures with regard to the introduction of noise-related operating restrictions at Community airports)	5.1 and Annex II, point 3.2	When considering a decision on operating restrictions, (a.o.) an assessment of the cost-effectiveness should be taken into account; the assessment should take into account the socio-economic effects of the measures on the users of an airport	Member States, before making a decision on operating restrictions			No	No
Directive 2002/49 (Assessment and management of environmental noise)	11.3	The selection of strategies and measures the Commission may propose should be determined by the reduction of harmful effects and the cost-effectiveness ratio	Commission, 18.07.2009			No	No
Directive 2002/59 (Community vessel traffic monitoring and information)	26	Ascertain whether and to what extent the provisions of the Directive are helping to increase the safety and efficiency of maritime transport and prevent	Commission, 05.08.2007 and 30.06.2010	Yes	Doubtful whether 'efficiency' in this case relates to cost-effectiveness	No	No



<b>Legislative item</b>	<b>Article</b>	<b>Requirement</b>	<b>Addressee and deadline</b>	<b>Ex-post</b>	<b>Remarks</b>	<b>Guidance documents</b>	<b>Assessments carried out</b>
system)		pollution by ships			(in environmental terms)		
Directive 2003/30 (Promotion of biofuels and other renewable fuels)	4.2	Report on, inter alia, the cost-effectiveness of measures taken by Member States to promote the use of biofuels or other renewable fuels	Commission, 31.12.2006	Yes		No	No
Regulation 2152/2003 (monitoring of forests and environmental interactions - Forest Focus)	18	Submit a report on the implementation of the scheme, reviewing its effectiveness	Commission (assisted by the EEA), 30.06.2006	Yes	No specific requirement to evaluate cost-effectiveness	No	No
Directive 2004/8 (Cogeneration)	7.3	Evaluate (ex-post) the success, including cost-effectiveness, of support systems in promoting the use of high-efficiency cogeneration	Commission, 21.02.2008 and every four years thereafter	Yes		No	No
Directive 2004/8 (Cogeneration)	Annex IV	Analyse the national potential for high-efficiency cogeneration including an assessment, in terms of energy savings, of the cost-effectiveness of increasing the share of high-efficiency cogeneration in the national energy mix	Member States, 21.02.2007 and every four years thereafter			No	No

## **Annex 2 Effectiveness assessment provisions in international environmental treaties and conventions to which the EU is a party**

### **Convention on the Protection of the Rhine**

Art. 8

To achieve the aims set out in Article 3 the Commission shall accomplish the following tasks:

- (d) **evaluate the effectiveness of the actions decided upon**, notably on the basis of the reports of the Contracting Parties and the results of the measuring programmes and studies of the Rhine ecosystem;

### **Agreement for Cooperation in Dealing with Pollution of the North Sea by Oil and other Harmful Substances**

Art. 14

It shall be the duty of meetings of the Contracting Parties:

- (b) to **review the effectiveness of the measures taken** under this Agreement

### **Cooperation Agreement for the Protection of the Coasts and Waters of the North-East Atlantic against Pollution**

Art. 17

Meetings of the Parties shall be responsible for:

- (b) regular **examination of the effectiveness of measures taken** pursuant to this Agreement;

### **Convention for the Protection of the Marine Environment of the North-East Atlantic**

Art. 6

The Contracting Parties shall, in accordance with the provisions of the Convention, in particular as provided for in Annex IV:

- (b) include in such assessments both an **evaluation of the effectiveness of the measures taken** and planned for the protection of the marine environment and the identification of priorities for action.

Art. 10

2. It shall be the duty of the Commission:

(b) generally to **review** the condition of the maritime area, **the effectiveness of the measures being adopted**, the priorities and the need for any additional or different measures;

### **Convention on the Protection and Use of Transboundary Watercourses and International Lakes**

Art. 9

2. The agreements or arrangements mentioned in paragraph 1 of this article shall provide for the establishment of joint bodies. The tasks of these joint bodies shall be, inter alia, and without prejudice to relevant existing agreements or arrangements, the following:

(d) To elaborate emission limits for waste water and **evaluate the effectiveness of control programmes**;

Art. 11

3. The Riparian Parties shall, at regular intervals, **carry out joint or coordinated assessments** of the conditions of transboundary waters and **the effectiveness of measures taken** for the prevention, control and reduction of transboundary impact. The results of these assessments shall be made available to the public in accordance with the provisions set out in article 16 of this Convention.

### **Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Persistent Organic Pollutants**

Art. 10

3. The Parties shall, at sessions of the Executive Body, **review the sufficiency and effectiveness of the obligations** set out in the present Protocol.

### **Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Heavy Metals**

Art. 10

3. The Parties shall, at sessions of the Executive Body, **review the sufficiency and effectiveness of the obligations** set out in the present Protocol.

### **United Nations Framework Convention on Climate Change**

Art. 7

2. The Conference of the Parties, as the supreme body of this Convention, shall keep under regular review the implementation of the Convention and any related legal instruments that the Conference of

the Parties may adopt, and shall make, within its mandate, the decisions necessary to promote the effective implementation of the Convention. To this end, it shall:

- d) **Promote and guide**, in accordance with the objective and provisions of the Convention, **the development and periodic refinement of comparable methodologies**, to be agreed on by the Conference of the Parties, inter alia, for preparing inventories of greenhouse gas emissions by sources and removals by sinks, and **for evaluating the effectiveness of measures** to limit the emissions and enhance the removals of these gases;

### **Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal**

Art. 15

7. The Conference of the Parties shall undertake three years after the entry into force of this Convention, and at least every six years thereafter, **an evaluation of its effectiveness** and, if deemed necessary, to consider the adoption of a complete or partial ban of transboundary movements of hazardous wastes and other wastes in light of the latest scientific, environmental, technical and economic information.

### **International Tropical Timber Agreement**

Art. 25

2. The Council, in approving pre-projects and projects, shall take into account:

- (f) Their **cost-effectiveness**;

### **Convention on Biological Diversity**

Art. 21

3. The Conference of the Parties shall review the **effectiveness of the mechanism established under this Article**, including the criteria and guidelines referred to in paragraph 2 above, not less than two years after the entry into force of this Convention and thereafter on a regular basis. Based on such review, it shall take appropriate action to improve the effectiveness of the mechanism if necessary.

### **Cartagena Protocol on Biosafety to the Convention on Biological Diversity**

Art. 35

The Conference of the Parties serving as the meeting of the Parties to this Protocol shall undertake, five years after the entry into force of this Protocol and at least every five years thereafter, **an evaluation of the effectiveness of the Protocol**, including an assessment of its procedures and annexes.

## Stockholm Convention on Persistent Organic Pollutants

### Art. 13

8. The Conference of the Parties shall **review**, not later than its second meeting and thereafter on a regular basis, **the effectiveness of the mechanism established under this Article**, its ability to address the changing needs of the developing country Parties and Parties with economies in transition, the criteria and guidance referred to in paragraph 7, the level of funding as well as the effectiveness of the performance of the institutional entities entrusted to operate the financial mechanism. It shall, based on such review, take appropriate action, if necessary, to improve the effectiveness of the mechanism, including by means of recommendations and guidance on measures to ensure adequate and sustainable funding to meet the needs of the Parties.

### Art. 16

1. Commencing four years after the date of entry into force of this Convention, and periodically thereafter at intervals to be decided by the Conference of the Parties, the Conference shall **evaluate the effectiveness of this Convention**.
2. In order to facilitate such evaluation, the Conference of the Parties shall, at its first meeting, initiate the establishment of arrangements to provide itself with comparable monitoring data on the presence of the chemicals listed in Annexes A, B and C as well as their regional and global environmental transport. These arrangements:
  - (a) Should be implemented by the Parties on a regional basis when appropriate, in accordance with their technical and financial capabilities, using existing monitoring programmes and mechanisms to the extent possible and promoting harmonization of approaches;
  - (b) May be supplemented where necessary, taking into account the differences between regions and their capabilities to implement monitoring activities; and
  - (c) Shall include reports to the Conference of the Parties on the results of the monitoring activities on a regional and global basis at intervals to be specified by the Conference of the Parties.
3. The evaluation described in paragraph 1 shall be conducted on the basis of available scientific, environmental, technical and economic information, including:
  - (a) Reports and other monitoring information provided pursuant to paragraph 2;
  - (b) National reports submitted pursuant to Article 15; and
  - (c) Non-compliance information provided pursuant to the procedures established under Article 17

## Annex 3 Summaries of Manuals and Guidance Documents

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## RPA 2004: CEA and Developing a Methodology for Assessing Disproportionate Costs

REFERENCE INFORMATION: G2
Title: <i>CEA and Developing a Methodology for Assessing Disproportionate Costs</i>
Authors: Risk and Policy Analysts Ltd
Clients/Target audience: UK Department for the Environment, Food and Rural Affairs and UK Environment Agency - staff dealing with compliance with the Water Framework Directive (WFD)
Year of publication: 2004
Availability: <a href="http://www.defra.gov.uk/environment/water/wfd/economics/pdf/ceafreport.pdf">http://www.defra.gov.uk/environment/water/wfd/economics/pdf/ceafreport.pdf</a>
Country/ies: for UK Government, but relevant to all EU countries
The purpose: Internal document and guidance for a legal obligation - the economic assessment of potential measures to achieve good water status in compliance with the Water Framework Directive (UK's Article 5 Report for the WFD).
Policy area: Water
Details of legislation: Water Framework Directive (Directive 2000/60/EC). "Under the WFD, cost-effectiveness analysis (CEA) is to be used for assessing the relative performance of potential measures for achieving the environmental objectives set out in the Directive"
Policy measures discussed: measures to achieve "good status" for water quality
Type of analysis: Cross-measure comparison
Summary: The document contains many very specific details on tailoring cost-effectiveness analysis for the WFD (i.e. economic assessment of potential measures to reach good water status). "The aims of this document are to scope out and outline alternative methodologies for conducting cost-effectiveness analysis, to define a suggested methodology and identify appropriate cost and benefit information". The information resulting from analysis is to be fed into the UK's Article 5 report for the WFD. Questions answered include: (1) what is the least-costly set of measures that will ensure good water status (GWS)? (2) how much will it cost to reach GWS? (3) what is the likely economic impact of proposed measures on key economic sectors/water uses? (4) how will it be determined whether the costs of achieving GWS are considered to be disproportionate? Chapter summaries: (CH2) details related studies and activities. (CH3) addresses the proposed methodology, including a summary of the contents of the WATECO guidelines. Also mentioned are the problems that can be associated with CEA (e.g., the analysis may not reflect the full social costs, problems associated with multiple objectives): (CH4) the range of potential measures; (CH5) definition of costs (including a discussion of considering the economic viability of affected parties); (CH6) assessing effectiveness; and (CH7) managing uncertainty. The report suggests three alternative approaches: (1) perform a "financial cost" CEA; (2) perform an "economic cost" CEA and (3) cost-benefit analysis. It is repeatedly pointed out that measures may have benefits other than the meeting of the required targets which should also be taken account via the use of CBA for a full assessment.
METHODOLOGY
Definition of effectiveness: "Effectiveness is measured in terms of some physical measure of environmental outcome." Factors which should be considered when determining the definition of effectiveness include: (a) the characteristics of the water body; (b) the components of 'good status'; (c) the activities leading to the pressures and resultant failure to achieve good; and (d) issues surrounding timing of measures and their



ability to deliver good.
Definition of costs: "Cost" represents the estimated financial or economic costs of adopting a particular option to meet the specified target. Economic costs include: (a) the costs of complying with the requirements (including any savings in costs arising from the adoption of 'win-win' measures); (b) any welfare losses to consumers, including those arising from changes in product quality or availability (assessed in terms of changes in consumer surplus); (c) any environmental costs arising from the introduction of a measure (both water-related and non-water-related, such as habitat impact); (d) induced effects to the wider economy as a result of readjustments to changes in the affected industry sector; (d) transaction costs to industry and regulators associated with structural changes to systems, education and training, etc; and (e) the costs to government agencies in administering, monitoring and enforcing the requirements. Economic costs must provide the basis for the CEA or CBA in accordance with the UK Treasury's "Green Book".
Definition of cost-effectiveness: Cost-effectiveness is the "ratio that indicates the costs of achieving a per-unit change in a specified physical outcome". The alternative is to "determine the minimum cost of meeting a specified outcome". "The CEA would then be carried out to determine which option out of a set of competing options provides the least-cost approach to achieving a desired and pre-specified outcome."
Does the document mention ex-ante and ex-post assessment separately and if so, are the recommendations different for each?: By definition, this guidance only covers ex ante analysis
Stages of the cost-effectiveness methodology: The following stages are recommended for implementation at two different levels; water body and national level. Stages (1)-(4) are to be performed at national level: (1) overview the "pressures and impacts" of measures; (2) estimate costs in "qualitative, quantitative and monetary terms"; (3) predict potential effectiveness of measures; and (4) calculate cost-effectiveness. Step (5) involves repeating steps (1)-(4) at water body level and addressing water body specific issues. Finally: Stage (6) Assess uncertainty surrounding estimates of costs and effectiveness (7) perform a supplementary CBA.
Boundaries/scope: Application of CEA to WFD compliance. "The CEA should be conducted at the river basin level wherever possible. However, other factors will also determine the most appropriate scale - e.g. where water users are located". CEA should cover not only those measures which are within the Environment Agency's current implementary powers, but also measures which may require new legislation or which may call for voluntary action. Distributional impacts are touched upon in the report but not discussed in detail.
Objectives of analysis: WFD compliance: to develop a ratio that indicates the costs of achieving a per unit change in a specified physical outcome OR to determine the minimum cost of meeting a specified physical outcome. Another objective of the guidance is to help determine whether a package of measures is disproportionately expensive.
Definition of baseline: "A baseline scenario is to be taken as a 'projection' of business-as-usual policies and trends." The report recognises that the baseline may need to be redefined to take statutory measures into account.
Data collection and analysis: The possibility of decision support software including Data Envelope Analysis and multiple objective linear programming methods is discussed.
Models recommended: n/a
Methodological simplifications recommended: In order to implement CEA, it is assumed that the benefits of setting targets outweigh the (least) costs of achieving them. Otherwise, CBA will have to be implemented to compare costs and benefits of setting / achieving the targets.
Other guidelines / legislation etc. used or referred to: EU Legislation: measures to reduce non-agricultural diffuse pollution (expected to be introduced in 2005); new 10-20 year flood and coastal erosion strategy (2004/2005); EU marine strategy (2005); CAP Reform; implementation of Groundwater Daughter Directive and Priority Hazardous Substances Daughter Directive; revisions to the EU Bathing Water



Directive. Guidelines: WATECO.
<b>CONCLUSIONS/ EVALUATION</b>
Robustness and current relevance of the recommended approach: The document is a guide to performing cost-effectiveness analysis for the WFD rather than a general cost-effectiveness guide, and as such it contains lengthy digressions well beyond the scope of standard CEA/CBA considerations. Nonetheless, it does contain some information that is relevant to general CEA.
General key recommendations worth noting: At a minimum, the aim of the CEA should be to refine the programme of measures proposed for a given water body by focusing on the largest cost components and the major determinants of the effectiveness of measures. Estimates of financial costs should be made using calculation of the present value of capital and operating costs rather than calculation of the sum of annualized costs plus depreciation plus the cost of capital finance. The latter is the Environment Agency's currently preferred approach. The user should be aware that when the proposed option has more than one target objective (e.g. achieving benefits across more than one environmental end-point), the options may vary in their cost-effectiveness with regard to different targets
Key recommendations worth noting with regards to data collection and assumptions: Analysts should find out: (a) what data are currently available; (b) how difficult it will be to develop new data?; (c) whether there are costs associated with obtaining data; (d) timescale of data availability and (e) reliability of data. The use of electronic proformas for the collection of cost data, so that data can be readily extracted, would allow for consistent data collection. Pro-formas should take into account the costs of data collection and analysis and be simple, flexible, transparent and comprehensive. They should be tailored to sector and type of measure. The report makes the following recommendations to improve the collection of cost data: (i) allow stakeholders to provide three different types of cost data: verifiable, anecdotal and other; (ii) given that the data are likely to vary in quantity and quality across different respondents, a process for independent expert review is also likely to be required; (iii) sufficient detail of the environmental protection measure should be given to avoid ambiguity, to define its performance characteristics, and to clarify any special circumstances limiting applicability of the measure; (iv) it is essential that reported costs are defined: what is included, what is excluded, how they have been attributed or apportioned and also explained in physical terms such as quantity of materials, and as unit prices; and (v) there is an obvious need for a central source of data on the costs and effectiveness of these measures for use by Agency staff. (NB - some of these recommendations are taken directly from G3 below).



**EEA 1999: Guidelines for Defining and Documenting Data on Costs of Possible Environmental Protection Measures**

REFERENCE INFORMATION: G3
Title: <i>Guidelines for Defining and Documenting Data on Costs of Possible Environmental Protection Measures</i>
Authors: European Environment Agency
Clients/Target audience: Environmental policy data managers/collectors/documenters/originators in EEA and elsewhere
Year of publication: 1999
Availability: <a href="http://reports.eea.eu.int/TEC27/en">http://reports.eea.eu.int/TEC27/en</a>
Country/ies: EU countries
The purpose: General document seeking compatibility in regulatory cost reporting
Policy area: Environmental protection
Details of legislation: n/a
Policy measures discussed: Environmental protection measures
Type of analysis: Cross-country and cross-measure comparison
Summary: The document provides guidelines for the collection and management of data on the costs of environmental protection measures which could be used in CEA. Part 1 presents guidelines on defining and documenting data for single environmental protection measures. It outlines the minimum supporting information considered adequate to describe the cost of an environmental measure. Part 2 describes issues surrounding discounting, adjustment for inflation and accounting for price changes over the lifetime of a policy measure, along with good practice for documentation of such adjustment. There is also discussion of dealing with retrofit costs and interactions between measures.
METHODOLOGY
Definition of effectiveness: The document provides guidance on collating cost information for economic analysis, and as such does not detail the analysis itself.
Definition of costs: The guidelines are only concerned with direct compliance costs and states that "indirect costs should be excluded from the cost data".
Definition of cost-effectiveness: n/a
Does the document mention ex-ante and ex-post assessment separately and if so, are the recommendations different for each?: n/a
Stages of the cost-effectiveness methodology: n/a
Boundaries/scope: n/a
Objectives of analysis: n/a



Definition of baseline: The baseline is defined as the situation in which the environmental protection measure has not been implemented.
Data collection and analysis: This is the document's central concern - see recommendations.
Models recommended: n/a
Methodological simplifications recommended: n/a
Other guidelines / legislation etc. used or referred to: None.
<b>CONCLUSIONS/ EVALUATION</b>
Robustness and current relevance of the recommended approach: Could usefully inform on data collection and management for economic analysis.
General key recommendations worth noting: n/a
Key recommendations worth noting with regards to data collection and assumptions: The report makes several recommendations about data collection: (i) pollutant definitions and assumptions regarding scope of pollutant categories should always be given wherever there is any possibility of ambiguity; (ii) sufficient detail of the pollution source should be given to enable comparison with similar processes and to avoid ambiguity; (iii) sufficient detail of the environmental protection measure should be given to avoid ambiguity, to define its performance characteristics, and to clarify any special circumstances limiting applicability (also lifetime, side-effects); (iv) it is essential that reported costs are defined: what is included, what is excluded, how they have been attributed or apportioned. It is recommended that costs are also explained in physical terms such as quantity of materials, and as unit prices; (v) as a minimum, all data should have a background discussion of the key uncertainties related to the data; (vi) the year in which the following data apply should always be given: costs, currency exchange rates, description of control and process technologies (e.g. efficiency, applicability), and emissions to the environment; (vii) the sources and origins of all data should be recorded as precisely as possible so that data may be traced at a later date if necessary; (viii) as a minimum, any discount/interest rates used should be recorded; (ix) if cost data are adjusted for inflation or changes in price through time, then the adjustment method used should be recorded and any index used should be recorded and referenced and (x) if determining annual cost data, the approach which has been used to derive the annual costs should be recorded, along with all underlying assumptions.



**UK Treasury 2003: The Green Book: Appraisal and Evaluation in Central Government**

REFERENCE INFORMATION: G8
Title: <i>The Green Book: Appraisal and Evaluation in Central Government</i>
Authors: UK Treasury
Clients/Target audience: The UK civil service and other public sector bodies. The report states that "the Green Book will be useful for anyone required to conduct a basic appraisal or evaluation of a policy, project or programme"
Year of publication: 2003
Availability: <a href="http://www.hm-treasury.gov.uk/economic_data_and_tools/greenbook/data_greenbook_index.cfm">http://www.hm-treasury.gov.uk/economic_data_and_tools/greenbook/data_greenbook_index.cfm</a>
Country/ies: UK
The purpose: Public sector policy appraisal and evaluation with the objective of achieving efficient policy development and resource allocation across Government
Policy area: All
Details of legislation: n/a
Policy measures discussed: none specifically
Type of analysis: Most of the document addresses ex ante cross-measure CBA, but it is largely relevant for CEA as well. There is limited detail on ex post analysis.
Summary: The Green Book is a very general set of guidelines for policy appraisal and evaluation in the UK public sector, and as such it covers the whole policy appraisal and evaluation cycle including guidelines on the rationale for and feasibility of appraisals. Relevant chapters of the report include: (CH2) general discussion of the policy appraisal process; (CH4) setting objectives, targets etc.; (CH5) shortlisting options and estimating the costs and benefits of different options, discussion of distribution, adjusting for relative price changes and discounting, discussion of risk and uncertainty and consideration of non-monetised costs and benefits. (CH6) criteria for selecting the best option. Discussion of implementing solutions. (CH7) Application to policy evaluation Relevant appendices include: (A2) valuing non-market impacts; (A3) discussion of valuation of land and buildings; (A4) more detailed discussion of risk and uncertainty; (A5) distributional impacts and (A6) discount rate.
METHODOLOGY
Definition of effectiveness: Effectiveness is defined by the targets and objectives set. "Outcomes are the eventual benefits to society that proposals are intended to achieve ... But outcomes sometimes cannot be directly measured, in which case it will often be appropriate to specify outputs", or targets.
Definition of costs: "Relevant costs and benefits are those that can be affected by the decision at hand". "Costs should be expressed in terms of relevant opportunity costs". Costs and benefits can be split into those accruing to government (e.g. financial costs) and those accruing to society (economic costs). "Wider social and environmental costs and benefits for which there is [sic] no market price also need to be brought into any assessment". "Costs and benefits considered should normally be extended to cover the period of the useful lifetime of the assets encompassed by the options under consideration".
Definition of cost-effectiveness: Cost-effectiveness analysis is defined in the report as: "analysis that



compares the costs of alternative ways of producing the same or similar outputs".
Does the document mention ex-ante and ex-post assessment separately and if so, are the recommendations different for each?: Most of the document is a discussion of ex ante analysis, but Chapter 7 deals with ex post evaluation.
Stages of the cost-effectiveness methodology: The following stages of the CBA are given in the report: (1) Perform research (into relevant current and projected trends, whether the scope or magnitude of the problem is time-dependent, who the potential beneficiaries and disadvantaged are, etc.); (2) Set objectives and/or targets; (3) List options/identify the full range of policy instruments; (4) calculate benefits and costs and discount; (5) adjust benefits and costs according to distributional effects, optimism bias, risk etc.; (6) perform sensitivity analysis; and (7) select best option (option with lowest net present risk-adjusted cost for achievement of a given target).
Boundaries/scope: The document advises consideration of the full range of costs and benefits, including those external to markets. The affected population is "society" ("appraisals should take account of all benefits to the UK"). Discussion of distributional issues, affordability, capital flows and contingent liabilities are also included.
Objectives of analysis: Achievement of target at least cost (ex ante) OR compare actual outcome with that predicted (ex post)
Definition of baseline: The Green Book does not explicitly mention the formulation of a baseline case as an integral part of economic appraisal.
Data collection and analysis: The report does not contain specific guidance about data definitions and collection. However, it makes the following reference to other studies especially in terms of benefit assessment: "The results of previous studies may sometimes be used to estimate t
Models recommended: None.
Methodological simplifications recommended: None identified.
Other guidelines / legislation etc. used or referred to: Cabinet Office Strategy Unit Policy Hub
<b>CONCLUSIONS/ EVALUATION</b>
Robustness and current relevance of the recommended approach: This document represents the "first port of call" for anyone looking at CBA in the UK. There is less detail on CEA, but it is still of relevance to CEA.
General key recommendations worth noting: The report makes the following recommendations: (i) objectives and targets should be stated so that it is clear what proposals are intended to achieve. Targets should be should be specific, measurable, achievable, relevant and time-bound; (ii) for a major programme, a wide range [of options] should be considered before short-listing for detailed appraisal; (iii) where a number of expenditures or activities are linked together and the costs or benefits are mutually dependent, the proposal must be appraised as a whole; and (iv) adjust cost and benefit estimates for optimism bias (the noted tendency of appraisers to be overly optimistic) and risk, and perform a sensitivity analysis to account for uncertainty.
Key recommendations worth noting with regards to data collection and assumptions: The report recommends distinguishing between fixed, variable, semi-variable and step costs and avoiding spurious accuracy in data as well as in the CEA itself. The report recognises the relationship between the reliability of data and the importance of the analysis when it states: "confidence in the data used will need to increase depending on the importance or scale of the decision at hand". In the absence of an existing robust monetary valuation of an impact, the report recommends that the users decide whether to commission a new study. Where it is concluded that a research project to determine valuations is not appropriate, a central estimate, together with a maximum and minimum plausible valuation should be included



**US EPA 2000: Guidelines for Preparing Economic Analyses**

REFERENCE INFORMATION: G9
Title: <i>Guidelines for Preparing Economic Analyses</i>
Authors: US Environment Protection Agency.
Clients/Target audience: Target audience is "analysts in the economic analysis of environmental policies" in the US public sector.
Year of publication: 2000
Availability: <a href="http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/Guidelines.html">http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/Guidelines.html</a>
Country/ies: USA
The purpose: Generally available guidance for US public sector "on the preparation and use of sound science in support of the decision-making process". The document is not intended to provide a "rigid blueprint" for CEA or CBA.
Policy area: all environmental
Details of legislation: Executive Order 12866 "Regulatory Planning and Review", requiring analysis of benefits and costs for all significant regulatory actions. Others outlined in Chapter 2.
Policy measures discussed: Some discussion of different measures (e.g. taxes, marketable permits, subsidies) in Chapter 8.
Type of analysis: General - Cost-effectiveness analysis, cost-benefit analysis and economic impact assessment
Summary: This document provides very general but detailed guidance for anyone involved in economic assessment of environmental policy in the US. Relevant chapters are the following: (CH5) overview of economic analysis of environmental policy, including framework, baseline specification, analyzing uncertainty, sensitivity analysis, welfare considerations related to uncertainty and risk and cross-cutting issues such as tax interactions; (CH6) analysis of social discounting; (CH7) discussion of theory behind analysis of benefits (e.g., willingness to pay / willingness to accept compensation, market and non-market goods), different types of benefits (amenity, ecosystem services, etc.) and methods for valuation; (CH8) analysing social costs; (CH9) distributional analyses, economic impact assessment and profiling of affected entities and (CH10) application to decision-making, communication and presentation of results. This is the only set of guidelines reviewed which goes into detail on theoretical issues surrounding calculation of the social costs of regulation, e.g. consumer surplus, estimating elasticities, etc., and includes a discussion of partial and general equilibrium analysis.
METHODOLOGY
Definition of effectiveness: Gains in non-monetised benefits to be defined by the policy context.
Definition of costs: Costs are defined as "the sum of the opportunity costs incurred by society because of a new regulatory policy", i.e., the value of goods and services lost and reductions from output. There are five basic components to costs: (i) real-resource compliance costs; (ii) government regulatory costs; (iii) social welfare losses (losses in consumer and producer surplus); (iv) transitional costs (value of resources displaced because of regulation-induced reductions in production) and (v) indirect costs (reductions in productivity, innovation etc.).



<p>Definition of cost-effectiveness: The document states that "cost-effectiveness is calculated by dividing the annualised cost of the policy/option by its non-monetary benefit measures." Most other commentators would define the cost-effectiveness ratio the other way round.</p>
<p>Does the document mention ex-ante and ex-post assessment separately and if so, are the recommendations different for each?: Not mentioned separately</p>
<p>Stages of the cost-effectiveness methodology: The document lists the following stages: (1) identify potentially affected benefit categories by developing an inventory of the physical effects that may be caused/averted by the policies; (2) quantify significant physical effects; (3) identify costs according to the five categories of each policy and calculate them; and (4) divide (non-monetised) benefits (e.g. tons emissions reduced) by costs and identify the least-cost option.</p>
<p>Boundaries/scope: The guidance is relevant for "economic analyses typically conducted for environmental policies" and includes discussion of distributional concerns and equity.</p>
<p>Objectives of analysis: Assessing proposed policy measures. CEA is to be used when "many benefits are not easily monetized and when the statutes of other authorities dictate specific regulatory objectives"</p>
<p>Definition of baseline: The baseline is defined as "the world absent the policy or regulation".</p>
<p>Data collection and analysis: See data recommendations.</p>
<p>Models recommended: Discussion of Input-Output, linear programming and computable general equilibrium models for calculating social costs</p>
<p>Methodological simplifications recommended: "Given the complexity of modern economies, measuring and predicting all of the consequences of a particular action would involve a significant effort." Therefore a necessary simplifying assumption may be to omit analysis of some of the affected markets. B</p>
<p>Other guidelines / legislation etc. used or referred to: The US Office and Management and Budget's "Best Practices" and OMB Cost Benefit Guidelines; also Regulatory Impact Assessment Guidelines,</p>
<p><b>CONCLUSIONS/ EVALUATION</b></p>
<p>Robustness and current relevance of the recommended approach: The document represents the most thorough, widely-applicable but also relevant guidance among those reviewed here</p>
<p>General key recommendations worth noting: The document stresses the need to strive for maximum clarity and transparency in order to withstand close scrutiny and makes the following recommendations: (i) clearly state the "starting point" of baseline and policy scenarios. It may be necessary take account of regulations other than the one of primary concern; (ii) clearly identify all aspects of the baseline conditions that are uncertain and all assumptions made in specifying the baseline; (iii) be clear about assumptions on compliance (i.e. compliance with the proposed or pre-existent regulation may not be immediate but there may be a time-lag); (iv) explicitly address uncertainty: treatment of uncertainty should be considered part of the communication process between analysts and decision-makers. At a minimum, uncertainties should be explored through the use of expected values supplemented by upper and lower bounds for important inputs, assumptions and results; (v) present outcomes based on expected or most plausible values and provide descriptions of key assumptions and perform sensitivity analysis; (vi) describe qualitatively effects that cannot be quantified especially if these 'non-monetized effects' are important for policy decisions; (vii) focus resources on benefit categories that are likely to influence policy decisions if resources for the analysis are limited; (viii) guard against double-counting of benefits - if there is significant overlap across the values used for estimating the benefits of different effects, summing values across these effects could substantially overstate expected benefits and (ix) organise the analytic framework in order to provide information on separate economic consequences of component contributors to costs and benefits.</p>
<p>Key recommendations worth noting with regards to data collection and assumptions: The report makes the following recommendations about data collection and presentation: (i) economic analyses should clearly describe all important data sources and references used, as well as key assumptions and their justifications;</p>



(ii) the source of cost and benefits estimates and the degree of confidence in those sources should be described; and (iii) how uncertainty in the data and assumptions used is likely to affect the results should be discussed.



**Ecologic 2004: Basic Principles for Selecting the most Cost-Effective Combinations of Measures as Described in Article 11 of the Water Framework Directive HANDBOOK**

REFERENCE INFORMATION: G12
Title: <i>Basic Principles for Selecting the most Cost-Effective Combinations of Measures as Described in Article 11 of the Water Framework Directive HANDBOOK</i>
Authors: Ecologic, Institute for International and European Environmental Policy
Clients/Target audience: German Ministry for Environment/ Target audience is "decision-makers in the water management authorities and independent planning offices entrusted with the tasks of the WFD"
Year of publication: 2004
Availability: <a href="http://www.umweltbundesamt.de/wasser/themen/2404_e_komplett.pdf">http://www.umweltbundesamt.de/wasser/themen/2404_e_komplett.pdf</a>
Country/ies: Germany
The purpose: Guidance for a legal obligation.
Policy area: water
Details of legislation: Water Framework Directive (Directive 2000/60/EC).
Policy measures discussed: measures to achieve "good status" for water quality
Type of analysis: Cross-measure comparison
Summary: Outlines a methodology for selecting the most cost-effective set of measures as part of the river basin management plans to be set up for each river basin by 2009 according to Article 11 of the Water Framework Directive (WFD). Relevant section is (5.1) Selection of effective measures, determination of costs and identification of the most cost-effective combination of methods.
METHODOLOGY
Definition of effectiveness: Achievement of a specific objective, i.e. good water status
Definition of costs: The document distinguishes between direct (operational) and indirect (economic) costs. Indirect costs are those "incurred by measures and instruments in the sense that the measures restrict or change the uses of a water body, or necessitate adaptation measures".
Definition of cost-effectiveness: Cost-effectiveness is achieved by the package of measures which produces "greatest ecological effect in relation to costs".
Does the document mention ex-ante and ex-post assessment separately and if so, are the recommendations different for each?: By definition, this guidance only covers ex ante analysis
Stages of the cost-effectiveness methodology: The document contains the following stages of CEA: (1) select the system of measures based on the identified pressures; (2) select effective measures; (3) combine measures and determine supporting instruments - assess effectiveness; (4) describe interactions between instruments and combinations of measures; (5) determine costs, and (6) calculate cost-effectiveness and identify the most cost-effective combination of measures.



Boundaries/scope: Application of CEA to WFD compliance.
Objectives of analysis: Least cost compliance with the WFD.
Definition of baseline: Not explicitly discussed.
Data collection and analysis: Discussion of data issues is highly WFD-specific.
Models recommended: n/a
Methodological simplifications recommended: None identified
Other guidelines / legislation etc. used or referred to: Working Group of the Federal States on Water, EU_IMPRESS Working Group, WATECO
<b>CONCLUSIONS/ EVALUATION</b>
Robustness and current relevance of the recommended approach: The guidance would be confusing for anything other than CEA advice specific to Water Framework Directive compliance, as the WFD itself introduces many supplementary issues addressed in the document which would not be considered in standard CEA.
General key recommendations worth noting: Recommendations are mostly WFD-specific.
Key recommendations worth noting with regards to data collection and assumptions: As a general principle, mean averages and bandwidths should be given for calculated costs, provided the available cost information permits this.

**WATECO 2003: Economics and the Environment: the Implementation Challenge of the Water Framework Directive, Guidance Document**

REFERENCE INFORMATION: G14
Title: <i>Economics and the Environment: the Implementation Challenge of the Water Framework Directive, Guidance Document</i>
Authors: WATECO
Clients/Target audience: Target audiences are "experts and stakeholders" in the implementation of the Water Framework Directive.
Year of publication: 2003
Availability: on-line (e.g. <a href="http://www.kaderrichtlijnwater.nl/import/guidancenr8.pdf">http://www.kaderrichtlijnwater.nl/import/guidancenr8.pdf</a> )
Country/ies: EU countries
The purpose: "This document aims at guiding experts and stakeholders in the implementation of the Directive 2000/60/EC establishing a framework for Community action in the field of water policy."
Policy area: water
Details of legislation: Water Framework Directive (Directive 2000/60/EC)
Policy measures discussed: measures to achieve "good status" for water quality
Type of analysis: cross-measure
Summary: Discussion of the role of economics in the WFD and guidance on planning, undertaking and reporting the required economic analysis is provided in this document. The relevant sections are as follows: (SEC2) role of economics in the directive; (SEC3) roadmap for implementing directive's economic analysis; (SEC4) preparing for cost-effectiveness analysis; and (SEC5) ensuring coherence with the overall implantation process.
<b>METHODOLOGY</b>
Definition of effectiveness: Achievement of a specific objective (good water status)
Definition of costs: "Economic costs" are costs to society as a whole, while "financial costs" are costs to particular economic agents. Financial costs comprise of capital, operation, maintenance and administrative costs. Economic costs comprise of resource costs, water-related environmental costs and non-water-related environmental costs (including non-priced environmental costs).
Definition of cost-effectiveness: Cost effectiveness is defined as the achievement of objective at least cost.
Does the document mention ex-ante and ex-post assessment separately and if so, are the recommendations different for each?: By definition, this guidance only covers ex ante analysis
Stages of the cost-effectiveness methodology: The document presents the following stages of CEA: (1) define scale of analysis; (2) define time horizons for measures; (3) determine the effects of measures on water; (4) estimate the costs of proposed measures (including consideration of distribution); (5) assess cost-effectiveness by determining which package of measures would incur least cost and (6) assess wider economic impacts.



Boundaries/scope: Application of CEA to WFD compliance.
Objectives of analysis: Achievement of "good status" at least cost
Definition of baseline: Establishment of baseline in the case of the WFD is fairly complicated and a thorough discussion is given in Annex 3 of the guidelines. Assessment of forecasts in key (non-water related) policy and economic drivers likely to influence pressures and thus w
Data collection and analysis: Discussion of data issues is highly WFD-specific.
Models recommended: n/a
Methodological simplifications recommended: None identified
Other guidelines / legislation etc. used or referred to:
<b>CONCLUSIONS/ EVALUATION</b>
Robustness and current relevance of the recommended approach: Very specific to the WFD context.
General key recommendations worth noting: The following general recommendations can be found in the document: (i) do not underestimate the resources required for developing the right process for the economic analysis; (ii) it might be preferable to first carry out a simple analysis followed by a more in-depth analysis in the most contentious cases and (iii) whether it is based on cost-effectiveness, cost-benefit assessment or any other economic method, the economic analysis does not take the decision! ... It is important to ensure the economic analysis and its output is well integrated with other analyses and expertise aimed at supporting policy and management decisions.
Key recommendations worth noting with regards to data collection and assumptions: Recommendations specific to data collection include: (i) develop a cost-database for the range of measures likely to be investigated, i.e. infrastructure, wetland restoration, demand management measures etc.; and (ii) cost information "should be collected for individual measures or units of measures, thus at a spatial or desegregation scale depending on the scale at which the measure is applied or implemented."



**Pearce 2004: What Constitutes a Good Agri-Environmental Policy Evaluation?**

REFERENCE INFORMATION: G18
Title: <i>What Constitutes a Good Agri-Environmental Policy Evaluation?</i>
Authors: Pearce, David
Clients/Target audience: Paper written for an OECD workshop
Year of publication: 2004
Availability: by request
Country/ies: OECD
The purpose: Theoretical discussion paper.
Policy area: Agriculture
Details of legislation: n/a
Policy measures discussed: Paying for environmental benefits on agricultural land
Type of analysis: Ex ante or ex post cross-measure analysis
Summary: This is a fairly theoretical paper on the problems associated with cost-effectiveness, cost-benefit and multi-criteria analyses with respect to agri-environmental schemes. Relevant sections include: determining the baseline; what costs are comprised of; defining benefits; additionality; time-horizon and discounting; distributional impacts; descriptions of cost-effectiveness analysis, multi-criteria analysis and cost-benefit analysis. Some discussion of problems associated with identification of the correct target measure, i.e. individual vs. expert preferences, is also contained in the paper.
METHODOLOGY
Definition of effectiveness: Relevant "environmental unit, e.g. area of landscape, number of birds, etc." of concern
Definition of costs: Costs comprise of costs to taxpayers, costs to farmers (e.g. reduced output) and transaction costs.
Definition of cost-effectiveness: Cost-effectiveness is the ratio of benefits achieved (effectiveness) over cost.
Does the document mention ex-ante and ex-post assessment separately and if so, are the recommendations different for each?: Not explicitly mentioned.
Stages of the cost-effectiveness methodology: As a theoretical piece, the paper does not go into details about the practicalities of performing CEA.
Boundaries/scope: Distributional issues should be considered - introduce distributional weighting.
Objectives of analysis: To put in place an agri-environmental measure at least cost achieving required benefits.
Definition of baseline: The paper points out that agri-environmental payments will be made out of existing



support payments and therefore recommends two baselines: one with the equivalent support payment still intact, and one without the support payment altogether.
Data collection and analysis: n/a
Models recommended: n/a
Methodological simplifications recommended: n/a
Other guidelines / legislation etc. used or referred to: Specific agri-environmental schemes are not mentioned, although the Common Agricultural Policy is briefly discussed.
<b>CONCLUSIONS/ EVALUATION</b>
Robustness and current relevance of the recommended approach: Theoretical paper, not a manual.
General key recommendations worth noting: The following recommendations can be taken from the paper: (i) any appraisal method must account for time issues: discounting, selection of terminal period and relative price effects; (ii) CBA is to be preferred where credible benefit estimates can be secured and (iii) CEA and MCA are second-best appraisal methodologies where CBA cannot be applied
Key recommendations worth noting with regards to data collection and assumptions: n/a



**US OMB 1992: Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs**

REFERENCE INFORMATION: G20
Title: <i>Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs</i>
Authors: US Office of Management and Budget
Clients/Target audience: US (federal) public sector is target audience.
Year of publication: 1992
Availability: <a href="http://www.whitehouse.gov/omb/circulars/a094/a094.html">http://www.whitehouse.gov/omb/circulars/a094/a094.html</a>
Country/ies: USA
The purpose: "Promote efficient resource allocation through well-informed decision-making by the Federal Government"
Policy area: All
Details of legislation: Budget and Accounting Act of 1921
Policy measures discussed: None specifically
Type of analysis: Mostly CBA, but some discussion of CEA
Summary: The document provides general guidance for conducting benefit-cost and cost-effectiveness analyses for US Federal agencies. Relevant sections include: (SEC6) identifying and measuring benefits and costs (including discussion of incremental costs, interactive effects with other government activities, and transfers; (SEC7-8) treatment of inflation and discounting; (SEC9) treatment of uncertainty and (SEC10) incidence of costs and benefits.
METHODOLOGY
Definition of effectiveness: None given.
Definition of costs: Costs of concern are social costs, which may be different from private costs due to externalities and market power. The document stresses that "costs should reflect the opportunity cost of any resources used, measured by the return to those resources in their most productive application elsewhere."
Definition of cost-effectiveness: A program is cost-effective if, on the basis of life cycle cost analysis of competing alternatives, it is determined to have the lowest costs expressed in present value terms for a given amount of benefits ... Cost-effectiveness analysis can also be used to compare programs with identical costs but differing benefits. In this case, the decision criterion is the discounted present value of benefits.
Does the document mention ex-ante and ex-post assessment separately and if so, are the recommendations different for each?: Implicitly ex ante
Stages of the cost-effectiveness methodology: The document must presume that readers already know the rudiments of cost-effectiveness analysis, as stages are not described explicitly.
Boundaries/scope: The document applies specifically to benefit-cost or cost-effectiveness analysis of Federal programs or policies, regulatory impact analysis, etc. Specifically exempted from the scope are



<p>decisions concerning: water resource projects and Federal energy management programs. The affected population is citizens of the United States and the document states that where programs or projects have effects outside the United States, these effects should be reported separately. Some discussion of distributional impacts can also be found in the report</p>
<p>Objectives of analysis: Achieve (non-monetised) benefits at least cost</p>
<p>Definition of baseline: Not explicitly addressed.</p>
<p>Data collection and analysis: See data recommendations.</p>
<p>Models recommended: n/a</p>
<p>Methodological simplifications recommended: None identified.</p>
<p>Other guidelines / legislation etc. used or referred to: "Regulatory Impact Analysis Guidance," in Regulatory Program of the United States Government, "Federal Energy Management and Planning Programs; Life Cycle Cost Methodology and Procedures". Various Office of Management and Budget circulars.</p>
<p><b>CONCLUSIONS/ EVALUATION</b></p>
<p>Robustness and current relevance of the recommended approach: Basic concise set of guidelines on policy or project appraisal.</p>
<p>General key recommendations worth noting: The following recommendations can be found in the document: (i) analyses should be explicit about the underlying assumptions (e.g. number of future beneficiaries) used to arrive at estimates of future benefits and costs. The analysis should include a statement of the assumptions, the rationale behind them, and a review of their strengths and weaknesses; (ii) analyses should also consider alternative means of achieving program objectives by examining different program scales, different methods of provision, and different degrees of government involvement; (iii) retrospective studies to determine whether anticipated benefits and costs have been realized are potentially valuable. Such studies can be used to determine necessary corrections in existing programs and to improve future estimates of benefits and costs in these programs or related ones. Agencies should have a plan for periodic, results-oriented evaluation of program effectiveness.</p>
<p>Key recommendations worth noting with regards to data collection and assumptions: The document suggests that key data and results, such as year-by-year estimates of benefits and costs, should be reported to promote independent analysis and review.</p>



**ADB 1997: Guidelines for the Economic Analysis of Projects**

REFERENCE INFORMATION: G21
Title: <i>Guidelines for the Economic Analysis of Projects</i>
Authors: Asian Development Bank
Clients/Target audience: Target audience is analysts at the ADB
Year of publication: 1997
Availability: <a href="http://www.adb.org/Documents/Guidelines/Eco_Analysis/default.asp">www.adb.org/Documents/Guidelines/Eco_Analysis/default.asp</a>
Country/ies: Asian countries
The purpose: internal document
Policy area: development projects - bank lending operations
Details of legislation: n/a
Policy measures discussed: None specifically
Type of analysis: ex-ante cross-project
Summary: Guidance for the appraisal of development projects (including some concerns specific to this context). Relevant chapters include: (CH5) integrated approach to economic analysis; (CH6) identification and quantification of costs and benefits. There is more emphasis than other guidelines on the notion that markets may not be competitive due to government intervention and imperfect competition, due to factors which would need to be considered in analysis. The document includes guidance on how to calculate shadow prices to account for government intervention. Some discussion of issues such as prices of non-traded benefits, affordability, the possibility that projects may have more than one outcome, sensitivity analysis and treatment of uncertainty can also be found here.
METHODOLOGY
Definition of effectiveness: Achievement of a given benefit.
Definition of costs: The guidance makes a distinction between economic and financial costs: the latter accrue to the project-operating entity, while the former diminish the economic welfare of the citizens of the country concerned. The document states that "costs reflect the degree to which consumption elsewhere in society is sacrificed by diverting the resources required by the project from other uses". It also emphasises that external costs must be included: "many of the project impacts that are to be included in the economic analysis either will be non-marketed, for example, biodiversity preservation, or incompletely marketed, such as, water supply and sanitation benefits. Thus, some form of non-market value must be estimated." Non-quantifiable benefits should be stated along with an estimate of the number of beneficiaries." Finally, contingencies should be included in cost estimates.
Definition of cost-effectiveness: Cost-effectiveness is the ratio of a (non-monetised) benefit to the cost of meeting the benefit.
Does the document mention ex-ante and ex-post assessment separately and if so, are the recommendations different for each?: ex ante
Stages of the cost-effectiveness methodology: The following stages of CEA are included in the guideline:



(1) define project objectives and economic rationale; (2) forecast effective demand for project outputs; (3) choose the least cost method of determining the objective; (4) assess whether benefits will be sustainable through the project's life-cycle; (5) test for risks; (6) identify distributional effects and (7) enumerate non-quantifiable effects.
Boundaries/scope: "Project planning and project economics are now affected by environmental issues; various aspects of sustainability, including those of a financial, environmental, economic, social, and political nature; equitability; participation; and governance, including the role of women and non-government organizations in development. Economic analysis must facilitate the analysis of these additional issues whilst maintaining the basic focus on economic viability."
Objectives of analysis: Achievement of objectives at least cost
Definition of baseline: Baseline is defined as the "without-project situation": "that which would prevail without the project."
Data collection and analysis: See data recommendations.
Models recommended: n/a
Methodological simplifications recommended: Assume that projects "will not have a substantial impact on the government budget or the exchange rate". "In the case of large projects that have a considerable impact on the regional, national, or international economy", additional analysis will have to
Other guidelines / legislation etc. used or referred to: n/a
<b>CONCLUSIONS/ EVALUATION</b>
Robustness and current relevance of the recommended approach: Thorough, but contains many details only relevant to a developing country context.
General key recommendations worth noting: One of the most important recommendations of this guidance is about the definition of options. The report states that: "mutually exclusive project options must be alternative ways of producing the same output of a specified service quality. If differences in output or service quality exist, a normalization procedure that takes the foregone incremental benefits of one option relative to another as a cost to the deficient option must be followed to ensure equivalence."
Key recommendations worth noting with regards to data collection and assumptions: The guidelines recommend that costs and benefits should be valued in constant prices, that is, in terms of the price level prevailing in the year in which the project is appraised. However, if it is expected that there will be significant changes in relative prices over the life of the project, then this relative price change must be incorporated in the valuation of the cost or benefit item.



**Government of Canada 2004: Opportunities Envelope Guidelines for Proposals**

REFERENCE INFORMATION: G22
Title: <i>Opportunities Envelope Guidelines for Proposals</i>
Authors: Government of Canada
Clients/Target audience: Target audience is applicants for government funding for greenhouse gas emissions reduction projects
Year of publication: 2004
Availability: <a href="http://www.climatechange.gc.ca/english/publications/oe_guidelines/guidelines_e.pdf">http://www.climatechange.gc.ca/english/publications/oe_guidelines/guidelines_e.pdf</a>
Country/ies: Canada
The purpose: To undertake projects which help Canada meet its Kyoto Protocol obligations.
Policy area: Climate Change
Details of legislation: Measures to reduce greenhouse gas emissions.
Policy measures discussed: For applicants to decide reduction method.
Type of analysis: ex ante cross-measure
Summary: The relevant part of the document is Chapter 3 on cost-effectiveness (information required for the calculation, both on costs and on expected results, and the calculation itself) and Appendix A examples of cost-effectiveness calculations.
METHODOLOGY
Definition of effectiveness: Greenhouse gas emissions reductions achieved.
Definition of costs: The guidelines are concerned with "incremental costs", i.e., those costs "directly related to implementation of the proposed program that would not have been incurred in its absence.
Definition of cost-effectiveness: The initiative's cost-per-tonne ratio
Does the document mention ex-ante and ex-post assessment separately and if so, are the recommendations different for each?: ex ante
Stages of the cost-effectiveness methodology: The document recommends the following states: (1) estimate cost of proposed program; (2) estimate emissions reductions from proposed program and (3) calculate cost-effectiveness ratio
Boundaries/scope: The document concerns bare cost-effectiveness related to a very specific context.
Objectives of analysis: Emissions reductions at least cost
Definition of baseline: Baseline is defined as: "the level of emissions that would have occurred in the absence of the proposed project or program"
Data collection and analysis: Not specifically addressed.



Models recommended: n/a
Methodological simplifications recommended: None given.
Other guidelines / legislation etc. used or referred to: n/a
<b>CONCLUSIONS/ EVALUATION</b>
Robustness and current relevance of the recommended approach: Very basic document.
General key recommendations worth noting: The document recommends providing upper and lower cost and emissions reduction ranges to reflect "uncertainty around underlying market behaviours"
Key recommendations worth noting with regards to data collection and assumptions: n/a

**PEEM 1993: PEEM Guidelines 3 - Guidelines for cost-effectiveness analysis of vector control.**

REFERENCE INFORMATION: G24
Title: <i>PEEM Guidelines 3 - Guidelines for cost-effectiveness analysis of vector control.</i>
Authors: Panel of Experts on Environmental Management for Vector Control (PEEM), a body set up by the World Health Organisation
Clients/Target audience: Health-care professionals and academics in relevant field
Year of publication: 1993
Availability: <a href="http://www.who.int/docstore/water_sanitation_health/Documents/PEEM3/english/peem3toc.htm">http://www.who.int/docstore/water_sanitation_health/Documents/PEEM3/english/peem3toc.htm</a>
Country/ies: Countries where vector-borne diseases are problematic
The purpose: internal document
Policy area: Vector-borne diseases
Details of legislation: n/a
Policy measures discussed: None specifically
Type of analysis: ex ante cross-measure
Summary: Relevant chapters of the report include: (CH1) planning a cost-effectiveness study, including specifying the problem and identifying alternatives; (CH2) estimating costs (including which costs to include, adjusting for inflation); (CH3) estimating effectiveness (choosing appropriate indicators for effectiveness, socioeconomic impacts); (CH4) performing cost-effectiveness analysis, including sensitivity analysis and consideration of marginal differences between options. Two Annexes are also relevant: (A2) details of how to estimate costs (e.g. shadow prices) and (A3) discounting and annualization
METHODOLOGY
Definition of effectiveness: Benefits derived from an intervention. Non-health impacts should also be identified.
Definition of costs: Conventional distinction made between financial and economic costs.
Definition of cost-effectiveness: Ratio of an expected benefit from an intervention to cost.
Does the document mention ex-ante and ex-post assessment separately and if so, are the recommendations different for each?: both
Stages of the cost-effectiveness methodology: The following stages are presented in the document: (1) specify problem and define objectives; (2) identify alternative feasible interventions; (3) estimate the cost and effectiveness of each of the alternative interventions; and (4) compare cost-effectiveness of alternative interventions
Boundaries/scope: Approach of cost-effectiveness along with many context-specific practicalities. Distributional impacts and financial feasibility discussed.



Objectives of analysis: benefits of interventions to be obtained at least cost
Definition of baseline: “To measure change, a reference point is needed for comparison.” This can either be: “the level of the indicator before and after the intervention (temporal comparison using baseline data)” or “the level of the indicator in a population with the interven
Data collection and analysis: Data collection is covered in detail, although this discussion is highly specific to epidemiology.
Models recommended: n/a
Methodological simplifications recommended: None identified.
Other guidelines / legislation etc. used or referred to: n/a
<b>CONCLUSIONS/ EVALUATION</b>
Robustness and current relevance of the recommended approach: Very thorough, but also highly specific to the vector-borne disease context.
General key recommendations worth noting:
Key recommendations worth noting with regards to data collection and assumptions: The document includes the following recommendations: (i) on selecting data samples when performing ex post analysis (as it may not be possible to include all data); (ii) collect data over several years both before and after the intervention to obtain a reliable average; (iii) ensure that differences in the indicator detected between areas with and without the intervention can be attributed to the intervention by choosing areas where (a) the level of the effectiveness indicator was the same before the intervention and (b) which have been exposed to similar changes other than the intervention; (iv) be aware that if data in existing records have been collected passively (that is, the data have come to the collector rather than the other way around) there may be potential problems both of incompleteness and of bias; (v) if special surveys have to be conducted to collect the data, it should be decided whether a sample will be adequate and whether the survey technique used could skew results; and (vi) the possibility of collecting data on other effectiveness indicators should be considered in order to explain results and support the conclusions and to build up a data base of the relationship between different effects.



**eftec 1999: Review of Technical Guidance on Environmental Appraisal**

REFERENCE INFORMATION: G25
Title: <i>Review of Technical Guidance on Environmental Appraisal</i>
Authors: eftec / UK Department for the Environment, Transport and the Regions
Clients/Target audience: Civil servants interested in different environmental appraisal techniques
Year of publication: 1999
Availability: <a href="http://www.defra.gov.uk/environment/economics/rtgea/">http://www.defra.gov.uk/environment/economics/rtgea/</a>
Country/ies: UK
The purpose: internal document
Policy area: all environmental
Details of legislation: n/a
Policy measures discussed: None specifically
Type of analysis: General - Cost-effectiveness analysis, cost-benefit analysis and economic impact assessment
Summary: This is a general discussion document for environmental policy appraisal, rather than a manual, reviewing a selection of economic and environmental appraisal techniques and weighing up their pros and cons. Relevant chapters include: (CH3) description of different appraisal techniques, e.g. cost-effectiveness analysis, cost-benefit analysis, economic impact assessment, multi-criteria analysis ;(CH4) matching guidance with policy issues including a matrix of which forms of appraisal suit which policy areas; (CH5) general guidance on the appraisal of policies; and (CH6) guidance for full appraisals, including a discussion of the fact that framework guidance for economic analysis of policy exists, but not much guidance on how to perform the necessary valuation of especially non-market costs and benefits
METHODOLOGY
Definition of effectiveness: Benefits from a policy
Definition of costs: Not discussed in detail
Definition of cost-effectiveness: Ratio of non-monetised benefit to cost
Does the document mention ex-ante and ex-post assessment separately and if so, are the recommendations different for each?: both
Stages of the cost-effectiveness methodology: The stages of CEA as outlined in this document are: (1) estimate cost of proposed action; (2) estimate environmental benefits from the action; and (3) calculate cost-effectiveness ratio.
Boundaries/scope: Application of economic appraisal of UK Government environmental projects and policies.
Objectives of analysis: policy appraisal



Definition of baseline: Not specifically addressed.
Data collection and analysis: n/a
Models recommended: n/a
Methodological simplifications recommended: n/a
Other guidelines / legislation etc. used or referred to: Several specific environmental impact assessment, strategic environmental assessment risk assessment guidelines. Some economic appraisal guidance now out of date.
<b>CONCLUSIONS/ EVALUATION</b>
Robustness and current relevance of the recommended approach: Overview of different techniques rather than guidance on how to perform them.
General key recommendations worth noting: n/a
Key recommendations worth noting with regards to data collection and assumptions: n/a

## EC DG Budget 2001: Ex-ante evaluation: a practical guide for preparing proposals for expenditure programmes

REFERENCE INFORMATION: G40
Title: <i>Ex-ante evaluation: a practical guide for preparing proposals for expenditure programmes</i>
Authors: European Commission DG Budget
Clients/Target audience: Commission employees engaged in policy evaluation
Year of publication: 2001
Availability: <a href="http://europa.eu.int/comm/budget/evaluation/Key_documents/evalguides_en.htm">http://europa.eu.int/comm/budget/evaluation/Key_documents/evalguides_en.htm</a>
Country/ies: EU countries
The purpose: Internal document providing guidance on ex ante policy evaluation
Policy area: All
<p>Details of legislation: The general requirement for carrying out ex ante evaluations is based on the Financial Regulation (December 1977 as amended by Council regulation 2333/95 of September 1995), Article 2 of which stipulates that: "The budget appropriations must be used in accordance with the principles of sound financial management, and in particular those of economy and cost-effectiveness. Quantified objectives must be identified and the progress of their realisation monitored. <i>To this end, the mobilisation of Community resources must be preceded by an evaluation to ensure that the resultant benefits are in proportion to the resources applied.</i>" The Implementation Rules for the Financial Regulation (Commission regulation no. 1687/2001, Art. 1) states that: "Proposals for all new programmes and actions occasioning expenditure from the general budget of the European Communities shall be the subject of an <i>ex ante</i> evaluation, which shall identify: (a) the need to be met in the short or long term; (b) the objectives to be realised; (c) the results expected and the indicators needed to measure them; (d) the added value of Community involvement; (e) the risks, including fraud, linked with the proposals and the alternative options available; (f) the lessons learned from similar experiences in the past; (g) the volume of appropriations, human resources and other administrative expenditure to be allocated with due regard to the cost-effectiveness principle; (h) the monitoring system to be set up.</p>
Policy measures discussed: none specifically
Type of analysis: Ex ante policy evaluation, including cost-effectiveness
<p>Summary: Ex ante evaluation is a fundamental tool for effective management and a formal requirement. This document provides practical advice for Commission services starting preparations for a new or renewal of an expiring expenditure programme. It is not a standard, but meant to help solve the problems that services face when doing or commissioning ex ante evaluations. This guide is specifically intended to give advice on ex ante evaluation of expenditure programmes. However, some of the approaches and ideas presented in it may also be applicable to policies, projects or other types of activities. Section 2 outlines why ex ante evaluation is necessary and describes the formal requirements for doing so. Section 3 discusses some practicalities associated with performing the evaluation. Section 4 describes the qualitative analysis which should be undertaken, as well as a brief discussion of quantitative cost-effectiveness analysis.</p>
METHODOLOGY
Definition of effectiveness: Outcome achieved by the intervention
Definition of costs: "Types of cost that should be taken into account are: i) direct financial outlays (for

beneficiaries or third parties) from the EU budget; ii) administrative costs for the Commission; and iii) human resources needed to manage the intervention.
Definition of cost-effectiveness: Cost per unit of outcome achieved.
Does the document mention ex-ante and ex-post assessment separately and if so, are the recommendations different for each?: Ex ante
Stages of the cost-effectiveness methodology: i) Determine resources and timing required for the evaluation; ii) formulate a 'roadmap' for qualitative discussion of the intervention; iii) set objectives, indicators and baseline; iv) consider alternative delivery mechanisms and risk assessment; v) consider added value of Community involvement; vi) perform cost-effectiveness analysis by comparing the unit cost of an intervention "compared to other interventions or to other methods for delivering the same outcome".
Boundaries/scope: Document covers all considerations of ex ante policy evaluation, not just economic evaluation.
Objectives of analysis: Policy appraisal.
Definition of baseline: Not explicitly defined. Implied to be the expected state of the world without the policy, measure or intervention
Data collection and analysis: Ease and cost of data collection may be a factor in indicator choice. See also "Data recommendations" field
Models recommended: None.
Methodological simplifications recommended: None.
Other guidelines / legislation etc. used or referred to: "Evaluating EU Expenditure Programmes", European Commission DG Budget
<b>CONCLUSIONS/ EVALUATION</b>
Robustness and current relevance of the recommended approach: Robust, thorough and very relevant, although more biased towards qualitative rather than quantitative economic analysis.
General key recommendations worth noting: i) It is essential that the baseline is known at the outset and that objectives are precise enough to allow verification of their achievement. ii) The use of indicators always needs to be complemented with an analysis of qualitative factors and with an interpretation of the data produced. iii) "At the minimum, an ex ante evaluation should present a broad estimate of the cost of the proposed intervention; ask if the objectives justify the cost - bearing in mind that ultimately this is a political judgement; and ask if the same results could be achieved by a lower cost by using a different approach of other instruments, or if more or better results could be achieved with the same cost by using a different approach or other instruments."
Key recommendations worth noting with regards to data collection and assumptions: It is essential that indicators are chosen for which mechanisms are in place for data collection. "Collecting data on an indicator should not be more costly than the use-value of the information it provides." "Systematic collection of monitoring data should to start at the beginning of every intervention. Reconstituting missing data from the initial phase for the purposes of later evaluation is cumbersome, expensive and usually unreliable."

**Ministerie van Financiën 2003: Concept wegwijzer evaluatieonderzoek ex post**

REFERENCE INFORMATION: G44
Title: <i>Concept wegwijzer evaluatieonderzoek ex post: een praktisch handvat voor de opzet en uitvoering van evaluatieonderzoek ex post (Guidance for ex-post evaluation research)</i>
Authors: Dutch Ministry of Finance, Department for Policy Evaluation
Clients/Target audience: Officials within public administration
Year of publication: 2003
Availability: <a href="http://www.minfin.nl/default.asp?CMS_ITEM=MFCWDD44CF899BB8F475A8F9D3E593BE304F5X2X48214X59">http://www.minfin.nl/default.asp?CMS_ITEM=MFCWDD44CF899BB8F475A8F9D3E593BE304F5X2X48214X59</a>
Country/ies: The Netherlands
The purpose: The guidance is intended for public administration officials that carry out or commission evaluation studies. It is targeted at all branches of the national public administration, including ministries and executive state agencies. The document is expressively not intended as a blueprint, but rather as a supporting guidance document. Although it is publicly available at the Ministry's website, it is a draft internal document.
Policy area: General
Details of legislation: The Dutch Regulation on Performance Data and Evaluation Research (Regeling Prestatiegegevens en Evaluatieonderzoek Rijksoverheid, RPE) was introduced by the Minister of Finance on 1 January 2002. It contains, among others, regulations on the extent and the frequency at which all government policies will be subjected to periodic ex post evaluation. The regulation mandates that all policy objectives have to be assessed at least once every five years by means of an ex-post evaluation. It specifies quality requirements for ex-post evaluation as well as ways of assessing the quality and independence of the evaluation.
Policy measures discussed: none specifically
Type of analysis: Ex post policy evaluation, including cost-effectiveness
Summary: The report provides understandable and illustrative guidance for ex-post evaluation of policies in general. It is not specifically targeted at environmental policies, but the recommendations made are by and large applicable to the environmental sector. Cost-effectiveness is listed as one of four possible criteria to be assessed in an ex-post evaluation, understood as the relation between inputs (money, person-months) and outcomes (results that can be attributed to the policy). Other categories are the rate of target achievement (i.e. the outcome), the effectiveness of a measure (i.e. in how far target achievement (outcome) is due to the measures taken (output)), and the efficiency / quality of the policy making process (i.e. the relation between inputs and outputs). The report makes recommendations regarding the timing of an analysis in the policy process, and describes requirements for an analysis in terms of the validity, reliability and precision of the results, as well as their practical usefulness.
METHODOLOGY
Definition of effectiveness: Outcome achieved by the intervention (in relation to pre-defined objectives)
Definition of costs: no systematic definition



<p>Definition of cost-effectiveness: the relation between the costs (input) and the realised, intended effects (outcomes) (i.e. could policy outcomes have been achieved with less input, or could better outcomes have been obtained with the same input).</p>
<p>Does the document mention ex-ante and ex-post assessment separately and if so, are the recommendations different for each?: Ex post only</p>
<p>Stages of the cost-effectiveness methodology: The evaluation process is described through four broad steps: i) formulating the research question (problem) to be analysed, ideally based on previously determined, quantified policy objectives; ii) determining the focus of the analysis (measurement of the results obtained and relating them to the measures taken, e.g. comparing before / after or action / no-action cases); iii) collecting and analysing the necessary data; iv) reporting / presentation of results and follow-up.</p>
<p>Boundaries/scope: The document is applicable to all policy areas, i.e. not explicitly targeted at environmental policy. It is geared at ex-post evaluation, however the evaluation framework is not confined to cost-effectiveness, but also covers other evaluation criteria. Concrete appraisal techniques (such as CEA, CBA, MCA) are not discussed.</p>
<p>Objectives of analysis: Policy appraisal and evaluation (in response to legal requirements for periodic evaluation).</p>
<p>Definition of baseline: No explicit definition of a baseline, but the report discusses a comparison of the state ex-ante and ex-post, and the state with and without the policy intervention, or a combination of both.</p>
<p>Data collection and analysis: Document makes several recommendations on potential data sources (e.g. document study, interviews, surveys, participatory observation and case studies). Distinction between quantitative and qualitative information is discussed, as well as the appropriate use of both. The document stresses the role of ex ante evaluation in defining data needs</p>
<p>Models recommended: None.</p>
<p>Methodological simplifications recommended: None.</p>
<p>Other guidelines / legislation etc. used or referred to: Regeling Prestatiegegevens en Evaluatieonderzoek Rijksoverheid (General regulation on Performance Data and Evaluation Research)</p>
<p><b>CONCLUSIONS/ EVALUATION</b></p>
<p>Robustness and current relevance of the recommended approach: Good discussion of the problems of establishing the effectiveness of individual measures and possible approaches for doing so. The document does not offer any recommended approach, but describes possible methods and criteria to be used in an analysis. Contains many hands-on recommendations on the political use of evaluation results (communicating to decision makers, feeding into the policy process etc.)</p>
<p>General key recommendations worth noting: The document underlines that results of an evaluation are most useful if they come at the right moment, and that good timing is therefore essential. Another condition is that results need to be of a sufficient (scientific) quality. The document also notes that ex ante and ex post appraisal should be related to each other. As ex ante appraisal identifies critical assumptions and risk factors, these should be revisited in the research question that guides the ex post analysis.</p>
<p>Key recommendations worth noting with regards to data collection and assumptions: The document notes that in most cases, assessing the relation between observed effects and policy measures taken will require an extensive ex post evaluation study. In order to assess whether policies have reached their objectives, one essential precondition is that these objectives need to be formulated in terms of precise, if possible quantified, targets and timetables.</p>





## Annex 4 Distribution of Case Studies by Country and EEA Environmental Themes

Notes: Bold = ex post analysis; ? = it is not clear from the abstract which countries are covered (and the full paper is either not currently available or not in English); \* = priority paper (i.e. with three stars). 'New' refers to the new accession countries. Only those studies to be included in the final database are shown.

	AU	BG	DA	FI	FR	DE	EL	IR	IT	LX	NL	PT	ES	SW	UK	New	EU - wide	Non-EU
<b>Environmental issues</b>																		
Acidification				CS8*	CS8*	CS8*	CS8*	CS8*	CS8*		CS8* CS12		CS8*		CS8*		CS7 CS9 CS51	CS9
Air quality					CS4 CS73* CS74*	CS4 CS73* CS74*					CS15 CS20 CS73* CS74*				CS4 CS73* CS74*		CS3 CS5 CS7 CS9 CS17 * CS51 CS63	CS1 CS2 CS9 CS22 CS24 CS25 CS26 CS41 CS42
Biodiversity change											CS10 CS14				CS47*			
Chemicals															CS49 CS57* CS72			CS32 CS36 CS38 CS40
Climate change			CS69*	CS52* CS69*		CS69*					CS13*? CS69*			CS69*	CS69*		CS17 CS53* CS54 CS62	CS55 CS69*
Human health																		
Natural resources																		
Noise															CS50			
Ozone depletion																	CS9	CS9 CS30*
Waste	CS71*	CS58 CS59 CS60 CS61	CS70* CS71*		CS4 CS70* CS74*	CS4 CS74*		CS71*	CS71*		CS19 CS70* CS74*		CS70*		CS4 CS71* CS74*	CS70* (ET PL)		CS33 CS39 CS41
Other			CS31*	CS31*		CS31*								CS31*	CS49*	CS31* (ET)		CS31* CS35



	AU	BG	DA	FI	FR	DE	EL	IR	IT	LX	NL	PT	ES	SW	UK	New	EU - wide	Non-EU
																LV LT PL)		
Sectors																		
Agriculture			CS31*	CS31*		CS31*					CS14			CS31*	CS47* CS57*	CS31* (ET LV LT PL)	CS7 CS17	CS31* CS35 CS36 CS38
Energy											CS13* <sup>?</sup> CS16 <sup>?</sup>							CS22 CS24 CS25 CS32 CS42
Fisheries																		
Households	CS71*		CS71*		CS74*	CS74*		CS71*	CS71*		CS19 CS74*				CS71* CS74*			CS2 CS33 CS39
Industry			CS69*	CS69*	CS4 CS73* CS74*	CS4 CS69* CS73* CS74*					CS12 CS15 CS69* CS73* CS74*			CS69*	CS49* CS69* CS72 CS73* CS74*		CS3 CS5 CS7 CS9 CS51 CS63	CS2 CS9 CS24 CS25 CS30* CS33 CS39 CS40 CS41 CS42 CS69*
Population & Economy																		
Tourism																		
Transport			CS69*	CS8* CS69*	CS8*	CS8* CS69*	CS8*	CS8*	CS8*		CS8* CS12 CS15 CS20 CS69*		CS8*	CS69*	CS8* CS50		CS7 CS9* CS51	CS1 CS9 CS24 CS25 CS26 CS42 CS69*



	AU	BG	DA	FI	FR	DE	EL	IR	IT	LX	NL	PT	ES	SW	UK	New	EU - wide	Non-EU
<b>Media</b>																		
Air			CS69*	CS8* CS52* CS69*	CS4 CS8* CS73* CS74*	CS4 CS8* CS69* CS73* CS74*	CS8*	CS8*	CS8*		CS8* CS12 CS13*? CS15 CS20 CS69* CS73* CS74*		CS8*	CS69*	CS4 CS8* CS73* CS74*		CS3 CS5 CS7 CS9 CS17 * CS51 CS53* CS54 CS62 CS63	CS1 CS2 CS9 CS22 CS24 CS25 CS26 CS30* CS36 CS41 CS42 CS55 CS69*
Nature											CS10 CS14				CS47*			CS9 CS36
Soil																	CS9	CS9 CS33 CS36
Water			CS31* CS70*	CS31*	CS70*	CS31*					CS11* CS70*		CS70*	CS31*	CS49*	CS31* (ET LV LT PL) CS70* (ET PL)	CS9 CS56*	CS9 CS31* CS32 CS35 CS36 CS38 CS40



## Annex 5 Case Study Fiches

REFERENCE INFORMATION: CS11
Study title: Kosteneffectiviteit van Verspreiding naar Water (Cost effectiveness of water policy)
Study authors: K.F. van der Woerd, E.C.M. Ruijgrok en R.B. Dellink
Author institution: Instituut voor Milieuvraagstukken
Author URL: <a href="http://www.vu.nl/ivm/">http://www.vu.nl/ivm/</a>
Clients / contracting authority / Target audience: Rijksinstituut voor Integraal Zoetwaterbeheer en Afvalwaterbehandeling (RIZA)
Year of publication: 2000
Year of the case / data: 1995
Availability: IVM Rapport E-00/01
Availability URL: <a href="http://www.vu.nl/ivm/">http://www.vu.nl/ivm/</a>
Status: published research report
Language of the document: Dutch
Country(ies): Netherlands
Environmental issue: Water
Sector / activity: general
Details of legislation: none
Legal obligation: none
Type of analysis: ex-ante, cross-measure comparison.
Purpose: The study analyses constructs a cost-effectiveness curve for different measures to limit water pollution from toxic chemicals (mainly heavy metals). In the curve, the options are ranking according to their cost-effectiveness, whereby relatively cheapest measures are followed by increasingly expensive ones.
Perspective and level of detail: environmental perspective, containing both theoretical discussion of the methodology and applied evaluation.
Summary: The study presents a cost-effectiveness curve of different measures to reduced water pollution from a set of toxic chemical substances. It is based on a previous study which assessed the costs and effectiveness of some 200 measures. The set of measures comprises both upstream (integrated) and downstream (end-of-pipe) measures. To account for the fact that different measures may reduce emissions of more than one pollutant, the study tests different weighing scheme whereby the different emissions are aggregated into pollution equivalents. A key finding of the report is that the majority of emission reductions (80% of all emissions) can be achieved at fairly low cost (20% of the total cost).
DETAILS OF MEASURES EVALUATED
Policy measure(s) evaluated: The study builds cost-effectiveness curves for some 200 measures targeted at



<p>the reduction of different heavy metals and other toxic substances (Hg, Cd, Pb, Zn, Cu, Ni, Cr, As). The study is not linked to any specific policy measure, but the implementation of the EC Water Framework Directive and the 4<sup>th</sup> Dutch Water Act (NWA4) are mentioned as the policy context of the analysis.</p>
<p>Original objectives of measure: The measures covered in the analysis aim at reducing water pollution (pressures) from a set of toxic substances (Hg, Cd, Pb, Zn, Cu, Ni, Cr, As). Quality objectives (impacts) are not discussed in the report.</p>
<p>Data collection methods/reporting requirements: The majority of data is taken from an earlier study on communal waste water treatment strategies. No reporting requirements mentioned.</p>
<p>Other:</p>
<p><b>METHODOLOGY</b></p>
<p>Scope of analysis: Ex-ante cost-effectiveness analysis of several options to reduce water pollution from Hg, Cd, Pb, Zn, Cu, Ni, Cr and As. In addition, the study also considers side-effects of measures on climate change, acidification potential and eutrophication. The cost-effectiveness of some 200 options is calculated on the national level for the Netherlands.</p>
<p>Definition of effectiveness: Effectiveness is measured as the reduced emissions of Hg, Cd, Pb, Zn, Cu, Ni, Cr and As into the water environment. As some measures may affect emissions of different substances, the emissions were aggregated using four different weighing mechanisms. In addition, side-effects of the measures on climate change, acidification and eutrophication are calculated. For the emissions of CO<sub>2</sub>, N<sub>2</sub>O, NO<sub>x</sub>, SO<sub>2</sub> and SO<sub>x</sub>, emissions were calculated based on the energy consumption of measures.</p>
<p>Definition of costs and cost-effectiveness:                  The distinction of cost categories is based on a report issued by the Dutch Ministry of Spatial Planning, Housing and the Environment, "Costs and benefits in environmental policy: definitions and computational methods". The report considers annualised cost figures.                  This document would require that the following cost categories be considered:                  Capital costs, i.e. annualised investment costs, consisting of depreciation and interest payments;                  Operating costs, consisting of labour cost, energy costs, administrative overhead and other costs;                  Operational incomes (deducted as negative costs), including savings on energy and raw material inputs, reduced insurance fees and earnings from sales of by-products.                  However, the data base used for the analysis only reported capital costs, with operational costs only roughly estimated as a fixed percentage (3%) of capital costs. Since this percentage is the same for all measures, it would not have an impact on the ranking of different measures, operating costs were not considered in the analysis. It is mentioned that the analysis used average costs rather than marginal costs (which would be the theoretically appropriate unit), since data on average costs was more widely and more easily available.                  Cost-effectiveness is defined as costs (expressed in monetary terms) divided by effects (measures in reduced environmental pressure, e.g. kg of emissions reduced), so that a low cost-effect ratio indicates a high level of cost-effectiveness.</p>
<p>Definition of baseline: None specified. The report mentions that scenario analysis has been used to test the impact of the choice of weights, but does not specify which scenarios were used.</p>
<p>Treatment of confounding factors: The study discusses the problem that one measure may have different impacts on different types of water pollution. To be able to compare them, weighing of the different impacts is necessary. Different weights are discussed and included in the sensitivity analysis. Likewise, the study discusses interactions between different measures and ways of accounting for these in the cost-effectiveness analysis.</p>
<p>Methodological simplifications applied: To assess costs, the study used average costs instead of marginal costs, since data on average costs is more easily and more widely available.</p>
<p>Models used: none specified.</p>

Tests for Validity: The assessment includes sensitivity and scenario analyses, controlling for variations in the weighing of different water-related impacts (where one measure leads to multiple impacts), the interest rate used, the depreciation model or depreciation period applied, and the policy objective. The study finds that variations in all of these have little influence on the ranking of different options. The study mentions that the impact of using average costs instead of marginal costs should have been subject to a sensitivity analysis, but this was not carried out due to a lack of data.
Ex-ante assessment undertaken: Yes (The study is an ex-ante assessment)
Guidelines used/referred to: Costs and benefits in environmental policy: definitions and computational methods. Dutch Ministry of Spatial Planning, Housing and the Environment. Publicatiereeks Milieubeheer, nr. 1998/6. Zoetermeer
<b>DATA</b>
Data issues: In the introduction, the availability of data is identified as one key problem of conducting a robust CEA. Data for the study were taken from a previous study on communal waste water treatment strategies, which assessed the cost of some 200 measures. However, some of these were excluded from the current study, where parts of the data (either on costs or on effects) were deficient. The report does not provide detailed information about the measures themselves.
<b>CONCLUSIONS / EVALUATION</b>
Robustness of approach: This study considers a vast number of alternative measures and combines these into cost curves. Unfortunately, a list of all measures is missing, so that there is practically no information on the measures themselves. This limits the transparency of the approach, preventing an assessment of whether the results can be generalised to other settings. At the same time, the study is very transparent about the simplifications and assumptions made, and their potential impact on the results of the analysis.
Key Findings: The study finds strong support for the so-called „20-80“ hypothesis, that 80 percent of emission reductions can be achieved at 20% of the total costs. In terms of changing assumptions about weighing methods, interest rates and depreciation periods used, the study found that these have an impact on the total cost, but not on the ranking of options.
Comparison with ex-ante analysis: (The study is an ex-ante analysis)
Practical impact of the analysis: Actual impacts are not specified. The study makes little reference to actual policy processes.
Other:

<b>REFERENCE INFORMATION: CS12</b>
Study title: Kosteneffektiviteit van milieumaatregelen (Cost effectiveness of environmental measures)
Study authors: K. Vringer, A.H. Haanemaijer
Author institution: Rijksinstituut voor Volksgezondheid en Milieu (RIVM)
Author URL: <a href="http://www.rivm.nl/">http://www.rivm.nl/</a>
Clients / contracting authority / Target audience: Dutch Ministry of Spatial Planning, Housing and the Environment
Year of publication: 2000

Year of the case / data: 1998-1999
Availability: RIVM rapport 773008002
Availability URL: <a href="http://www.rivm.nl/bibliotheek/rapporten/773008002.pdf">http://www.rivm.nl/bibliotheek/rapporten/773008002.pdf</a>
Status: published research report
Language of the document: Dutch, with an English abstract
Country(ies): Netherlands
Policy area: acidification
Details of legislation: The study is not connected to any specific legislative item, but was carried out in the context and support of the 4 <sup>th</sup> national environmental policy plan (NMP4)
Legal obligation: none
Type of analysis: ex-ante, cross-measure comparison.
Purpose: The study analyses more than 100 environmental measures that contribute to reducing emissions of acidifying emissions (mainly NO <sub>x</sub> , SO <sub>2</sub> and NH <sub>3</sub> emissions) and compares these in terms of their cost-effectiveness. It suggests an order of potential measures, and demonstrates how the cost of these measures are distributed among economic sectors. The study was carried out to calculate the cost-effectiveness curves for NO <sub>x</sub> and acidification, and supported the 4 <sup>th</sup> National Environmental Policy Plan (NMP4).
Perspective and level of detail: environmental perspective, containing both theoretical discussion of the methodology and applied evaluation.
Summary: RIVM carried out an ex-ante cost-effectiveness study of different options to reduce acidifying emissions in the Netherlands. The study considered more than 100 measures targeted at different sectors and at different acidifying pollutants (mainly NO <sub>x</sub> , SO <sub>2</sub> and NH <sub>3</sub> ). The cost-effectiveness of the different measures was calculated per kiloton of reduced pollutant emissions as well as per 1000 acid equivalents. Impacts on other pollutants unrelated to acidification were also considered. The study is national in scope and based on long-term projections (until 2030).
<b>DETAILS OF MEASURES EVALUATED</b>



<p>Policy measure(s) evaluated: The study evaluates more than 100 measures targeted at the reduction of NO<sub>x</sub>, SO<sub>2</sub>, NH<sub>3</sub>, VOC, CO and PM10. The measures are classified as technical measures (including end-of-pipe, process-integrated or product measures), volume measures (affecting the scale of activities), or organisational measures. They are further distinguished according to the target sector (transport, utilities, industry, refineries, agriculture, waste, households, and commerce, services &amp; government).</p>
<p>Original objectives of measure: The measures aim at reducing emissions of acidifying substances (NO<sub>x</sub>, SO<sub>2</sub>, NH<sub>3</sub>). In addition, the effects of these measures on VOC, carbon monoxide and fine particulate matter are also considered.</p>
<p>Data collection methods/reporting requirements: Data is gathered from a range of academic reports, grey literature and results of research projects, but also from environmental reports by firms in the chemical industry and metal production.</p>
<p>Other:</p>
<p><b>METHODOLOGY</b></p>
<p>Scope of analysis: Ex-ante cost-effectiveness analysis of several options to reduce acidification potential, esp. NO<sub>x</sub> emissions. Impacts on emissions of VOC, fine particles and carbon monoxide are also considered. The development and refinement of the CEA methodology was in itself part of the project and is documented in the report.</p>
<p>Definition of effectiveness: Effectiveness is measured as the reduced emissions in kilotons of three acidifying substances (NO<sub>x</sub>, SO<sub>2</sub> and NH<sub>3</sub>). Based on the acidification potential of the three different substances, the sum of these three is calculated as the acidification equivalent.</p>
<p>Definition of costs and cost-effectiveness:                  The distinction of cost categories is based on a report issued by the Dutch Ministry of Spatial Planning, Housing and the Environment, "Costs and benefits in environmental policy: definitions and computational methods". Based on this, the following cost categories are considered:                  Annualised investment costs, including start-up costs, installation costs and transaction costs;                  Operating costs;                  VAT in the case of expenditure by private households and government                  Subsidies and taxes                  Savings on energy and raw material inputs (deducted as negative costs)                  In assessing these costs, the study considers the influence of the depreciation method chosen, the interest rate applied, and the amortisation period.</p> <p>Cost-effectiveness is simply defined as costs (expressed in monetary terms) divided by effects (measures in reduced environmental pressure, e.g. kg of emissions reduced). It is mentioned that the effectiveness of one measure will often depend on whether other measures are in place, and on the timing of the implementation. These factors are mentioned, but not addressed in detail.</p>
<p>Definition of baseline: The baseline is established by the "European Coordination" scenario, one of three long-term scenarios for the development of key environmental pressures identified by the Dutch Central Planning Bureau.</p>
<p>Treatment of confounding factors: Interactions / interdependencies between different measures, as well as the timing of measures, are mentioned, but is only included in the sensitivity analysis. The study also discusses the case of measures having multiple impacts beyond their main target (i.e. impact on VOC or particle emission reductions, in addition to acidification potential alone).</p>
<p>Methodological simplifications applied:</p>
<p>Models used: excel-based model developed by RIVM in order to calculate cost-effectiveness ratios of the measures, to build cost curves of the abatement options for different pollutants, and to combine the different options based on the acidification potential of pollutants</p>

Tests for Validity: The assessment includes sensitivity testing, controlling for variations in the interest rate used, the depreciation model or depreciation period applied, inclusion of indirect or social costs, effect of interactions between measures, and the impacts of relative price changes.
Ex-ante assessment undertaken: Yes (The study is an ex-ante assessment)
Guidelines used/referred to: Costs and benefits in environmental policy: definitions and computational methods. Dutch Ministry of Spatial Planning, Housing and the Environment. Publicatierreeks Milieubeheer, nr. 1998/6. Zoetermeer
<b>DATA</b>
Data issues: Data for the analysis was obtained from a range of academic publications, government research reports, official statistics and from different firm-level environmental performance reports from the chemical industry and the steel manufacturing sector.
<b>CONCLUSIONS / EVALUATION</b>
Robustness of approach: This study is a special case in that it considers a vast number of alternative measures and combines these into cost curves. While all measures are listed in an annex, the level of detail of the information provided for each measure is obviously limited. This also means that the transparency of the approach is restricted, preventing an assessment of whether the results can be generalised to other settings.
Key Findings: Compared to the base year 1995, the total emission reduction of the package of measure analysed in the study amounts to 9 billion acid equivalents in 2020. Across all measures, the averaged cost-effectiveness is roughly 200 Euro per 1000 acid equivalents. The largest share (50%) of the total emission reductions can be realised through measures in the transport sector, however these measures are also most costly at 320 Euro per 1000 acid equivalents. Measures taken by industry are relatively cheapest at 55 Euro per 1000 acid equivalents, and contribute a quarter of the total reduction potential. Changes in the interest rate affect the total predicted cost of emission reductions, but not the ranking of different measures.
Comparison with ex-ante analysis: (The study is an ex-ante analysis)
Practical impact of the analysis: It was expected that results would provide input to the 4 <sup>th</sup> National Environmental Policy Plan (NMP4). Actual impacts are not specified.
Other:
<b>REFERENCE INFORMATION: CS13</b>
Study title: Milieukosten energiemaatregelen 1990-2010 - Overzicht kosten en mogelijke verbeteringen in de monitoring (Environmental costs of energy measures 1990-2010 – Overview of costs and possible monitoring improvements)
Study authors: P.G.M. Boonekamp, P.G.M., J.P.M. Sijm J.P.M. and R.A. van den Wijngaart, R.A.
Author institution: Rijksinstituut voor Volksgezondheid en Milieu (RIVM)
Author URL: <a href="http://www.rivm.nl/">http://www.rivm.nl/</a>
Clients / contracting authority / Target audience: Environmental and Nature Planning Bureau (Milieu- en Natuurplanbureau), RIVM
Year of publication: 2004

Year of the case / data: 1990-2010
Availability: RIVM rapport 773001026
Availability URL: <a href="http://www.rivm.nl/bibliotheek/rapporten/773001026.html">http://www.rivm.nl/bibliotheek/rapporten/773001026.html</a>
Status: published report
Language of the document: Dutch, with an English abstract
Country(ies): The Netherlands
Policy area: air quality, climate change / energy, population and economy
Details of legislation: n/a
Legal obligation: n/a
Type of analysis: ex-post and ex-ante, cross-measure comparison.
Purpose: research report, external document
Perspective and level of detail: environmental perspective. Provides a survey of the cost-effectiveness of reducing energy-related CO <sub>2</sub> -emissions on a sectoral level and for different government programmes, but not on the level of individual measures.
Summary: This report presents the costs of reducing CO <sub>2</sub> emissions with an emphasis on the environmental costs of savings on fossil fuel consumption. First, the principles of calculating costs and cost effectiveness are presented. Then, using a number of data sources on the historic costs of saving measures, the cost effectiveness is estimated for different sectors and the years 1995 and 2000. The cost effectiveness of different measures is also determined for the period up to 2010, using the results of scenarios with and without policy measures. Finally an analysis is presented of the possibilities to determine more structurally the environmental costs in the field of energy policy.
<b>DETAILS OF MEASURES EVALUATED</b>

Policy measure(s) evaluated: The analysis considers a range of measures taken to reduce CO <sub>2</sub> emissions from different sectors. The individual measures are not presented in detail, but rather sorted by economic sector and by the government programme under which they were carried out. The classification into government programmes means that the comparability of measures is limited, as the number and type of measures supported by the programmes may differ.
Original objectives of measure: The measures considered are all aimed at reducing CO <sub>2</sub> emissions, either in households, industry, agriculture/horticulture or in the public sector.
Data collection methods/reporting requirements: Analysis is partly based on the data reported for different emission reduction programmes conducted in the Netherlands.
Other:
<b>METHODOLOGY</b>
Scope of analysis: Comparison of the cost-effectiveness of different programmes to reduce CO <sub>2</sub> emissions in the Dutch energy sector between 1990 and 2000, sorted by economic sectors. Partly based on this, the cost-effectiveness of further emission reductions in the period 2000 – 2010 is assessed, with a focus on the sectoral distribution of the expected costs.
Definition of effectiveness: Measures are evaluated based on the tons of CO <sub>2</sub> emissions they reduce.
Definition of costs and cost-effectiveness: Costs are defined as the sum of investments and other expenses related to CO <sub>2</sub> -reducing measures, less the saved energy costs and other earnings related to the measures. Investment costs are calculated as annuities. For the calculation of the costs, the study distinguishes between two calculation methods: if costs are calculated as ‘national costs’ the nationwide economic costs to society are included, irrespective of who is carrying out the measures. If the costs are calculated as ‘end user costs’, the actual expenditures by firms and households are considered, giving an overview of the sectoral distribution of costs. The main difference between the two is in the treatment of subsidies (not included in the national cost, as they are merely a reallocation of costs from the private to the public sector), and the choice of discount rate (which is substantially higher in the calculation of end user costs). Cost-effectiveness is measured as cost per reduced ton of CO <sub>2</sub> emissions, i.e. comparing the costs of measures (less the value of saved energy) against the emission reductions achieved. The report also mentions the concept of “subsidy efficiency”, whereby the amount of government subsidies and the emission reductions achieved are compared across sectors.
Definition of baseline: The reference scenario is the “no action” scenario, where no new policy measures are taken in addition to existing ones, and where the effect of existing policy measures is assumed to wear off and converge to zero at the end of the period.
Treatment of confounding factors: n/a
Methodological simplifications applied: Analysis is carried out on the level of government policies and programmes for emission reduction rather than specifying individual measures.
Models used: none
Tests for Validity: The analysis presents results for two different cost estimation methods (national vs. end-user cost approach), often with diverging results.
Ex-ante assessment undertaken: Yes
Guidelines used/referred to: “Costs and benefits in environmental policy: definitions and computational methods”. Dutch Ministry of Spatial Planning, Housing and the Environment. Publicatiereeks Milieubeheer, 1998/6. Zoetermeer

DATA
Data issues: Data for the analysis was obtained from different databases with CO <sub>2</sub> reduction measures, including the SENTER, IDEE and ECN databases, projects listed in the Dutch CO <sub>2</sub> reduction plan (CRP), and data gathered under the Environmental Action Plan (MAP).
CONCLUSIONS / EVALUATION
Robustness of approach: The study combines an ex-ante with an ex-post assessment. There is a strong focus on the comparison of different cost calculation methods (national costs vs. end user costs). The results of the analysis are presented for different programmes and policies targeted at CO <sub>2</sub> reduction, rather than at the level of individual measures. This leads to the problem that the comparability of programmes and policies may not always be given.
Key Findings: The analysis of past emission reduction activities revealed that both for the national cost approach and the end user cost approach, the costs of measures are often negative. This means that the initial investment is more than compensated by the cost of saved energy. Due to rising energy prices, this tendency has become even more visible over the years. In most cases, the reduction costs would tend to be lower if they are valued on the basis of the end user cost method, and higher with the national cost method. For the assessment of future emission reductions until 2010, the study calculates a total reduction potential of 15 Mton. The annual 'national cost' for this amounts to 763 Million Euro, or 50 Euro per ton of CO <sub>2</sub> . If considered as 'end user cost', however, the cost of future emission reductions actually turns negative, at a total of 1.3 billion Euro or 73 Euro per ton of CO <sub>2</sub> .
Comparison with ex-ante analysis: The study contains both an ex-ante and an ex-post analysis. Results of the ex-post analysis for the period 1990-2000 are projected into the future until 2010, so that a comparison of the results is not possible.
Practical impact of the analysis: no information available.
Other:
REFERENCE INFORMATION: CS15
Study title: Beoordeling van de Uitvoerinsnotitie Emissieplafonds verzuring en grootschalige luchtverontreiniging 2003 (Evaluation of the Implementation memorandum for emission ceilings, acidification and large-scale air pollution 2003)
Study authors: J.P. Beck, R.J.M. Folkert, W.L.M. Smeets
Author institution: Rijksinstituut voor Volksgezondheid en Milieu (RIVM)
Author URL: <a href="http://www.rivm.nl/">http://www.rivm.nl/</a>
Clients / contracting authority / Target audience: Directorate General for Environmental Policy at the Netherlands Ministry of Housing, Spatial Planning and the Environment ( <a href="http://www.vrom.nl/international">www.vrom.nl/international</a> )
Year of publication: 2004
Year of the case / data: 2000 - 2010
Availability: RIVM rapport 500037003/2004
Availability URL: <a href="http://www.rivm.nl/bibliotheek/rapporten/500037003.pdf">http://www.rivm.nl/bibliotheek/rapporten/500037003.pdf</a>
Status: published report

Language of the document: Dutch, with an English abstract
Country(ies): The Netherlands
Policy area: air quality, acidification
Details of legislation: The study evaluates a national programme for the reduction of SO <sub>2</sub> , NO <sub>x</sub> , NH <sub>3</sub> and VOC emissions. The programme, which is documented in the implementation memorandum 'Make it or Break it' ('Erop of Eronder'), was adopted in the framework of national implementation of the National Emissions Ceilings Directive, Directive 2001/81. ( <a href="http://www.vrom.nl/pagina.html?id=10142">http://www.vrom.nl/pagina.html?id=10142</a> )
Legal obligation: n/a
Type of analysis: ex-ante, cross-measure comparison.
Purpose: research report, external document
Perspective and level of detail: environmental perspective. Scoping study, general approach.
Summary: The Dutch Cabinet has set down a national programme, drawn up in the framework of the European Directive on national emission ceilings (the NEC Directive), in an Implementation Memorandum, 'Erop of eronder'. On request of the Cabinet, the Netherlands Environmental Assessment Agency (MNP) – RIVM took on the evaluation of the objectives and costeffectiveness of this programme. Conclusions and recommendations are reported here. A major conclusion is the strong probability that the Netherlands will not meet its international emission obligations for 3 out of 4 NEC compounds, SO <sub>2</sub> , NO <sub>x</sub> and VOCs. Many of the measures and options for additional measures are not concrete and lack sufficient policy instruments for implementation. The choice made to translate national ceilings into sector targets has not been accepted by any of the sectors. This increases the risks surrounding implementation because of the uncertainty in the results of the policy package. Furthermore, the passage of time may mean that some of the reductions needed cannot be realised, making a declaration of default a very real possibility. In the case of ammonia, current policies may be sufficient to meet the target, although there is still a chance that the emission ceiling will be exceeded. Additional measures proposed are expected to bring the ammonia emissions under the ceiling. It will be possible to update the policy programme in 2006. In the meantime, it still remains to be seen whether 'Make it or break it' has set out the right implementation course for realising the Dutch national emission ceilings.
<b>DETAILS OF MEASURES EVALUATED</b>
Policy measure(s) evaluated: The report analyses two general types of environmental policy measures. <i>Hard</i> policy measures are those that are fully elaborated and supported by legal and economic instruments. The responsibilities and the funding for these measures are clearly allocated, and there is reasonable certainty about the expected results. <i>Soft</i> policy measures, by contrast, are those that are still in the process of development and refinement, and where suitable supporting instruments still need to be established. The individual measures are sorted by pollutants and by economic sectors. A total of some 50 measures is considered in the report, including several permutations and variants of otherwise similar measures.
Original objectives of measure: The study considered a range of measures aimed at reducing emissions of SO <sub>2</sub> , NO <sub>x</sub> , NH <sub>3</sub> and VOC, for the sectors industry, transport, private households, trade and services and agriculture. Several measures also had beneficial side effects in terms of reducing CO <sub>2</sub> emissions and other emissions.
Data collection methods/reporting requirements: not specified
Other:
<b>METHODOLOGY</b>



<p>Scope of analysis: Scoping study to assess whether objectives of the National Emission Ceilings Directive can be achieved, and to compare potential measures across sectors.</p>
<p>Definition of effectiveness: Measures are assessed based on their potential to contribute to emission reductions of the four pollutants considered (SO<sub>2</sub>, NO<sub>x</sub>, NH<sub>3</sub> and VOCs). The total emission reduction potential of the different measures is reported as 95% confidence intervals, i.e. reporting upper and lower bounds for the expected emissions in 2010.</p>
<p>Definition of costs and cost-effectiveness:                  The document does not provide a definition of the costs included in the study; many cost estimates appear to be based on previous research reports. The report does not distinguish explicitly between investment costs, operational costs or capital costs, however it does assess in some detail the distribution of costs among economic sectors. It is noted that the administrative cost of implementing the measures described is negligible, as costs are mainly borne by the private sector.                  The cost-effectiveness of the measures is described as the costs in Euro / kg of reduced emissions. Cost-effectiveness figures are reported as bandwidths, with the upper bound often exceeding the mean by a factor of 10.</p>
<p>Definition of baseline: As a reference scenario, the report calculates the projected emissions and likelihood of target achievement for a scenario with no further policy action (only those policy measures already implemented or in the pipeline). This reference scenario does not include several influencing factors (both positive and negative), such as the CAP reform. Without further action, the emission ceilings for 2010 for SO<sub>2</sub>, NO<sub>x</sub> and VOC will most probably not be reached, while target attainment for the NH<sub>3</sub> ceiling is inconclusive.</p>
<p>Treatment of confounding factors: The analysis presents some calculations for the effects of measures on other pollutants, such as CO<sub>2</sub>, PM<sub>10</sub>, methane and nitrates. These effects are either quantified or assessed in qualitative terms, but are not included in the cost-effectiveness analysis itself, but are mentioned as additional variables.</p>
<p>Methodological simplifications applied: cost figures are based on estimates from previous studies, and are not reported in detail. Costs are reported as broad ranges.</p>
<p>Models used: The RAINS model is used to assess the impact of the National Emissions Ceilings Directive on air quality in Europe as a whole, however this assessment is not directly related to the analysis of measures.</p>
<p>Tests for Validity: There is no sensitivity analysis, but the report does provide bandwidths for costs and effectiveness to indicate the likelihood of target achievements.</p>
<p>Ex-ante assessment undertaken: Yes (the analysis is an ex-ante assessment)</p>
<p>Guidelines used/referred to: none</p>
<p><b>DATA</b></p>
<p>Data issues: The data base for the report is not documented in detail. Data on the costs of some measures, as well as the baseline scenario for future pollutant emissions, are based on previous research projects.</p>
<p><b>CONCLUSIONS / EVALUATION</b></p>
<p>Robustness of approach: The analysis is general in nature, providing an assessment of the likelihood that the objectives of the National Emission Ceilings Directive will be reached in the Netherlands, and a scoping of necessary additional measures. The analysis focuses on hard vs. soft measures, defined as measures that are either already in the policy making process, or measures that still lack a solid legal and administrative underpinning.</p>



Key Findings: The analysis reveals that the targets of the National Emission Ceilings Directive will not be reached in 2010 if no additional measures are taken. If only “hard measures” are taken, the targets will only be met for NH <sub>3</sub> , but not for the other three pollutants. If hard and soft measures are implemented, the targets will be met for NH <sub>3</sub> and SO <sub>2</sub> , but not for NO <sub>x</sub> , with VOC indeterminate. The cost of most measures is moderate at 2 – 5 Euro / kg of reduced emissions. Total annual costs for the hard measures are estimated at 35 – 50 million Euro, against 200 – 250 million Euro if hard and soft measures are implemented.
Comparison with ex-ante analysis: The study is an ex-ante analysis.
Practical impact of the analysis: no information available.
Other:

REFERENCE INFORMATION: CS26
Study title: <i>The Enhanced I/M Program in Arizona: Costs, Effectiveness, and a Comparison with Pre-regulatory Estimates</i>
Study authors: Winston Harrington, Virginia McConnell, Amy Ando
Author institution: Resources for the Future
Author URL: <a href="http://www.rff.org">http://www.rff.org</a>
Clients / contracting authority / Target audience: US Environmental Protection Agency (USEPA) ( <a href="http://www.epa.gov">www.epa.gov</a> )
Year of publication: 1999
Year of the case / data: 1995-6
Availability: Resources for the Future: <a href="http://www.rff.org">http://www.rff.org</a>
Availability URL:
Status: discussion paper (not peer reviewed)
Language of the document: English
Country(ies): USA (Arizona)
Policy area: air quality / transport / air / regions
Details of legislation/treaty: Enhanced Inspection and Maintenance programs in ‘serious’ and ‘severe’ non-attainment areas by the Clean Air Act Amendments of 1990. ( <a href="http://www.epa.gov/oar/caa/contents.html">www.epa.gov/oar/caa/contents.html</a> )
Legal obligation: All subject vehicles (1981 and later models) to report to a centralized inspection station periodically (usually every two years) for an emission test.
Type of analysis: ex post
Purpose: internal document to assess costs and effectiveness of the Enhanced I/M Program and compare these results with those of an EPA ex ante study
Perspective and level of detail: environmental perspective, in-depth analysis, applied evaluation
Summary: This study estimates the cost of the Arizona Enhanced I/M Program and the emission reductions



<p>achieved. The components of I/M costs are identified. This is followed by a description of the empirical information from Arizona and the methodology used to construct cost estimates for both vehicle inspection and repair of failing vehicles. Inspection costs include the costs of operating the test stations and the costs motorists incur in time and money to get to the station and go through the testing process. It is found that the inspection costs account for over two-thirds of the full costs of I/M, while costs associated with actual vehicle repair account for only one third. The study concludes with a comparison of the empirical estimates of costs and program effectiveness in the Arizona program with the ex ante estimated Enhanced I/M program costs made by the EPA in the 1992 Regulatory Impact Analysis (RIA). The ex ante EPA analysis appears to have underestimated the costs of achieving the ambitious reductions in emissions hoped for under I/M.</p>
<p><b>DETAILS OF MEASURES EVALUATED</b></p>
<p>Policy measure(s) evaluated: vehicle emission test</p>
<p>Original objectives of measure: to reduce vehicle emissions of HC, CO and NOx. No targets are reported</p>
<p>Data collection methods/reporting requirements: Inspection stations provide data on: costs of emission test, emission test results and cost of vehicle repairs. The cost of vehicle repairs are self-reported by the motorist or mechanic and given to the inspection stations at the time of testing.</p>
<p>Other:</p>
<p><b>METHODOLOGY</b></p>
<p>Scope of analysis: In-depth cost effectiveness analysis for the improved vehicle emissions test</p>
<p>Definition of effect(iveness): For those vehicles that fail the emissions test, effectiveness is described as: (i) reductions in HC, CO and NOx emissions after repair and (ii) the fuel economy improvements after repair.</p>
<p>Definition of costs and cost-effectiveness: Costs are made up of inspection costs and vehicle repair costs, as listed below. The bearer of each cost is reported in brackets. Costs: travel to/from inspection stations (motorist); queuing at station (motorist); emission test (motorist or taxpayers); and vehicle repairs (motorist or manufacturer). The costs data are combined in order to estimate total cost per vehicle tested. This feeds into the cost-effectiveness analysis. Cost-effectiveness ratio: The cost-effectiveness ratio of Enhanced I/M program in Arizona is given as: cost per vehicle tested / emission reductions (tons per 1000 vehicles).</p>
<p>Definition of baseline: not discussed</p>
<p>Treatment of confounding factors: not discussed</p>
<p>Methodological simplifications applied: The cost of travel to/from inspection stations is estimated by combining an assumed travel time estimate of 27 minutes with an estimate of the value of time (based on the average after-tax manufacturing wage rate, \$8.62 per hour). The cost of time spent at inspection stations is estimated by summing an expected service time of 8.7 minutes and an expected queuing time of 18.3 minutes. This is combined with the estimate for value of time given above.</p>
<p>Models used: None.</p>
<p>Tests for Validity: Two cost effectiveness ratios are reported. They are based on differing weightings for the three emissions. Ratio A weights: HC=1, CO=0.1 and NOx = 2.5. Ratio B weights: HC=1, CO=0.1 and NOx = 1</p>
<p>Ex-ante assessment undertaken: Yes</p>
<p>Guidelines used/referred to: None</p>
<p><b>DATA</b></p>



Data issues: Inspection and repair data collected between January 1995 and May 1996 for the Arizona program. Inspection data provided by the inspection stations. Repair information is self-reported by motorists or mechanics. Queuing time estimates made use of average queue length data for July 1998. It is assumed that operating conditions and practices are the same in 1998 and 1995/6.
<b>CONCLUSIONS / EVALUATION</b>
Robustness of approach: A thorough ex post CEA analysis of the Enhanced I/M program in Arizona and a comprehensive comparison of results with the USEPA's ex ante analysis.
Key Findings: Emission reductions due to enhanced I/M test are given as: HC (13%), CO(13%) and NOx (8%). Total Costs per vehicle tested are estimated as: \$18.98. Cost effectiveness (A weights): \$3661/ton. Cost effectiveness (B weights): \$5408/ton.
Comparison with ex ante analysis: The results of this study are compared with those given in the EPA Regulatory Impact Analysis for the Enhanced I/M rule (USEPA, 1992, see "Other" for details). Overall, the EPA's total cost estimates are about 15% below the estimates of costs for the Arizona program (\$16.94 compared with \$18.98). This is mainly due to differences in fuel economy improvements. The EPA estimates that fuel economy for failed vehicles will improve on average by 12.6%. This study estimates a much smaller improvement, at 3.5% better than pre-repair levels. The EPA's ex ante estimates of the costs of other aspects of the program, however, are much closer to the ex post estimates of the cost outcomes reported in this study. For both studies the costs of inspecting vehicles are a large fraction of the total costs of the program. For the EPA analysis, the inspection costs are almost all of the costs; in this study they are over two thirds of the total costs. The emission reductions reported by the EPA are greater by a wide margin than those found for Arizona in this study. While EPA had HC and CO emission rates falling by 33% and 39% respectively, the Arizona analysis finds reductions in these pollutants at 12-13% only. Both estimates put NOx rate reductions at about 7%. The EPA forecasts for emissions reductions may be explained by the differences in programs analysed. The EPA program had more stringent emission limits for all three pollutants. The costs of the Arizona Enhanced I/M program are slightly greater than the EPA ex ante estimate, and the estimated emission reductions achieved are much lower. To achieve the emission reductions envisioned by the EPA in 1992, the Arizona program would be even more costly. It is assumed that at tighter emissions levels costs rise more than in proportion to emission reductions. It is concluded that the pre-regulatory estimates of the costs of achieving the forecasted emission reductions from I/M were underestimated.
Practical impact of the analysis: not discussed
Other: Further research suggestion: In-depth analysis of the relationship between changes in vehicle emission levels and the associated costs. Reference for the ex ante study: US Environmental Protection Agency (1992), "I/M Costs, Benefits and Impacts", Ann Arbor, Office of Mobile Sources (November).

<b>REFERENCE INFORMATION: CS30</b>
Study title: <i>Are the Costs of Proposed Environmental Regulations Overestimated? Evidence from the CFC phaseout</i>
Study authors: Hammitt, James K.
Author institution: Harvard School of Public Health
Author URL: <a href="http://www.hsph.harvard.edu/facres/hmmtt.html">http://www.hsph.harvard.edu/facres/hmmtt.html</a>
Clients / contracting authority / Target audience: No client. Target audience is academics/researchers.
Year of publication: 2000



Year of the case / data: 1986-1994
Availability: Environmental and Resource Economics 16(3):281
Availability URL:
Status: peer-reviewed journal-published paper
Language of the document: English
Country(ies): USA
Policy area: Ozone / industry / air
Details of legislation/treaty: The Montreal Protocol on Substances that Deplete the Ozone Layer (1987) and subsequent amendments (London, 1990 and Copenhagen, 1992) ( <a href="http://www.undp.org/seed/eap/montreal">www.undp.org/seed/eap/montreal</a> )
Legal obligation: Executive Orders 12291 and 12866 to use benefit-cost analysis in regulatory impact analyses of proposed regulations imposing annual costs exceeding \$100 million (or meeting other criteria of 'major' impact). "The Unfunded Mandates Reform Act of 1995 requires executive agencies to conduct analyses of the costs and benefits of major rules and to justify selecting any but the 'least costly, most cost-effective or least burdensome' option."
Type of analysis: ex post
Purpose: Academic paper
Perspective and level of detail: Fiscal perspective, academic analysis
Summary: Benefit-cost and cost-effectiveness analysis are often advocated for decision making about environmental, health, and safety regulations, but there has been little research evaluating the accuracy of prospective estimates of regulatory costs and benefits. Prospective estimates of the marginal cost of limiting chlorofluorocarbon (CFC) consumption in the United States, published shortly before and after the September 1987 adoption of the Montreal Protocol, are compared with retrospective estimates based on realized market prices. Estimates published before international regulations were adopted (in May 1986) substantially overestimate the marginal costs of limiting CFC-11 and CFC-12 consumption but modestly underestimate the costs of limiting CFC-113 consumption. In contrast, estimates published shortly after adoption of the Protocol (in August 1988) appear to underestimate the marginal cost of limiting CFC consumption.
<b>DETAILS OF MEASURES EVALUATED</b>
Policy measure(s) evaluated: Tradable permits and excise taxes for the manufacture and import of CFCs
Original objectives of measure: The final amended objective was the elimination of CFC consumption by 1996. Various intermediate targets were also used.
Data collection methods/reporting requirements: No ex nunc (concurrent) reporting requirements detailed.
Other:
<b>METHODOLOGY</b>
Scope of analysis: Comparison of ex ante estimates of marginal costs with control costs of the three main CFCs, as (mostly) discovered through the permit market.
Definition of effect(iveness): Not formally defined, but implicitly a 1kg reduction in CFC consumption.



<p>Definition of costs and cost-effectiveness: Costs are the costs of abatement paid by industry. Cost-effectiveness is not formally defined; marginal abatement costs are used as a proxy.</p>
<p>Definition of baseline: The "baseline" specified by the Montreal Protocol is the CFC consumption status quo in 1986. Three Business-As-Usual "true baselines" (i.e. the world without attempted reductions) are constructed by the authors.</p>
<p>Treatment of confounding factors: Includes discussion of technological change. The fact that the 1990 and 1992 amendments (unforeseen at the time of the ex ante study) probably accelerated consumption reductions is also mentioned.</p>
<p>Methodological simplifications applied: Marginal abatement costs are calculated by adding the permit market price, <math>p</math>, to the excise tax rate, <math>t</math>. This assumes that the market functioned well enough for accurate price revelation (i.e., sufficient liquidity, no market control). Furthermore, the marginal abatement cost is only a proxy for cost-effectiveness, as <math>(p + t) \times</math> (a firm's emissions) only represents a proportion of each firm's abatement costs. Uncertainties over CFC consumption due to illegal imports are by necessity assumed away. Costs do not include changes in consumer and producer surplus.</p>
<p>Models used: None.</p>
<p>Tests for Validity: Sensitivity analysis is to some extent embodied by the use of three different baselines.</p>
<p>Ex-ante assessment undertaken: Yes</p>
<p>Guidelines used/referred to: None</p>
<p>DATA</p>
<p>Data issues: Ex ante estimates were taken from (i) a RAND consultation with technical experts in relevant firms and (ii) a USEPA analysis of technical options for reducing CFC use. Realized market prices were taken from a trade publication.</p>
<p>CONCLUSIONS / EVALUATION</p>
<p>Robustness of approach: A rigorous analysis, albeit using marginal abatement costs instead of a cost-effectiveness ratio. The sensitivity analysis afforded by the use of three different baselines is hardly needed due to large differences in realized and predicted marginal costs.</p>
<p>Key Findings: Realised marginal abatement costs were found to increase from under \$3 per kg in 1986 to over \$15 per kg in 1994. The RAND ex ante estimates of marginal abatement costs for CFC-11 and CFC-12 were very much overestimated, while those for CFC-113 modestly underestimated. This highlights the difficulties of estimating the cost and effectiveness of new technologies. However, the EPA estimates were more accurate in the medium term, presumably because they were published two years after the RAND estimates, therefore encapsulated intervening accrued knowledge, and were more comprehensive.</p>
<p>Comparison with ex ante analysis: RAND Ex ante costs were either very much overestimated or marginally underestimated. EPA cost estimates wildly overestimated for initial reductions, but were accurate for mid-term reductions, diverging again in the longer term.</p>
<p>Practical impact of the analysis: Those undertaking ex ante assessments should be aware of the likely discrepancy between their cost-effectiveness estimate and what actually transpires.</p>
<p>Other:</p>
<p>REFERENCE INFORMATION: CS47</p>
<p>Study title: <i>The cost-effectiveness of biodiversity management: a comparison of farm types in extensively</i></p>



<i>farmed areas of Scotland.</i>
Study authors: Gerard Wynn
Author institution: Macaulay Land Use Research Institute, Aberdeen, UK
Author URL: <a href="http://www.mluri.sari.ac.uk">http://www.mluri.sari.ac.uk</a>
Clients / contracting authority / Target audience: Scottish Executive Environment and Rural Affairs Department ( <a href="http://www.scotland.gov.uk/topics/agriculture">www.scotland.gov.uk/topics/agriculture</a> )
Year of publication: 2002
Year of the case / data: 2000
Availability: Journal of Environmental Planning and Management, 45:827-840.
Availability URL:
Status: peer-reviewed published paper
Language of the document: English
Country(ies): UK (Scotland)
Policy area: Biodiversity change / agriculture / nature / regions
Details of legislation/treaty: Environmentally Sensitive Areas (ESA) were introduced under the 1986 Agriculture Act, and are voluntary arrangements with farmers.
Legal obligation: no obligation to undertake cost-effectiveness analysis for individual ESAs.
Type of analysis: ex post, cross-measure comparison
Purpose: The paper determines whether or not targeting ESA schemes according to different farm types might yield cost-effectiveness gains and is an outcome of the Macaulay Institute research objective 'Methodological development to support economic analysis of natural resource management', No 051908.
Perspective and level of detail: environmental perspective, in-depth analysis, applied evaluation.
Summary: This report compares the cost-effectiveness of biodiversity management of heather, herb-rich grassland and wetland habitats between four different farm types in Scotland. Biodiversity is measured at two spatial levels. Costs to the public exchequer of habitat management are compared with private costs to the farmer. Biodiversity and cost are combined in cost-effectiveness ratios. Biodiversity, cost and cost-effectiveness differentials are found between farm types for all three habitats. Farms incur negligible opportunity costs in the management of all three habitats, implying farmer retention of compensating ESA management payments. It is concluded that greater account of biodiversity and cost characteristics of entrants to agri-environmental schemes would increase the cost-effectiveness and transparency of schemes, and assist towards scheme assessment at the individual farm level.
<b>DETAILS OF MEASURES EVALUATED</b>
Policy measure(s) evaluated: agri-environmental scheme: habitat management
Original objectives of measure: The biodiversity conservation objectives of the scheme are to conserve and enhance the natural beauty, flora and fauna associated with extensive agricultural systems.
Data collection methods/reporting requirements: ESA entrants must undertake a conservation audit.



Other:
METHODOLOGY
Scope of analysis: In-depth cost-effectiveness analysis for participation in heather, wetlands and herb-rich grassland habitat management through ESA schemes.
Definition of effect(iveness): Biodiversity is measured according to two types of species-based measures: habitat suitability and the Shannon index. The habitat suitability measures assign values to species according to their tolerance to an environmental condition characteristic of the habitat, such as wetness and acidity. This measure is not suitable for herb-rich grassland which has no prevailing environmental condition, thus the Shannon index of species diversity (an index which is maximised when the proportion of ground covered by each different plant species is equal) is used.
Definition of costs and cost-effectiveness: Costs: Social costs are measured by government ESA payments. Private costs to the farmer resulting from ESA participation are measured by changes in fixed costs and gross margins resulting from ESA participation. Cost-effectiveness: Measures of cost and biodiversity of each farm type are combined in cost-effectiveness ratios. This is given as: $v = C/B$ where $v$ is the cost-effectiveness ratio, $C$ is the annual cost of management of biodiversity, and $B$ is a physical measure of changes from baseline biodiversity. A lower value for $v$ corresponds to a higher cost-effectiveness of management. Ratios are calculated separately for each habitat, each measure of cost (social or private) and for each measure of biodiversity (at the plot level or farm level).
Definition of baseline: status quo in 1997
Treatment of confounding factors: not discussed
Methodological simplifications applied: Four farm types are used. Three of these were defined as farms in less favoured areas (LFA), that is, rural areas with land of poor productivity and low population. The four farm types are: cattle and sheep (LFA), mixed, specialist beef (LFA) and specialist sheep (LFA).
Models used: none
Tests for Validity: Biodiversity measures are compared to findings reported by the ESA conservation audit data (SEERAD, 1997a)
Ex-ante assessment undertaken: No
Guidelines used/referred to: not discussed
DATA
Data issues: All data were collected in 1997. Biodiversity data were collected from all 10 ESA in Scotland at two spatial levels (i) plot level and (ii) farm level, measuring the presence and area of plant species and semi-natural habitats, respectively. At the plot level, square plots were 4 m <sup>2</sup> in size for the herb-rich grassland and wetland habitats, and 200 m <sup>2</sup> for heather. Plot-level data were derived from environmental monitoring of the ESA scheme in 1997 (Cummins et al., 2000). Farm level data recorded the area of herb-rich grassland, wetland and woodland on the farm unit where the plot was situated, and were derived from a Scottish Executive Environment and Rural Affairs Department (SEERAD) census of ESA entrant conservation audits (SEERAD, 1997a). Habitat suitability measures are those developed by the Agricultural Development and Advisory Service (1995) as applied to the ESA environmental monitoring programme in Scotland (Cummins et al., 2000). Social costs are reported as per hectare 1997 ESA capital payments compensating farmers for conservation outlays in heather, herb-rich grassland and wetland management (SEERAD, 1997b). Private costs are taken from data on 252 farms participating in the ESA in 1997 (Crabtree et al., 1999).
CONCLUSIONS / EVALUATION



Robustness of approach: A thorough cost-effectiveness analysis
Key Findings: Specialist sheep farms (LFA) are found to require the least per hectare capital compensation for habitat management (£57/ha), while mixed farms require the most (£111/ha). Overall, private costs were found to be neither consistently larger nor smaller than the social costs. Cost-effectiveness ratios were calculated separately for public and private costs. At the plot level, using measures of government costs, cattle and sheep (LFA) farms were the most cost-effective managers of heather (low costs combined with mid-range biodiversity scores) and mixed farms were the most cost-effective managers of herb-rich grassland (very low costs). Overall, wetland management cost-effectiveness ratios are poor relative to heather and herb-rich grassland management. Although mixed farms had the highest wetland biodiversity scores, they were also the most expensive managers of wetlands, and as a result do not emerge the most cost-effective managers of wetlands.
Comparison with ex ante analysis: not discussed
Practical impact of the analysis: The report recommends that greater account be given to biodiversity and management cost in selecting entrants to agri-environmental schemes. This would increase the cost-effectiveness and transparency of the scheme and thus enable measurement of scheme success at the farm level.
Other:

REFERENCE INFORMATION: CS49
Study title: <i>Cost Effective Reduction of Copper Pollution in the Humber Estuary</i>
Study authors: Beamont, N. and Tinch, R.
Author institution: The Centre for Social and Economic Research on the Global Environment (CSERGE), School of Environmental Sciences, University of East Anglia, Norwich, UK
Author URL: <a href="http://www.uea.ac.uk/env/cserge">http://www.uea.ac.uk/env/cserge</a>
Clients / contracting authority / Target audience: Environment Agency for England and Wales, UK ( <a href="http://www.environment-agency.gov.uk">www.environment-agency.gov.uk</a> )
Year of publication: 2004
Year of the case / data: 1990-1996
Availability: CSERGE Working Paper ECM 03-04, CSERGE, University of East Anglia, UK
Availability URL: <a href="http://www.uea.ac.uk/env/cserge/pub/wp/ecm/ecm_2003_04.pdf">http://www.uea.ac.uk/env/cserge/pub/wp/ecm/ecm_2003_04.pdf</a>
Status: working paper
Language of the document: English
Country(ies): UK
Policy area: Chemicals / Industry / water
Details of legislation/treaty: European Dangerous Substance Directive (76/464/EEC) ( <a href="http://europa.eu.int/eur-lex/lex/en/index.htm">europa.eu.int/eur-lex/lex/en/index.htm</a> )
Legal obligation: Environment Agency obligation to meet Environmental Quality Standards (EQS) for



copper in the Humber Estuary
Type of analysis: ex post, cross-measure comparison
Purpose: Discussion paper presenting abatement cost curves for the reduction of industrial sources of copper to the Humber estuary.
Perspective and level of detail: environmental and private cost perspective, scoping document, applied evaluation
Summary: The Environment Agency is obliged to meet the Environmental Quality Standard (EQS) for copper in the Humber estuary, and as a result considerable investment has been made to reduce copper discharges to the estuary. Despite this reduction, the copper concentration in the Humber still occasionally exceeds the EQS of 5µg/l. To ensure the reduction of copper inputs in the future is effective and efficient it is essential to understand the economic implications of reducing waste discharges. This paper aims to detail a cost-effectiveness analysis for the reduction of industrial sources of copper to the Humber estuary. All industries which discharge copper to the Humber were identified, and all the abatement options available to them were collated. A detailed analysis of currently available copper abatement technologies, and their associated costs, is undertaken. This economic analysis permits the representation of the copper abatement information in a transparent format, which is of use to environmental policy decision-makers. The development of abatement cost curves highlights the most effective and efficient way of reducing copper discharges, and also provides a valuable insight into the potential for de-coupling environmental degradation from economic development.
<b>DETAILS OF MEASURES EVALUATED</b>
Policy measure(s) evaluated: Environmental Quality Standard for copper emissions to the Humber Estuary
Original objectives of measure: The environmental quality standard for copper in estuarine waters aims to keep soluble copper levels below an annual average concentration of 5µg/l.
Data collection methods/reporting requirements: Industries provide relevant information to the Environment Agency in order for them to receive consents to discharge copper to the Humber.
Other:
<b>METHODOLOGY</b>
Scope of analysis: An investigative study to develop abatement cost curves for industrial reductions in copper emissions. Analysis is restricted to industrial discharges of copper. Riverine, sediment, sewerage and diffuse sources of copper to the Humber are outside the scope of this study.
Definition of effect(iveness): Reductions in copper emissions.
Definition of costs and cost-effectiveness: Costs are restricted to the 'first-order' investment costs associated with each abatement technology. These include the initial capital costs for set-up and the subsequent operating costs.
Definition of baseline: not discussed
Treatment of confounding factors: not discussed
Methodological simplifications applied: Different measures have different combinations of initial capital cost and ongoing operating costs. To facilitate a comparison of costs they were converted to a cost per year basis by calculating the annuities equivalent to the actual cost profile using a 5% discount rate and a 10 year time horizon. Certain impacts were excluded from the analysis, as the analysis considers first order costs and benefits only. Impacts excluded from the analysis are as follows: (i) impacts to the national economy, such as increased expenditure, jobs in pollution prevention industry, loss of business to



<p>competitors with lower standards, etc.; (ii) secondary environmental impacts of the abatement technologies, such as simultaneous reductions in other pollutants; and (iii) other secondary effects, such as energy savings, increased recovery of material, improved conditions and safety, enhanced production and reduced running costs. Secondary costs could include indirect costs from the implementation of a new process.</p>
<p>Models used: not discussed</p>
<p>Tests for Validity: It is assumed that the reported abatement measures will become obsolete over time. Thus different time horizons for the lifetime of an abatement measure are used: 5, 10 and 20 years. Longer time periods result in lower costs per year. Sensitivity analysis was also applied by using different discount rates. Higher discount rates (higher opportunity costs of capital) give higher costs per year. Results show similar cost distributions to those reported in Riege-Weislo and Heinze (1996, see "Guidelines" field).</p>
<p>Ex-ante assessment undertaken: No</p>
<p>Guidelines used/referred to: i) Riege-Weislo, W. and Heinze, A. (1996), "The construction of abatement cost curves: methodological steps and empirical experiences", German Environmental Economic Accounting (GEFA), Federal Statistical Office, Federal Republic of Germany. ii) Wickborn, G. (1996), "Avoidance cost curves for NOx", London group meeting on environmental accounting, Third meeting, Stockholm.</p>
<p><b>DATA</b></p>
<p>Data issues: Study area: from the estuary head at Trent Falls to the estuary mouth at Spurn Head. Data are from the period 1990-1996. The Environment Agency provided data on industries and sewage works currently holding consents to discharge copper to the Humber. Further data were collected from the internet, the British Telecom telephone directory, company environmental reports, journals and newspapers. Data on abatement techniques were collated using four methods: a detailed questionnaire, data from the Environmental Industries Commission, scientific literature and extrapolation of data between industries. All data were adjusted for inflation to the baseline year of 1998 using the retail price index.</p>
<p><b>CONCLUSIONS / EVALUATION</b></p>
<p>Robustness of approach: This is a good exploratory analysis of copper abatement technologies and their associated costs. This study is unique because it includes a variety of industry types and includes all combinations of abatement options.</p>
<p>Key Findings: The abatement cost curve informs on the most cost-effective way to achieve a certain standard. As expected the abatement cost curve is a stepwise function constructed from the costs of combinations of discrete abatement measures. Just less than 50% of the total abatement potential can be reached by the implementation of 9 abatement techniques, costing less than 15% of the total costs. The abatement cost curve can be used directly as a policy tool. Certain measures or groups of measures have drawbacks and access to information about similar alternative measures or groups of measures is useful. For example, some abatement measures have non-cost related issues, in this instance the cost curves can be used to provide the next best option. Analysis is limited to technical changes, thus, it is assumed that the estimated abatements costs are an upper bound on the costs of abatement.</p>
<p>Comparison with ex ante analysis: none</p>
<p>Practical impact of the analysis: The process of deriving abatement cost curves can be as valuable as the end result, as this process improves the awareness of abatement technologies and encourages open discussion of pollution reduction options by both the regulator and industries. The methodology used in this study is relevant to many situations since the derivation of abatement cost curves provide information which is critical to ensure that pollution reduction is effective and efficient.</p>
<p>Other:</p>
<p>REFERENCE INFORMATION: CS51</p>

Study title: <i>Economic Evaluation of a Directive on National Emission Ceilings for Certain Atmospheric Pollutants. Part A Cost-Effectiveness Analysis.</i>
Study authors: Markus Amann et al.
Author institution: International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria
Author URL: <a href="http://www.iiasa.ac.at">http://www.iiasa.ac.at</a>
Clients / contracting authority / Target audience: EC Environment DG <a href="http://europa.eu.int/comm/dgs/environment/index_en.htm">europa.eu.int/comm/dgs/environment/index_en.htm</a>
Year of publication: 1999
Year of the case / data: 1990 baseline data, 2010 forecasts
Availability: European Commission, DG Environment
Availability URL: <a href="http://europa.eu.int/comm/environment/enveco/air/cost-effectiveness.pdf">http://europa.eu.int/comm/environment/enveco/air/cost-effectiveness.pdf</a>
Status: published report
Language of the document: English
Country(ies): Particular focus given to EU15, but also all other European countries (excluding Malta and Cyprus but including all European ex-Soviet countries).
Policy area: : Acidification, natural resources & human health /agriculture, energy & transport / air
Details of legislation/treaty: Protocols under the Convention on Long-range Transboundary Air Pollution for reducing emissions of sulphur dioxide (SO <sub>2</sub> ), nitrogen oxides (NO <sub>x</sub> ) and volatile organic compounds (VOC) and the EC Directives on emission standards for large combustion plants, for mobile sources, and the limit of sulphur content in liquid fuels. ( <a href="http://www.unece.org/env/lrtap">www.unece.org/env/lrtap</a> )
Legal obligation: A combination of legally binding legislation and voluntary participation.
Type of analysis: ex ante, cross-country, cross-measure comparison.
Purpose: This study conducts a cost-effectiveness analysis for a number of emission reduction scenarios for SO <sub>2</sub> , NO <sub>x</sub> , VOC and NH <sub>3</sub> for EU15 and other countries.
Perspective and level of detail: environmental perspective, in-depth analysis, applied evaluation.
Summary: This report develops emission reduction scenarios for controlling acidification, eutrophication and ground-level ozone in the EU15 and explores the sensitivity of the optimized emission reductions against variations in a range of important input assumptions. This report is divided into two parts: Part A describes the methodology of the analysis and reviews the present state of the databases used for the scenario calculations, presents the results of the cost-effectiveness analysis and studies the sensitivity of optimized emission reductions against modified input assumptions. Part B explores some of the monetized benefits of the emission reduction scenarios and their international distribution.
<b>DETAILS OF MEASURES EVALUATED</b>
Policy measure(s) evaluated: Groups of abatement measures to meet the environmental long-term targets for the protection of human health and vegetation, in the context of the Commission's acidification and ozone strategies. A number of scenarios are developed that incorporate a variety of emission control measures to achieve varying emissions reductions. These include: 1) The 'Current Reduction Plans' (CRP)



<p>scenario. This incorporates officially adopted or internationally announced ceilings on national emissions, i.e. the Second Sulphur Protocol; 2) The 'Current Legislation' (CLE) scenario explores the impacts of the present legally binding emission control legislation for the European countries, taking into account already accepted regulations which will entry into force in the future; 3) A 'Reference' (REF) scenario. This selects the more stringent emission ceiling for each country; 4) The Maximum Feasible Reductions (MFR) scenario illustrates the potential of a full application of current control technologies and to quantify possible progress towards the ultimate target of full achievement of the environmental long-term targets; and 5) A Central Scenario for Reducing Acidification and Ground level Ozone (Scenario H1). In particular, the scenario aims at reducing: a) the area of ecosystems not protected against acidification by half; b) the health-relevant excess ozone exposure by two thirds, and c) the vegetation-relevant excess ozone exposure by one third.</p>
<p>Original objectives of measure: To reduce acidification, eutrophication and exposure to low level ozone by reducing emissions for SO<sub>2</sub>, NO<sub>x</sub>, VOC and NH<sub>3</sub></p>
<p>Data collection methods/reporting requirements: see 'Data issues' field</p>
<p>Other:</p>
<p><b>METHODOLOGY</b></p>
<p>Scope of analysis: A broad level cost-effectiveness analysis for abatement measures to reduce acidification and eutrophication in Europe.</p>
<p>Definition of effect(iveness): Effect is defined as (i) Reductions in emissions of SO<sub>2</sub>, NO<sub>x</sub>, VOC and NH<sub>3</sub>; (ii) Percentage of ecosystems with acid deposition rates above their critical loads; (iii) Percentage of ecosystems with nitrogen deposition rates above critical load; and (iv) Three indicators for low level ozone : a) number of days on which the WHO health guideline (60 ppb) and 90 ppb levels are exceeded; b) AOT60 values (AOT60 is the cumulative excess exposure over the WHO health guideline of 60ppb over a 6 month period).; and, c) the excess AOT40 over the critical level of 3 ppm.hours (the critical level for ozone exposure above which damage will occur to agricultural crops and natural vegetation).</p>
<p>Definition of costs and cost-effectiveness: Costs: Total emission control costs for all three environmental problems (acidification, eutrophication and exposure to low level ozone) are used. For each of the available emission control options, the RAINS model estimates the specific costs of reductions, taking into account investment-related and operating costs. Investments are annualized over the technical lifetime of the pollution control equipment, using a discount factor of 4%. Cost-effectiveness: comparison of per-capita emission control costs against environmental indices.</p>
<p>Definition of baseline: SO<sub>2</sub>, NO<sub>x</sub> and VOC baseline: This is an official 'business-as-usual' view of energy consumption. It is compiled from a variety of national and international sources. For the EU15 countries, the default projection is the pre-Kyoto (as Kyoto, although a treaty on greenhouse gases, will have implications for emissions of other pollutants from fossil fuels) 'Business as usual' (BAU) scenario of DGXVII (Capros et al., 1997, see 'Other' field for details). NH<sub>3</sub> baseline: IIASA has compiled a set of business-as-usual forecasts for European agricultural activities, based on national information and on international studies.</p>
<p>Treatment of confounding factors: The influence on emissions and control costs of the Kyoto agreement and reforms of the CAP are considered in the sensitivity analysis.</p>
<p>Methodological simplifications applied: Per capita abatement costs are related to the 1997 population of the countries (not the actual population figure for the year). The cost-effectiveness analysis is restricted to a comparison of per capita emission control costs for all pollutants with just the average ozone population exposure index.</p>
<p>Models used: The Regional Air Pollution INformation and Simulation (RAINS) model provides emission estimates for SO<sub>2</sub>, NO<sub>x</sub>, VOC and NH<sub>3</sub> for 1990 and 2010. The ECAM (European Community Agricultural Model) model is used for NH<sub>3</sub> emissions estimates.</p>

<p>Tests for Validity: Emissions: Comparison of the RAINS 1990 emission estimates of NO<sub>x</sub> and VOC with results from the CORINAIR'90 1990 inventory and the EMEP/UN-ECE databases (in kilotons). The following sensitivity analyses are conducted: variation of emissions targets; influence of single effects (the change in emissions and control costs to the EU15 for achieving the emissions targets for acidification only or achieving the low level ozone targets only); ECE-wide targets and measures (the change in emissions and control costs to the EU15 if the entire European ECE-region is included); and modified assumptions on economic drivers, i.e. the Kyoto agreement and a reformed Common Agricultural Policy.</p>
<p>Ex-ante assessment undertaken: no</p>
<p>Guidelines used/referred to: not discussed</p>
<p>DATA</p>
<p>Data issues: The databases on emission control costs are constructed based on the actual operating experience of various emission control options documented in a number of national studies (e.g., Schärer, 1993) as well as in reports of international organizations (e.g., OECD 1992, 1993; Takeshita, 1995; Rentz et al., 1987, Rentz et al., 1996, see 'Other' field for reference details). Country-specific information has been extracted from relevant national and international statistics (e.g., UN/ECE, 1996a). In 1998 the list of control options and the country-specific data used for the cost calculations were presented to the negotiating parties of the Convention on Long-range Transboundary Air Pollution for review and comments received from national experts were incorporated into the RAINS database.</p>
<p>CONCLUSIONS / EVALUATION</p>
<p>Robustness of approach: The study gives an in-depth discussion of the various scenarios in terms of emissions reduction achieved and the corresponding environmental impacts at the country level. The cost-effectiveness analysis is however very limited. It is restricted to a comparison of total per capita abatement costs for all emissions with an environmental index for exposure to low level ozone.</p>
<p>Key Findings: Firstly, findings for the REF scenario. Emissions reductions compared to 1990: NO<sub>x</sub> (48%) VOC (49%) SO<sub>2</sub> (71%) for EU15 and a 55% cut in the non-EU countries, NH<sub>3</sub> (12%). Emission control costs: for NO<sub>x</sub> and VOC these are given as 53 billion Euro/year, out of which 47 billion Euro/year are for the EU-15 countries. Control costs for SO<sub>2</sub> 14 billion Euro/year, of which 77% occurs in the EU countries. Total cost for ammonia reduction is about 0.4 billion Euro/year. Secondly, findings for the MFR scenario for all Europe: Emissions reductions compared to 1990: NO<sub>x</sub> (80%), VOC (75%), SO<sub>2</sub> (90%) and NH<sub>3</sub> (42%) Emission control costs: for NO<sub>x</sub> and VOC total costs amount to more than 110 billion Euro/year. SO<sub>2</sub> control costs are reported at 23 billion Euro/year. Ammonia control costs are reported at 22 billion Euro/year. An 11% reduction (0.8 million tons NH<sub>3</sub>) is caused by the projected decline in livestock numbers; the remaining 31% (2.3million tons NH<sub>3</sub>) is calculated as the consequence of technical control measures. Finally, for the H1 scenario: SO<sub>2</sub> and NO<sub>x</sub> emissions cut by 7% below the 'current legislation' case, VOC by 11% and ammonia emissions by 9%. These measures would increase total emission control costs by 7.5 billion Euro/year, i.e., by 13% compared to the Reference (current legislation) case. Of the additional costs, 11% would be allocated to SO<sub>2</sub> control, 60% to NO<sub>x</sub> and VOC control, and 29% for ammonia.</p>
<p>Comparison with ex ante analysis: not discussed</p>
<p>Practical impact of the analysis:</p>
<p>Other: References: (i) Capros et al. (1997) A Business as Usual Energy Scenario for EU-15. National Technical University of Athens (NTUA), Athens, Greece; (ii) Schärer B. (1993) Technologies to Clean up Power Plants. Experience with a 21 billion DM FGD and SCR Retrofit Program in Germany. Part 1 and 2. Staub - Reinhaltung der Luft 53 (1993) 87-92 , 157-160; (iii) OECD (1992) Emission Control for Nitrogen Oxides and Volatile Organic Compounds - Technology and Costs Compendium. Environment Monographs No. 22. Organization for Economic Co-operation and Development, Paris, France; (iv) Takeshita M. (1995) Air Pollution Control Costs for Coal-Fired Power Stations, IEAPER/17, International Energy Agency IEA Coal Research, London, UK; (v) Rentz O., Remmers J., Plinke E. (eds.) (1987): Proceedings of the Workshop on Emission Control costs, 28.09-01.10. 1987, Esslingen am Neckar,</p>

Germany. Institute for Industrial Production (IIP), University of Karlsruhe, Karlsruhe, Germany; (vi) Rentz O., Schleef H.-J., Dorn R., Sasse H., Karl U. (1996) Emission Control at Stationary Sources in the Federal Republic of Germany. Vol. I: Sulphur Oxide and Nitrogen Oxide Emission Control. French–German Institute for Environmental Research, University of Karlsruhe (TH), Karlsruhe, Germany; (vii) UN/ECE (1996a) Energy Balances for Europe and North America 1992, 1993-2010. United Nations Economic Commission for Europe, Geneva, Switzerland.

REFERENCE INFORMATION: CS52

Study title: *Integrated cost-effectiveness analysis of greenhouse gas emission abatement: the case of Finland*

Study authors: Antti Lehtilä and Sami Tuhkanen

Author institution: VTT Technical Research Centre of Finland

Author URL: <http://www.vtt.fi>

Clients / contracting authority / Target audience: This work has been carried out as part of the Energy and Environment Research Programme of the Technology Development Centre of Finland. Additional funding has been obtained from the Ministry of Environment.

Year of publication: 1999

Year of the case / data: 2005-2040

Availability: VTT Publications 374. VTT Technical Reseach Centre of Finland, Espoo, Finland

Availability URL: [www.vtt.fi/inf/pdf/publications/1999/P374.pdf](http://www.vtt.fi/inf/pdf/publications/1999/P374.pdf)

Status: published report

Language of the document: English

Country(ies): Finland

Policy area: Climate change / population and economy / air

Details of legislation/treaty: Burden-sharing agreement of the EU under the EU's collective Kyoto Protocol target ([unfccc.int/resource/docs/convkp/kpeng.html](http://unfccc.int/resource/docs/convkp/kpeng.html))

Legal obligation: None

Type of analysis: ex ante

Purpose: External document for purpose of exploring Finland's green house gas (GHG) reduction options.

Perspective and level of detail: environmental perspective, general-level analysis

Summary: In Finland, greenhouse gas emissions are expected to increase during the next decades due to economic growth, particularly in the energy intensive industrial sectors. The role of these industries is very central in the national economy. The emission control according to the Kyoto Protocol will therefore be quite difficult and costly. The study analyses the cost-effectiveness of different technical options for reducing the emissions of carbon dioxide, methane and nitrous oxide in Finland. The analysis is preformed with the help of a comprehensive energy system model for Finland, which has been extended to cover all major sources of methane and nitrous oxide emissions in the energy sector, industry, waste management and agriculture. The focus being on technical options, no consideration is given to possible policy



measures, emission trading or joint implementation in the study. Different emissions scenarios are considered, differentiated by different assumptions on security of gas supply, the cost of biomass fuels and generation, wind power potential, costs of other new technologies, costs of energy conservation measures and reduction objectives (i.e., just CO <sub>2</sub> or all greenhouse gases).
<b>DETAILS OF MEASURES EVALUATED</b>
Policy measure(s) evaluated: Energy conservation measures are amongst the factors defining the scenarios examined; however, the different scenarios are more related to different economic assumptions rather than policy alternatives.
Original objectives of measure: Total EU Kyoto commitment is an 8% reduction on 1990 emissions of all six major greenhouse gases by 2008-12 (averaged over this period). Finland's individual target is a 0% reduction on 1990 emissions; while not a reduction on 1990 emissions, this represents a reduction on business-as-usual emissions, therefore will still incur abatement cost and effort.
Data collection methods/reporting requirements: No reporting requirements.
Other:
<b>METHODOLOGY</b>
Scope of analysis: Comparison of the effectiveness and cost of various abatement technologies and different scenarios varying in assumptions on technological and economic trends. Technologies rather than policy measures are addressed.
Definition of effect(iveness): Reduction in greenhouse gas emissions achieved.
Definition of costs and cost-effectiveness: "Emission reduction costs are calculated by subtracting the annual costs of the Reference scenario from the corresponding costs of the reduction scenarios. The costs include the total expenditure in the described system that is due to the changes required to reach the target emissions. Indirect costs, e.g. administrative costs, and the costs which may arise due to the changes in the national economy, are not considered in this study."
Definition of baseline: The "Reference scenario" - business as usual, with no emissions targets or policies set.
Treatment of confounding factors: Growth in economic activity is directly reflected in the demand for energy services.
Methodological simplifications applied: By necessity the study had to condense information about an entire country's economy into a workable simplified model. The assumptions made for this are too technical to detail here. The reader is referred to section 5.3 of the report for details.
Models used: EFOM model of emissions of Finnish industrial CO <sub>2</sub> emissions.
Tests for Validity: Sensitivity analysis is embodied in the use of different scenarios based on different economic assumptions. The reader is referred to section 6.1 of the report for details on these scenarios.
Ex-ante assessment undertaken: The report is an ex ante analysis
Guidelines used/referred to: Scientific guidelines are referred to, but no economic evaluation guidelines.
<b>DATA</b>
Data issues: Data are taken from very many different sources, a mixture of official statistics and academic sources. Three main sources are Statistics Finland, the IPCC and Pipatti (1997), "Potential and cost-effectiveness of reducing methane and nitrous oxide in Finland", Technical Research Centre of Finland.



CONCLUSIONS / EVALUATION
Robustness of approach: The report is very comprehensive, but its broad scope inevitably leaves it vulnerable to data uncertainties.
Key Findings: GHG marginal abatement costs are expected to be about 230 FIM per tonne CO <sub>2</sub> e by 2010. Expected costs are significantly lowered by the inclusion of methane and nitrous oxide abatement options. In addition, "the most significant technical options that appear to become cost-effective by 2010 include the expanding use of biomass in fluidised bed combustion-based combined heat and power plants, and improved recovery boiler systems ... An accelerated wind power programme could also be considered to be among cost-effective measures". The catalytic abatement of nitrous oxide emissions from nitric acid production was also found to be cost-effective.
Comparison with ex ante analysis: This study is ex ante.
Practical impact of the analysis: Recommendations for Finnish GHG abatement.
Other:

REFERENCE INFORMATION: CS53
Study title: <i>Options to Reduce Nitrous Oxide Emissions</i>
Study authors: n.N.
Author institution: AEA Technology, Didcot, Oxfordshire
Author URL: <a href="http://www.aeat.co.uk">http://www.aeat.co.uk</a>
Clients / contracting authority / Target audience: EC Environment DG <a href="http://europa.eu.int/comm/dgs/environment/index_en.htm">europa.eu.int/comm/dgs/environment/index_en.htm</a>
Year of publication: 1998
Year of the case / data: various years
Availability: European Commission, DG Environment
Availability URL: <a href="http://europa.eu.int/comm/environment/enveco/climate_change/nitrous_oxide_emissions.pdf">europa.eu.int/comm/environment/enveco/climate_change/nitrous_oxide_emissions.pdf</a>
Status: published report
Language of the document: English
Country(ies): EU
Policy area: Climate change / industry, energy & agriculture / air
Details of legislation/treaty: Kyoto Protocol ( <a href="http://unfccc.int/resource/docs/convkp/kpeng.html">unfccc.int/resource/docs/convkp/kpeng.html</a> )
Legal obligation: Legal reporting obligations not discussed.
Type of analysis: cross-measure comparison; some cross-country comparison. Cost-effectiveness is discussed ex post, but effectiveness is discussed ex ante.
Purpose: Research document for internal and external use. Presumably will feed into greenhouse gas

emission reduction strategies.
Perspective and level of detail: environmental and fiscal perspective; applied, in-depth analysis
Summary: This report assesses anthropogenic nitrous oxide (N <sub>2</sub> O) emissions and strategies to control them. Section 2 discusses the properties of N <sub>2</sub> O, sources and sinks for the gas, and a global budget for emissions. Section 3 considers emissions within the EU, and sets these into context against global N <sub>2</sub> O emissions and emissions of carbon dioxide and methane. It also identifies the important emission sources within the EU. Section 4 summarises actions which are already proposed by Member States to reduce emissions. Sections 5 and 6 of the report consider in detail options for the reduction of emissions from the agricultural and chemical sectors, while Section 7 considers the options to reduce emissions from combustion processes. The cost-effectiveness of the different measures is then evaluated in Section 8. Section 9 contains projections of N <sub>2</sub> O emissions up to 2020 under a 'business as usual' scenario and under a 'with measures' scenario, and Section 10 contains a summary of the report.
<b>DETAILS OF MEASURES EVALUATED</b>
Policy measure(s) evaluated: Policy measures are relevant only for projecting environmental outcome, not for assessing cost-effectiveness. Policy measures discussed include: (non-agricultural) energy efficiency improvements, reduction of transport demand, etc. ; (agricultural) set-aside, agri-environment schemes, nitrate vulnerable zones, etc. Technical options are discussed in more detail than policy measures.
Original objectives of measure: Total EU Kyoto commitment is an 8% reduction on 1990 emissions of all six major greenhouse gases by 2008-12 (averaged over this period). Nitrous oxide reductions will play a minor part in this compared to carbon dioxide.
Data collection methods/reporting requirements: see "data issues" field
Other:
<b>METHODOLOGY</b>
Scope of analysis: Works out cost per ton reduction of various technological options in the past, and works out the predicted reductions from each option until 2020 - but does not go the whole hog and calculate the cost-effectiveness of each option.
Definition of effect(iveness): Effect is measured as reduced emissions of nitrous oxide.
Definition of costs and cost-effectiveness: Costs are costs of abatement, split into non-recurring (capital) costs and recurring (annual) costs. Capital costs are annualised using a discount rate of 8%. Cost-effectiveness is measured in 1995 ECU per ton of nitrous oxide abated.
Definition of baseline: legislation and policies which are already being implemented by Member States as described in their national communications."
Treatment of confounding factors: Again, this is not relevant to the cost-effectiveness analysis, only to the projections of future emissions. Two scenarios are outlined, one with and one without agricultural measures. Confounding factors such as economic growth, increased competition from overseas manufacturers and CAP reform were included in these scenarios.
Methodological simplifications applied: Simplifying assumptions are numerous and specific to each technological option / scenario being discussed.
Models used: The models formulated for the study are outlined in the report.
Tests for Validity: Comparison with previous modelling work on marginal abatement costs carried out for the European Commission (reference given is "Klassen, 1997" – apparently a personal communication).



Ex-ante assessment undertaken: No ex ante study on cost-effectiveness of nitrous oxide reductions (as opposed to effect) identified
Guidelines used/referred to: Scientific guidelines are referred to (see next field), but no economic evaluation guidelines.
DATA
Data issues: Emissions data were obtained from (i) the CORINAIR database (the Europe-wide emissions inventory compiled by the European Environment Agency from national inventories) supplied by countries; and (ii) Framework Convention on Climate Change submissions - the IPCC has issued guidelines for the compilation and reporting of inventory data by countries to the Framework Convention on Climate Change. At the time of writing, data was available for 1990 and 1994, for both of these sources. Data on the costs of abatement technologies was taken from a variety of sources, such as surveys of nitric acid production plants, etc. It was however noted that commercial sensitivity restricts the availability of cost data.
CONCLUSIONS / EVALUATION
Robustness of approach: This is a very thorough, careful analysis of past and future trends in nitrous oxide emissions in the EU. However, cost-effectiveness analysis is limited to historical data on technological options, and is not considered for policies, either in the past or in relation to future required emissions reductions.
Key Findings: Denmark is shown to have some of the highest N2O abatement costs in Europe, and Greece some of the lowest. The quantification of the impact of measures in the agricultural sector is hampered by a lack of detailed understanding. Emissions projections show that emissions are likely to decrease to 13% below 1990 levels by 2010 under business as usual, by 20% using just industrial measures, and by 29% using both industrial and agricultural measures. When converted to carbon dioxide equivalent, this represents a significant contribution to meeting the EU's Kyoto Protocol target, as much as a quarter or even a third. However, the cost of this is not estimated.
Comparison with ex ante analysis: Not discussed
Practical impact of the analysis: Report could provide input into strategies on nitrous oxide emission reductions as a package of general greenhouse gas emission control options.
Other:
REFERENCE INFORMATION: CS69
Study title: <i>Ex post evaluations of CO2-based taxes: a survey</i>
Study authors: Agnolucci, P.
Author institution: Tyndall Centre for Climate Change Research, UK
Author URL: <a href="http://www.tyndall.ac.uk">http://www.tyndall.ac.uk</a>
Clients / contracting authority / Target audience: No client. Target audience is academics/researchers.
Year of publication: 2004
Year of the case / data: varies, depending on country and measure being discussed.
Availability: Tyndall Working Paper 52, June 2004. Tyndall Centre for Climate Change Research



Availability URL: <a href="http://www.tyndall.ac.uk/publications/working_papers/wp52.pdf">http://www.tyndall.ac.uk/publications/working_papers/wp52.pdf</a>
Status: Working paper / grey literature
Language of the document: English
Country(ies): Denmark, Finland, Netherlands, Norway, Sweden, UK
Policy area: Climate change / Energy, industry & transport / air
Details of legislation/treaty: Specific to CO2 taxes in each country.
Legal obligation: Specific to each country
Type of analysis: Ex post
Purpose: External document for dissemination of research findings.
Perspective and level of detail: Environmental and fiscal perspective, academic study
Summary: Since 1991 eight countries (Denmark, Finland, Germany, Italy, the Netherlands, Norway, Sweden, and the United Kingdom) have introduced CO2-based taxes with the explicit intention of abating CO2 emissions. This paper surveys studies quantifying the effects of the CO2-based taxes which have been introduced, concentrating on the methodological approach used and assessing them against four criteria: (i) environmental effect and effectiveness (where the latter assesses the effect against the objectives of the tax or against other instruments); (ii) economic efficiency; and (iii), stability and (iv) quantity of revenues, and distributional effects (in respect of both households and industrial sectors). Cost-effectiveness analysis, while discussed in a theoretical context, is not the primary focus and is not attempted due to the lack of data. These criteria are not straightforward to interpret and the paper discusses their meaning, and the approaches that have been used to obtain quantitative indicators for them, in some detail. For those CO2-based taxes that have been evaluated (those of all the above countries except Italy and Germany), their nature and mode of implementation is described, revealing that they bear little relation to textbook examples of optimal environmental taxes, and differ substantially from each other. The differences between the taxes, their complexity, and the fact that they are often introduced as parts of policy packages or changed over time, makes individual ex post evaluation of them very difficult, and comparative evaluation across countries more difficult still. Several studies on effectiveness, distributional effects and effectiveness relative to administrative costs are reviewed. However, the paper does not contain a full cross-country comparative CEA with respect to administrative or any other costs.
<b>DETAILS OF MEASURES EVALUATED</b>
Policy measure(s) evaluated: Various taxes on CO2 emissions
Original objectives of measure: Reduce CO2 emissions
Data collection methods/reporting requirements: Reporting requirements specific to each country.
Other:
<b>METHODOLOGY</b>
Scope of analysis: Aims to discuss: "environmental effect and effectiveness, economic efficiency, stability and quantity of revenues, and distributional effects (in respect of both households and industrial sectors)."
Definition of effect(iveness): "It is worth pointing out that many studies confuse the environmental effect of CO2 taxes with their effectiveness: the amount of pollution abated measures the environmental effect, and not its effectiveness, as the latter implies ascertaining the effects of a tax in relation to the expected objectives and targets or to other instruments." Effect in this instance is CO2 emissions reductions



achieved.
Definition of costs and cost-effectiveness: The paper notes that costs should include changes in consumer and producer surplus, but “this approach has never been used” in evaluating CO2 taxes, probably because of the difficulties inherent in the fact that “the tax influences the equilibrium values of many economic variables”. For the purposes of this study, “only abatement and transaction costs are considered.” In fact transaction costs are more fully considered than abatement costs. "Transaction costs can be divided into preparatory, enforcement and monitoring, and compliance costs." Cost-effectiveness is not explicitly defined but is assumed to be the amount of money required to achieve a tonne reduction in CO2.
Definition of baseline: "comparison with what would have happened, had the policy not been implemented"
Treatment of confounding factors: n/a, as a cost-effectiveness analysis is not performed
Methodological simplifications applied: n/a, as a full cost-effectiveness analysis is not performed
Models used: None
Tests for Validity: n/a, as a full cost-effectiveness analysis is not performed
Ex-ante assessment undertaken: For some of the countries
Guidelines used/referred to: "Reporting on environmental measures - are we being effective?", EEA, 2001
DATA
Data issues: The study notes that the lack of data on the marginal costs of abating carbon dioxide make attempts to perform CEA problematic.
CONCLUSIONS / EVALUATION
Robustness of approach: This study is more of a description of the practical implementation details of the schemes in the studied countries and their divergence from "text-book" environmental taxes. Although there is discussion of cost-effectiveness from a theoretical standpoint, cost-effectiveness analysis is not actually performed, although there is limited and inconclusive discussion and of the reductions achieved compared with administrative costs in some of the countries.
Key Findings: The CO2 taxes in the countries reviewed have had the desired effect of reducing CO2 emissions. Static efficiency is not always achieved due to a differing price of carbon for different fuels.
Comparison with ex ante analysis: Some country-specific ex ante studies (not focussed primarily on cost-effectiveness) are reviewed.
Practical impact of the analysis:
Other: A good clear introduction to the CO2 taxes involved. "The three [evaluation] approaches mentioned above - theoretical, ex ante and ex post evaluations - should be thought of as parts of a package and not as three separated tools. If on one hand the results of ex post evaluations are the most interesting for policy-makers, on the other hand only ex ante simulations and theoretical evaluations can point out the criteria and the methodologies to be used in ex post studies." It is pointed out that "As the equimarginal principle is a necessary and sufficient condition of a cost-effective emission reduction, differences in the [marginal abatement costs] point out that the tax is not working properly."
REFERENCE INFORMATION: CS70
Study title: <i>Effectiveness of waste water policies in selected countries - an EEA pilot study</i>

Study authors: Mikael Skou Andersen
Author institution: Danish National Environmental Research Institute
Author URL: <a href="http://www.dmu.dk/International">http://www.dmu.dk/International</a>
Clients / contracting authority / Target audience: European Environment Agency ( <a href="http://www.eea.eu.int">www.eea.eu.int</a> )
Year of publication: 2004
Year of the case / data: 1972-2004
Availability:
Availability URL:
Status: as yet unpublished pilot study / grey literature
Language of the document: English
Country(ies): Denmark, Netherlands, France, Spain, Poland, Estonia (CEA for Netherlands and Denmark only)
Policy area: Waste / households / water
Details of legislation/treaty: i) National and regional initiatives following the 1972 Stockholm Earth Summit; and ii) the EU Urban Waste Water Treatment Directive (UWWTD) 91/271/EEC ( <a href="http://europa.eu.int/eur-lex/lex/en/index.htm">europa.eu.int/eur-lex/lex/en/index.htm</a> )
Legal obligation: Reporting requirements not detailed.
Type of analysis: Ex post cross-country comparison
Purpose: Largely internal document, part of the EEA Strategy's declared intention to prioritise ex post policy effectiveness analysis.
Perspective and level of detail: environmental perspective, in-depth analysis, applied evaluation.
Summary: This study addresses the issue of effectiveness of waste water policies in order to improve information about implementation shortfalls and our understanding of their reasons. In 2004 it was noted that several member states had failed to designate sensitive areas and were behind schedule in establishing the capacity of sewage treatment required by the Urban Waste Water Treatment Directive deadlines passed several years ago. This report provides information on policies and measures in six member states; two of which have almost fully implemented the directive, two of which have yet to do so, and finally two recently acceded member states which have been allowed another five years to accomplish the environmental acquis. The report seeks to clarify the role of local authorities, of policy instruments and of financial mechanisms in securing effective implementation. It also addresses the issue of cost-effectiveness.
<b>DETAILS OF MEASURES EVALUATED</b>
Policy measure(s) evaluated: Command and control, wastewater taxes.
Original objectives of measure: Improved quality of fresh and marine surface waters. The UWWTD required the establishment of sewage systems of different stringency (combinations of 'primary'/mechanical, 'secondary'/biological and 'tertiary'/nutrient removal) for 'sensitive' and 'non-sensitive' urban areas by 2000. Also food-processing industries discharging more than 4000 person-equivalents of BOD (Biological Oxygen Demand) were required to set up secondary treatment systems.

Data collection methods/reporting requirements: Reporting requirements associated with the directive are not detailed.
Other:
<b>METHODOLOGY</b>
Scope of analysis: Discussion of the implementation of policy instruments by the six countries and comparative analysis of environmental effectiveness and cost-effectiveness.
Definition of effect(iveness): Effect: “the outputs of a measure that can be directly attributed to its implementation”; in this case, plant capacity in 1998, measurable in terms of person-equivalents of resulting lower BOD. Net load of organic discharger is also mentioned as an effect indicator, but is not related to cost at any point. Effectiveness: “a judgement about outcome; whether or not the outputs have resulted in expected objectives and targets of the policy measure having been achieved.”
Definition of costs and cost-effectiveness: Costs in this case are investments in wastewater treatment. Cost-effectiveness: “a comparison of the effects of a set of measures with the costs of implementing them.” Cost-effectiveness is measured in units of euros per total plant capacity in 1998.
Definition of baseline: Baseline is not defined.
Treatment of confounding factors: The fact that it is extremely difficult to attribute changes in water quality to the UWWTD is discussed, given that so many other causal factors are related to water quality, particularly as water catchment areas often cross national borders. Caution is required in choice of appropriate indicators of effectiveness.
Methodological simplifications applied: Almost all the case study countries are removed from the cost-effectiveness analysis because of insufficient data (Spain, Estonia, Poland) or because of non-compliance (France). Costs are investment costs only, therefore do not include running costs.
Models used: None.
Tests for Validity: None used.
Ex-ante assessment undertaken: No
Guidelines used/referred to: None identified.
<b>DATA</b>
Data issues: The study reports that “Data on investments undertaken in wastewater pollution control have been compiled by Eurostat in recent years”. However, data are insufficient for three of the countries in this study (Spain, Estonia and Poland), the latter two, unsurprisingly so, given their recent accession.
<b>CONCLUSIONS / EVALUATION</b>
Robustness of approach: The cost-effectiveness part of this study is of limited value, as no baseline is defined – i.e. the reader does not know what would have happened without the directive. Furthermore, the use of total plant capacity as a measure of effectiveness implicitly includes plant capacity investments made prior to the directive. It is therefore very difficult to attribute changes in water quality associated with the directive to costs associated with the directive.
Key Findings: Disparities in compliance exist – two out of four of the established EU members reviewed are not fully compliant. Although Denmark has invested more in plants per capita than the Netherlands, investment per unit capacity are almost identical. This comparison shows that without full-cost pricing for sewerage, a risk of investment in excessive capacity is possible.

Comparison with ex ante analysis: None available.
Practical impact of the analysis: This report highlights the difficulties inherent in performing thorough cost-effectiveness analyses where there are significant data omissions.
Other:

REFERENCE INFORMATION: CS71
Study title: <i>Analysis of effectiveness of implementing packaging waste management systems</i>
Study authors: Henrik Jacobsen
Author institution: European Topic Centre on Waste and Material Flows
Author URL: <a href="http://waste.eionet.eu.int">http://waste.eionet.eu.int</a>
Clients / contracting authority / Target audience: European Environment Agency ( <a href="http://www.eea.eu.int">www.eea.eu.int</a> )
Year of publication: 2004
Year of the case / data: 1997-2001
Availability:
Availability URL:
Status: as yet unpublished pilot study / grey literature
Language of the document: English
Country(ies): Austria, Denmark, Ireland, Italy, UK
Policy area: Waste / industry & households / Environmental management and practices
Details of legislation/treaty: Directive 94/62/EC on packaging and packaging waste ( <a href="http://europa.eu.int/eur-lex/lex/en/index.htm">europa.eu.int/eur-lex/lex/en/index.htm</a> )
Legal obligation: Quantitative reporting on waste streams required. Member States are required to provide statistics on the generation and treatment of packaging waste every 12 months, and on the implementation of the packaging directive every 36 months. See also "Data Collection" field.
Type of analysis: Ex post cross-country comparison of effectiveness
Purpose: Largely internal document, part of the EEA Strategy's declared intention to prioritise ex post policy effectiveness analysis.
Perspective and level of detail: Applied, in-depth analysis from an environmental perspective
Summary: The objective of this study is to make an ex post analysis of the effectiveness of packaging waste management systems in selected countries in terms of their contribution to fulfilling the environmental objectives specified in the packaging directive as well as national targets, if any such targets have been set. The first part comprises a quantitative analysis of packaging waste generated and managed in the EU15 Member States. The second part includes the effectiveness analyses of packaging waste management systems in five countries. This includes an analysis of the effectiveness of the measures in each country, but also a comparative analysis across the five countries. The focus is primarily on the period



<p>1997-2001 due to availability of data. The case study countries have been selected to cover examples of packaging waste management systems which were implemented as a direct cause of the packaging directive, and systems which were fully or partly implemented before the directive. Mostly effectiveness and practical implementation matters are discussed, with very little discussion of cost-effectiveness analysis.</p>
<p><b>DETAILS OF MEASURES EVALUATED</b></p>
<p>Policy measure(s) evaluated: Producer responsibility, landfill bans for certain types of wastes, plastic bag levy, waste tax, mandatory waste collections, local authority targets, deposit-refund, etc.</p>
<p>Original objectives of measure: 15% of various types of packaging waste (glass, paper and board, metals, plastic), and between 25% and 45% of total packaging waste to be recycled by 2001. 50-65% of total packaging waste to be recovered by 2001. Lower targets applied for Ireland, Greece and Portugal. Targets were revised in 2004 (Directive 2004/12/EC), but this study is interested only in compliance with the original targets. Targets were also set for concentrations of heavy metals in packaging, and generic guidelines on recyclability and hygiene of packaging were laid down.</p>
<p>Data collection methods/reporting requirements: Article 12 of the directive states that: "Member States shall take the necessary measures to ensure that databases on packaging and packaging waste are established", that "the databases shall provide in particular information on the magnitude, characteristics and evolution of the packaging and packaging waste flows (including information on the toxicity or danger of packaging materials and components used for their manufacture) at the level of individual Member States" and that "the data obtained shall be made available with the national reports referred to in Article 17 and shall be updated in subsequent reports."</p>
<p>Other:</p>
<p><b>METHODOLOGY</b></p>
<p>Scope of analysis: Aims at wider policy evaluation: consideration of effectiveness, cost-effectiveness and institutional analysis.</p>
<p>Definition of effect(iveness): "Effectiveness relates to the outcomes of the measures: goal-achievement and problem solving." "Important components" include: "distance-to-target assessments" and "a judgement on the appropriateness of the targets to meeting the objectives." Effect in this instance is attainment of directive targets.</p>
<p>Definition of costs and cost-effectiveness: "The costs used in this analysis have been the turnover or financing need of compliance schemes", which are the organisations recovering and recycling waste. However, different compliance schemes perform different functions, so may not be fully comparable. Administration costs of public authorities and companies are not included in the costs. As "detailed information on costs and expenditures ... is not available, precluding a full cost-effectiveness evaluation ... the assessment focuses on cost-effective elements in the system", i.e. seeks to identify and highlight cost-effective measures.</p>
<p>Definition of baseline: Not explicitly defined, but assumed to be waste recovery and recycling rates in 1997.</p>
<p>Treatment of confounding factors: It is noted that the amount of packaging used is likely to be coupled to economic growth, but no discussion of how to treat this in analysis is provided.</p>
<p>Methodological simplifications applied: Using compliance scheme expenditures as a proxy for costs. The report acknowledges that "expenses and costs show a different perspective: expenses are closer to private and public investment figures ... By contrast, costs refer to all figures of direct, indirect and shadow costs (opportunity costs) associated to policy implementation and compliance." Thus, only a proportion of actual costs is considered.</p>
<p>Models used: None</p>

Tests for Validity: None used.
Ex-ante assessment undertaken: None identified
Guidelines used/referred to: "Reporting on environmental measures - are we being effective?", EEA, 2001. The document itself provides two pages on the background and rationale for cost-effectiveness in the European Environment Agency and European Commission
DATA
Data issues: Very little actual data on the costs of measures is presented, so discussion of cost-effectiveness is extremely limited. Only data on the cost of compliance schemes have become publicly available.
CONCLUSIONS / EVALUATION
Robustness of approach: The comparative analysis has little to say on comparisons between different countries on costs, as results are presented in terms of changes in costs since 1997, therefore are not comparable in absolute terms. The cost-effectiveness aspect of the study is limited.
Key Findings: It is however noted that Austria has the most costly packaging waste recovery/recycling system. Miscellaneous facts are presented, but no conclusion is given.
Comparison with ex ante analysis: n/a
Practical impact of the analysis:
Other:
REFERENCE INFORMATION: CS73
Study title: <i>The Large Combustion Plant Directive (88/609/EEC): An Effective Instrument For Pollution Abatement?</i>
Study authors: Eames, M.
Author institution: Science and Technology Policy Research, University of Sussex
Author URL: <a href="http://www.sussex.ac.uk/spru">http://www.sussex.ac.uk/spru</a>
Clients / contracting authority / Target audience: Funded by the European Commission's DGXII under its Environment and Climate Programme (contract ENV4-CT97-0569). This report is an outcome of The Implementation of EU Environmental Policies: Efficiency Issues (IMPOL) project. ( <a href="http://europa.eu.int/comm/dgs/environment/index_en.htm">europa.eu.int/comm/dgs/environment/index_en.htm</a> )
Year of publication: 2000
Year of the case / data: 1993, 1996, 1998. Also other years in country-specific discussion.
Availability: Science and Technology Policy Research, University of Sussex
Availability URL: <a href="http://www.cerna.ensmp.fr/Documents/Impol-UK1.pdf">http://www.cerna.ensmp.fr/Documents/Impol-UK1.pdf</a>
Status: published report
Language of the document: English

Country(ies): UK, France, Netherlands, Germany
Policy area: Acidification & air quality / energy & industry / air
Details of legislation/treaty: The Large Combustion Plant Directive 88/609/EEC (here referred to as the LCP Directive) ( <a href="http://europa.eu.int/eur-lex/lex/en/index.htm">europa.eu.int/eur-lex/lex/en/index.htm</a> )
Legal obligation: Member states were required to inform the Commission of the details of their national emissions reduction programmes by the 31 December 1990. They were also required to ensure appropriate monitoring of emissions, to prepare annual national emissions inventories (for SO <sub>2</sub> and NO <sub>x</sub> ) and submit periodic progress reports to the Commission.
Type of analysis: Ex post cross-country comparison
Purpose: The study reports on the significant differences in the cost-effectiveness of the various national policy instruments used to implement the Directive.
Perspective and level of detail: Regulatory perspective, applied evaluation
Summary: Implementation of the LCP Directive has been characterised by a significant degree of over compliance, with the national emission ceilings for sulphur dioxide, in all four of the case study countries examined. However, significant differences in the cost-effectiveness of the various national policy instruments used to implement the Directive were also observed. This paper seeks to explain these findings by reference to the national contexts and implementation processes. A number of key variables are identified including: regulatory context and choice of policy instrument; industrial structure and dynamics; technology choice and path dependency; public and political awareness; and, 'external' (i.e. not related to environmental policy) national specific policy considerations. At the same time, however, the LCP-Directive itself is found to have had little direct impact on the national outcomes obtained. The project sought to answer questions such as: (a) Does implementation result in the attainment of the environmental goals set out in EU Directives? (b) How does implementation affect the cost effectiveness of a particular environmental policy? The core of the project consisted of the ex post evaluation of the implementation outcomes of selected pieces of EU legislation in four Member States (France, Germany, the Netherlands and the United Kingdom). NOTE - There are separate reports outlining the detail for France, the Netherlands and Germany on the IMPOL website <a href="http://www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html">www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html</a> .
<b>DETAILS OF MEASURES EVALUATED</b>
Policy measure(s) evaluated: Report examines the electricity sector only: emission limits and upgrading timetable (Germany), emission limits and upgrading timetable and voluntary agreements (Netherlands), voluntary agreement (France), annual emissions quotas (UK).
Original objectives of measure: The directive sets emissions limits for SO <sub>2</sub> , NO <sub>x</sub> and dust. New plants were set uniform limits, while existing plants were set limits varying between countries, with different progressive targets to be met at five-year intervals. These limits were set as percentages of 1980 emissions.
Data collection methods/reporting requirements: Member states were required to inform the Commission of the details of their national emissions reduction programmes by 31 December 1990. They were also required to ensure appropriate monitoring of emissions, to prepare annual national emissions inventories (for SO <sub>2</sub> and NO <sub>x</sub> ) and submit periodic progress reports to the Commission.
Other:
<b>METHODOLOGY</b>
Scope of analysis: Due to time constraints, the analysis focuses on reductions in SO <sub>2</sub> emissions from existing plants in the electricity sector.
Definition of effect(iveness): The indicator of effect is that employed by the LCP Directive itself, i.e.: %



reduction over 1980 emissions. Effectiveness is then determined by comparing the % of reduction required to the % reduction achieved. A second indicator allows the extent of over-compliance to be assessed, in the form of compliance with national emission reduction targets.
Definition of costs and cost-effectiveness: "Cost effectiveness refers to the ability to achieve a given level of environmental quality at low cost." However, only a qualitative discussion of cost-effectiveness is given. Costs are not formally defined but are assumed to be abatement costs.
Definition of baseline: Emissions in 1980.
Treatment of confounding factors: not discussed
Methodological simplifications applied: Cost-effectiveness is limited to a qualitative classification ('high', 'medium', 'low')
Models used: none
Tests for Validity: none
Ex ante assessment undertaken: No
Guidelines used/referred to: The assessment has been carried out according to the IMPOL methodology based on both ex post indicators (e.g. the differentiation patterns of individual sources' abatement levels) and process related indicators (type of policy instruments, location of the allocation decisions, and so on).
<b>DATA</b>
Data issues: Abatement costs: (Germany) surveys were undertaken of electricity suppliers to gather data on abatement costs. Administrative costs: (France) resource costs were estimated in person months, e.g. no. of persons dealing with air issues related to industrial installations in government, no. of people in the field of statistics and involved in environmental reporting in industry.
<b>CONCLUSIONS / EVALUATION</b>
Robustness of approach: The report is a broad, thorough description of issues surrounding the implementation of the LCP Directive in the studied countries, but CEA elements are very limited.
Key Findings: France and the United Kingdom were both found to have high cost-effectiveness, the Netherlands medium-to-low, and Germany low. In environmental economics, the issue of cost effectiveness is above all a matter of policy instrument choice. As previously noted, therefore, from a theoretical perspective one of the most interesting facets of the LCP-Directive is that it left the choice of the implementing policy instrument to the Member State. It is perhaps not surprising that the choice of policy instrument should prove central to the overall cost effectiveness of the various national implementation processes. However, the analysis also suggests that there is scope for interaction between the type of policy instrument and market structure, and both the environmental outcome and cost effectiveness of the implementation process. Also the study finds that policy interactions cannot only have a dramatic impact on the environmental outcomes of implementation processes, they can also have a major impact on implementation costs.
Comparison with ex ante analysis: none
Practical impact of the analysis:
Other:
<b>REFERENCE INFORMATION: CS74</b>

Study title: <i>The Implementation of the Municipal Waste Incineration Directives</i>
Study authors: various authors
Author institution: Centre d'Économie Industrielle (CERNA), École Nationale Supérieure des Mines de Paris
Author URL: <a href="http://www.cerna.ensmp.fr">http://www.cerna.ensmp.fr</a>
Clients / contracting authority / Target audience: Funded by the European Commission's DGXII. This report is an outcome of The Implementation of EU Environmental Policies: Efficiency Issues (IMPOL) project. ( <a href="http://europa.eu.int/comm/dgs/environment/index_en.htm">europa.eu.int/comm/dgs/environment/index_en.htm</a> )
Year of publication: 2000
Year of the case / data: 1989-1999 (quantitative discussion limited to 1990-6)
Availability: Centre d'Économie Industrielle (CERNA), École Nationale Supérieure des Mines de Paris
Availability URL: <a href="http://www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html">http://www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html</a>
Status: published report
Language of the document: English
Country(ies): UK, Germany, Netherlands, France
Policy area: Air quality & waste/ households & industry / air / urban environment
Details of legislation/treaty: Municipal Waste Incineration Directives 89/369/EEC and 89/429/EEC ( <a href="http://europa.eu.int/eur-lex/lex/en/index.htm">europa.eu.int/eur-lex/lex/en/index.htm</a> )
Legal obligation: Reporting requirements not detailed.
Type of analysis: Ex post cross-country comparison
Purpose: Research document for internal and external use. The IMPOL project "sought to answer questions such as: (1) Does implementation result in the attainment of the environmental goals set out in EU Directives? (2) How does implementation affect the cost effectiveness of a particular environmental policy?"
Perspective and level of detail: Regulatory perspective, applied evaluation
Summary: The European Union decided to issue two European Directives on the atmospheric emissions from municipal waste incineration in 1989. This report focuses on the implementation and effects of the 1989 Directives. As its name suggests, the project concerns the implementation of EU environmental legislation. The core of the project consisted of the ex post evaluation of the implementation outcomes of selected pieces of EU legislation in four Member States (France, Germany, the Netherlands and the United Kingdom). Quantitative discussions of cost-effectiveness are only provided for Germany and the Netherlands. There are separate reports outlining the detail for France, the Netherlands and Germany on the IMPOL website <a href="http://www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html">www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html</a> .
<b>DETAILS OF MEASURES EVALUATED</b>
Policy measure(s) evaluated: Emissions standards for waste incinerators
Original objectives of measure: Emission requirements set for dust, several metals (lead, chromium, copper, manganese, nickel, arsenic, cadmium and mercury), hydrogen chloride and fluoride, sulphur



dioxide, carbon monoxide and organic compounds. Standard units were mg per cubic metre. Different standards were set according to the capacity of incinerators. New incinerators had less stringent standards until December 2000. Some pre-existing national standards were stricter than those set by the Directives.
Data collection methods/reporting requirements: Reporting requirements not detailed. See "data issues".
Other:
<b>METHODOLOGY</b>
Scope of analysis: Discussing issues surrounding compliance with the Directives, including (to a fairly qualitative extent) cost-effectiveness, in the four countries. The report also contains much discussion of achievement of economies of scale.
Definition of effect(iveness): In the qualitative discussions (UK and France), the effect is compliance with the standard. In the quantitative discussion (using data from Germany and the Netherlands only), the effect is defined as the average of all the changes in each pollutant as a proportion of its emissions target. It is not clear whether this change is relative to a (non-specified) baseline year or to each previous year. A range is given for this as well as a single figure, though it is not explained whether the range expresses variations in target achievement between different pollutants, plants or both.
Definition of costs and cost-effectiveness: Costs are costs to industry. Cost-effectiveness is not formally defined in the qualitative discussion. In the quantitative discussion it is defined as "Total yearly abatement costs/units improvement (each ton capacity)". It is not entirely clear why or how capacity is incorporated into this expression.
Definition of baseline: The baseline is not defined or specified.
Treatment of confounding factors: Confounding factors are minimal as the level of substances in point-source emissions can easily be measured.
Methodological simplifications applied: Not detailed in the summary report but further details may be contained in the individual country reports.
Models used: none
Tests for Validity: none
Ex-ante assessment undertaken: No
Guidelines used/referred to: None identified.
<b>DATA</b>
Data issues: In many instances what is reported as data for "Germany" in fact only covers the regions of North Rhine Westphalia and Bavaria. Detailed data on costs and emissions were only available for Germany (period 1994-6) and the Netherlands (1990-5).
<b>CONCLUSIONS / EVALUATION</b>
Robustness of approach: The report lacks clarity about certain key variables used in the cost-effectiveness calculations. It is difficult to understand how quantitative cost-effectiveness results have been arrived at, as they do not appear to relate to other data presented.
Key Findings: "The frontrunners, Germany and the Netherlands, scored relatively well on the environmental outcomes and less well on efficiency outcomes. France scored not so well on the environmental outcomes and scored well on the efficiency outcomes ... the United Kingdom scored well on both aspects."

Comparison with ex ante analysis: None
Practical impact of the analysis: Mechanisms for consistent data collation in order to determine the cost-effectiveness of environmental directives could be improved upon.
Other:

REFERENCE INFORMATION: CS75
Study title: <i>The Implementation of EMAS in Europe: a case of competition between standards for environmental management systems</i>
Study authors: Dr M Eames et al.
Author institution: SPRU – Science and Technology Policy Research, University of Sussex
Author URL: <a href="http://www.sussex.ac.uk/spru">http://www.sussex.ac.uk/spru</a>
Clients / contracting authority / Target audience: The European Commission, DGXII. The report is an outcome of The Implementation of EU Environmental Policies: Efficiency Issues (IMPOL) project. ( <a href="http://europa.eu.int/comm/dgs/environment/index_en.htm">europa.eu.int/comm/dgs/environment/index_en.htm</a> )
Year of publication: 2000
Year of the case / data: 1997 (Germany) 1999 (UK, France and The Netherlands)
Availability: SPRU – Science and Technology Policy Research, University of Sussex
Availability URL: <a href="http://www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html">http://www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html</a>
Status: published report
Language of the document: English
Country(ies): UK, France, The Netherlands, Germany
Policy area: Industry / Environmental management and practices
Details of legislation/treaty: The Council Regulation on the Eco-Management and Audit Scheme (1863/93) or EMAS. ( <a href="http://europa.eu.int/eur-lex/lex/en/index.htm">europa.eu.int/eur-lex/lex/en/index.htm</a> )
Legal obligation: Voluntary participation.
Type of analysis: ex post, cross-country comparison.
Purpose: Regulation research document
Perspective and level of detail: Scoping document, applied evaluation.
Summary: This report describes how EMAS was implemented in France, Germany, the Netherlands and the United Kingdom (UK). It explains the varying number of EMAS participants in the four countries as a result of the different implementation processes and the different levels of participation in other similar domestic and international schemes. Against the background of low participation rates in some Member States, the report analyses whether EMAS has so far been a successful policy instrument through cost effectiveness analysis. The report identifies all the relevant social and private costs and benefits associated with participation in the scheme. Estimates for the costs and benefits of participation are taken from the



<p>national reports. Net private and social benefits are then compared to the running costs of EMAS. The report concludes that benefits outweigh the costs and thus so far despite low uptake, EMAS is a successful policy. There are separate reports outlining the detail for France, the Netherlands and Germany on the IMPOL website <a href="http://www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html">www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html</a>.</p>
<p><b>DETAILS OF MEASURES EVALUATED</b></p>
<p>Policy measure(s) evaluated: Voluntary participation of companies in EMAS.</p>
<p>Original objectives of measure: The promotion of continuous improvements in the environmental performance of industrial activity.</p>
<p>Data collection methods/reporting requirements: Data are required on (i) number of registered companies participating in EMAS, and (ii) the environmental improvement brought about by EMAS on a site level. Companies are required to publish an environmental statement. This includes a description of the environmental policy, programme and management system as well as an assessment of all significant environmental issues related to the activities of the company site. If appropriate, environmental issues are presented in the form of quantitative figures on pollutant emissions, waste generation, energy consumption etc.</p>
<p>Other:</p>
<p><b>METHODOLOGY</b></p>
<p>Scope of analysis: Broad level cost effectiveness analysis for the voluntary company participation in EMAS</p>
<p>Definition of effect(iveness): i). number of firms (sites) participating in EMAS, (total and as a percentage of potential participants; and ii). environmental improvement brought about by EMAS on a site level.</p>
<p>Definition of costs and cost-effectiveness: The potential full range of costs are company participation costs, Government costs, such as subsidies for EMAS participants, and social costs incurred in running the accreditation, supervision and registration system. Of the latter, only running costs are considered since it was not possible to collect data on set-up, which happened some years ago. The report also does not provide details on the government subsidies for company participation in EMAS.</p>
<p>Definition of baseline: not discussed</p>
<p>Treatment of confounding factors: not discussed</p>
<p>Methodological simplifications applied: Many of the benefits of EMAS can only be described qualitatively. For example, improved communication with external stakeholders, (e.g. very useful, fair, etc.). Environmental improvements resulting from measures in solid waste, energy consumption, water usage and effluent water are also described qualitatively. All countries stated these reductions as 'medium'. The scope of the study did not permit a monetary valuation of the benefits to society.</p>
<p>Models used: none</p>
<p>Tests for Validity: none</p>
<p>Ex-ante assessment undertaken: No</p>
<p>Guidelines used/referred to: not discussed</p>
<p><b>DATA</b></p>
<p>Data issues: The data used in the CEA are provided in the individual case study reports. These data were collected from expert interviews, literature reviews and the completion of an identical company survey in</p>



<p>all four countries. The survey is based on questionnaires which were sent to all EMAS participants in France, Germany, the Netherlands and the UK. In France, the Netherlands, and the UK the survey was conducted by the IMPOL team in early 1999. The German data are taken from a survey carried out in mid 1997. At the time the questionnaires were sent out there were 32 EMAS participants in France, 22 in the Netherlands, 70 in the UK, and almost 700 in Germany. The return quotas ranged from about 20% in Germany to 63% in France, 68% in the Netherlands and 74% in the UK.</p>
<p><b>CONCLUSIONS / EVALUATION</b></p>
<p><b>Robustness of approach:</b> The report is a cost-benefit analysis, not a cost-effectiveness analysis. It provides a limited analysis of the costs and benefits of voluntary participation in EMAS. Some of the relevant private and social costs and benefits associated with the implementation of EMAS are identified and estimated in either monetary and/or qualitative terms.</p>
<p><b>Key Findings:</b> Despite low participation rates in France, the Netherlands and the UK, EMAS can be considered a successful policy instrument, because the benefits generated by EMAS outweigh its costs. Companies only participate in the voluntary scheme when their benefits exceed their costs, thus participation provides positive net benefits for them. In addition, there exist net benefits for society due to EMAS registered companies' improved environmental performance. Costs borne by government (and thus society) for running the accreditation, supervision and registration system are low.</p>
<p><b>Comparison with ex ante analysis:</b> none</p>
<p><b>Practical impact of the analysis:</b> The analysis shows that although participation in EMAS is low across the four countries, EMAS is a successful policy instrument. The report recommends participation could be made more attractive to companies and goes on to provide recommendations for revisions for EMAS.</p>
<p><b>Other:</b></p>

<p><b>REFERENCE INFORMATION: CS86</b></p>
<p><b>Study title:</b> Evaluation of the Dutch Manure and Fertiliser Policy, 1998-2002</p>
<p><b>Study authors:</b> Hans van Grinsven, Martha van Eerdt, Jaap Willems, Erik Mulleneers                  Three co-operating groups of research institutes have conducted this evaluation: the Netherlands Environmental Assessment Agency (MNP) [<a href="http://www.rivm.nl/">www.rivm.nl/</a>], the Agricultural Economics Research Institute (LEI) [<a href="http://www.lei.dlo.nl/">www.lei.dlo.nl/</a>] and the Centre of Expertise of the Ministry of Agriculture, Nature and Food Quality (EC-LNV) [<a href="http://www9.minlnv.nl/">www9.minlnv.nl/</a>].</p>
<p><b>Clients / contracting authority / Target audience:</b> Ministry of Agriculture, Nature and Food Quality (EC-LNV) [<a href="http://www9.minlnv.nl/">www9.minlnv.nl/</a>]</p>
<p><b>Year:</b> of publication of study: 2004 of the case / data: 1998-2002</p>
<p><b>Availability:</b> Available on the web</p>
<p><b>Status:</b> Publicly available</p>
<p><b>Language of the document:</b> English (also available in Dutch)</p>
<p><b>Country(ies):</b> Netherlands</p>
<p><b>Policy area:</b> Agriculture</p>
<p><b>Details of legislation/treaty:</b></p>



<p>Legal obligation: A biannual evaluation of the Fertilisers Act is compulsory under article 68 of that Act, which states that the Minister of Agriculture has to inform parliament every two years about the effects of the Act. That general obligation in the Fertilisers Act has been further filled in on the basis of a Dutch regulation on when and how to conduct policy evaluations like the evaluation of the Fertilisers Act: ‘Regeling Prestatiegegevens en Evaluatieonderzoek Rijksoverheid (RPE)’ (regulation on performance indicators and evaluation research) of the Dutch Ministry of Finance (FIN, 2002). This regulation contains rules on the use, frequency, quality (evaluation research should be valid, reliable and accurate, and useful) and reporting of policy evaluation research.</p>
<p>Type of analysis: ex-post, dynamic efficiency</p>
<p>Purpose: The ex post evaluation was primarily intended to support the decision process of the government on the necessary adaptation of the Manure en Fertiliser policies, and secondarily for other stakeholders.</p>
<p>Perspective and level of detail: Environmental perspective, in-depth analysis</p>
<p>Summary: In this evaluation project, five policy instruments were evaluated which the Netherlands has implemented to reduce the minerals surplus (the surplus of nitrogen and phosphate from agricultural sources) in order to prevent and reduce the diffuse pollution of ground and surface water by nitrogen and phosphate from agricultural sources.</p>
<p><b>DETAILS OF MEASURES EVALUATED</b></p>
<p>Policy measure(s) evaluated: The policy instruments that were evaluated are three of the core instruments of the Fertilisers Act:</p> <ol style="list-style-type: none"> <li>1. the Mineral Accounting System ‘MINAS’ (introduced in 1998 for farms with the highest environmental risk, from 2001 on compulsory for all farms);</li> <li>2. the system of manure transfer contracts (‘mestafzetovereenkomsten’, MAO) (since 2002);</li> <li>3. the system of production quota (or livestock quota)<sup>5</sup> (introduced in the 1990’s);</li> </ol> <p>and two additional instruments in Dutch manure policy:</p> <ol style="list-style-type: none"> <li>4. the buying up scheme (voluntary farm closure scheme) for production quota (executed in 2000 and 2001);</li> <li>5. Nitrate Projects Action Scheme (a set of research projects and communication tools, implemented from 2001 until 2004).</li> </ol>
<p>Original objectives of measure: The main objective of the Fertilisers Act is to improve the quality of groundwater and surface water by reduced and more efficient use of nutrients within the agricultural sector. The objective of both the system of production quota and of the system of manure transfer contracts (MAO) is to limit the total amount of nutrients produced in Dutch agriculture.</p>
<p>Data collection methods/reporting requirements: The main data sources for evaluating the relation between farmers behaviour and the environmental effects in this evaluation were the National Monitoring Programme for the effectiveness of the Minerals Policy (LMM) (nitrate concentration in shallow groundwater on farms), water quality measurements in regional surface waters, the Farm Accountancy Data Network (FADN), the Agricultural Census and Environmental Cost Statistics.</p>
<p>Other:</p>
<p><b>METHODOLOGY</b></p>
<p>Scope of analysis:</p>
<p>Definition of effect(iveness): <i>Effect of the policy</i>: the causal relations between the policy instruments and their intended objectives (the report gives examples of variables that influence the effect of manure policy instruments on environmental quality).  <i>Effectiveness</i>: whether the policy instruments used by Dutch government have led to the fulfilment of the environmental goals.</p>



<p>Definition of costs and cost-effectiveness: Costs include investments (annualised over the economic lifetime of the measure) and operational costs less the possible savings. Adding environmental levies (as far as they are earmarked for environmental objectives) to these costs and subtracting from them subsidies received, results in what is referred to as <i>environmental burden</i>.                  Cost effectiveness is referred to as 'efficiency', and is not defined in the report. However, it is implied to the relationship between the environmental burden (i.e. the costs as defined above) and the emissions reductions achieved for N and P – in other words the cost per emission reduction.</p>
<p>Definition of baseline: Baseline is the year 1985, for treatment of costs and effects.</p>
<p>Treatment of confounding factors:</p>
<p>Methodological simplifications applied:</p>
<p>Models used: No models for assessment of cost-effectiveness, but the variety of data sources, including: Data from an extensive research and communication projects on dairy farms, called 'Praktijkcijfers'; Data on MINAS (number and content of nutrient returns, levies imposed, levies paid, costs of implementation and enforcement), the system of manure transfer contracts and the systems of production quota gathered by the Levies Office and the National Regulation Agency; Data from interviews with staff members of the executive organisations (Levies Office and General Inspection Office) and representatives, scientific and field experts of interested parties; A survey among 300 farmers (in the FADN), with a response of 56 % on the systems of MINAS, Manure Transfer Contracts and Production quota and on the Nitrate Action Programme.</p>
<p>Tests for Validity: None</p>
<p>Ex-ante assessment undertaken: Not mentioned</p>
<p>Guidelines used/referred to: FIN, 2002. Performance Indicators and Evaluation Research (in Dutch). Ministry of Finance, The Hague.</p>
<p><b>DATA</b></p>
<p>Data issues: (a) Monitoring data as a rule become available one to two years after implementation of policy measures; (b) Limited information on ecological impacts and entangling contributions of effects of manure policy, autonomic effects, effect based measures and above all natural processes; (c) The available data do not allow evaluation of the manure surpluses on a regional scale; (d) Unsatisfactory knowledge about the processes responsible for the response of surface waters and deep groundwater to reduced soil loading; and (e) Separation of the effects of autonomous developments (like developments in trade of agricultural products, the reforms of the EU Common Agricultural Policy) and incidental occurrences (like epidemic outbreaks of animal diseases) from the effects of the policy instrument under evaluation is problematic.</p>
<p><b>CONCLUSIONS / EVALUATION</b></p>
<p>Robustness of approach: The study benefits from an enormous amount of data and is very thorough in its approach to evaluating the effectiveness of the measures. As stated in the study's introduction, however, the focus on the ex-post cost effectiveness evaluation was shifted half way through the project as the MINAS scheme was withdrawn. The project then shifted resources to an ex-ante evaluation of the new policy measure. Thus, the cost-effectiveness analysis is not as in-depth as the authors would have liked. Nonetheless, the approach taken appears to be robust.</p>
<p>Key Findings: Despite the substantial increase in emission reduction the Fertilisers Act and the corresponding policy in 1998-2002 were efficient since costs per emission reduction in nitrogen and phosphates did not rise compared with the previous period. In recent years (after 1999), these costs per emission reduction even declined. Unit costs are likely to increase for more drastic emission reductions. MINAS was a cost-effective measure in dairy farming but not in intensive livestock farming and arable farming. It was successful in dairy farming because efficient nutrient management was stimulated. The</p>



<p>manure contract system was neither effective nor efficient for livestock farming. The benefit over MINAS to control the manure production and regulating disposal was nil, while the costs were considerable.</p>
<p>Comparison with ex-ante analysis: None</p>
<p>Practical impact of the analysis: The government's decision to abolish the system of manure transfer contracts in favour of the system of manure production quota was partly based on the outcomes of this evaluation.</p>
<p>Other:</p>
<p> </p>

## Annex 6 All Case Study Summaries

CS1 ★★
<b>Study title:</b> Fleetwide Emissions and Cost-Effectiveness of the Consent Decree Pull-Ahead Requirements for Heavy-Duty Diesel Engines
<b>Study authors/clients:</b> NERA Economic Consulting ( <a href="http://www.nera.co.uk/">www.nera.co.uk/</a> )/ Detroit Diesel Corporation ( <a href="http://www.detroitdiesel.com/">www.detroitdiesel.com/</a> )
<b>Year:</b> 2002
<b>Policy area:</b> Air quality/transport/air
<b>Country/ies:</b> USA <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> The consent decrees entered into between the U.S. Environmental Protection Agency and the manufacturers of these engines regulate the emissions of nitrogen oxide (NO <sub>x</sub> ) and non-methane hydrocarbons from Class 8 heavy duty diesel vehicles. The new, more stringent, standards were planned to come into effect from 1 January 2004. The 'pull-ahead' option was to enforce the policy from 1 October 2002. This study evaluates the emission impacts and the cost-effectiveness of enforcing the more stringent emissions standards 15 months earlier than planned. Information at the time indicated that both the costs of implementing the more stringent standard are dramatically higher than anticipated, and that the lead-time for motor carrier fleets to test the new technology engines before October 2002 is less than anticipated.

CS2 ★★
★★ : A clear-cut application of cost effectiveness, and therefore a good example of application of the methodology, however as it is not EU, is not top priority (could move to 3 stars if other studies turn out to be less methodologically robust).
<b>Study title:</b> The Cost-Effectiveness of Reductions in Dioxin Emissions to Air from Selected Sources
<b>Study authors/clients:</b> Wright, Millichamp and Buckland / New Zealand Ministry for the Environment ( <a href="http://www.mfe.govt.nz/">www.mfe.govt.nz/</a> )
<b>Year:</b> 2001
<b>Policy area:</b> Air quality/household and industry/air
<b>Country/ies:</b> New Zealand <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> This report is an economic analysis of some technical options for reducing emissions of dioxins to air. Section 32 of the Resource Management Act 1991 requires that regard be taken of (economic) efficiency and effectiveness in the choice of policy instruments. The report provides a basis for a Section 32 analysis. Reduction of emissions of dioxins to air can be expected to yield human health benefits because dioxins are toxic, persistent, and bioaccumulative. Because non-tariff barriers to trade are increasingly given an environmental rationale, economic benefits can also be expected from dioxin reduction by strengthening New Zealand's environmental comparative advantage. Any attempt to quantify health and economic benefits in monetary terms would be extremely speculative, so the benefits from each technical option considered were expressed in terms of effectiveness in reducing dioxin emissions



compared to the option cost.

<b>CS3</b> <i>GL</i>
<b>Study title:</b> Assessment of the Effectiveness of European Air Quality Policies and Measures
<b>Study authors/clients:</b> Milieu Ltd ( <a href="http://www.milieu.be/">www.milieu.be/</a> ) / EC Environment DG ( <a href="http://europa.eu.int/comm/dgs/environment/index_en.htm">europa.eu.int/comm/dgs/environment/index_en.htm</a> )
<b>Year:</b> 2004
<b>Policy area:</b> Air quality/industry/air
<b>Country/ies:</b> EU <b>Language:</b> English
<b>Availability:</b> Report not yet finished
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> REQUIRED (report due end 2004)

<b>CS4</b> ✖
✖: This is the overview of case studies CS73-75, which have 3 star priority ratings. This document itself does not add any additional analysis on cost effectiveness.
<b>Study title:</b> How can the Implementation of EU Environmental Policy be more Effective and Efficient?
<b>Study authors/clients:</b> Centre d'Économie Industrielle (CERNA), École Nationale Supérieure des Mines de Paris ( <a href="http://www.cerna.ensmp.fr/">www.cerna.ensmp.fr/</a> ) / EU Climate and Environment Programme ( <a href="http://europa.eu.int/comm/dgs/environment/index_en.htm">europa.eu.int/comm/dgs/environment/index_en.htm</a> )
<b>Year:</b> 2000
<b>Policy area:</b> Air quality & waste/industry/air
<b>Country/ies:</b> France, Germany, UK, Netherlands <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> This final research report of the project IMPOL (short name for “The implementation of EU environmental policy: efficiency issues”) is written for an academic audience. For research users (policy makers, private decision-makers, NGOs), a separate policy oriented report is also available (Glachant, 2000). The IMPOL project is an exercise of ex post evaluation of the implementation of pieces of Community environmental policy. Implementation here encompasses all regulatory changes that follow the adoption of a Directive: transposition by Member States and implementation of national regulations. Two dimensions of this implementation are evaluated: the environmental effectiveness (i.e., the environmental outcome of the policy in comparison with the goal set in the Directives), and the cost effectiveness, i.e., the impacts of implementation on pollution abatement costs.

<b>CS5</b> ★
★ : While the study does not explicitly provide cost-effectiveness analysis, it details cost calculations, compares ex-ante and ex-post calculation and also looks at a range of economic and other effects. It also starts with an overview of eco-efficiency.
<b>Study title:</b> A Comparison of EU Air Quality Pollution Policies and Legislation with Other Countries



<b>Study authors/clients:</b> AEA Technology & Metroeconomica ( <a href="http://www.aeat.co.uk/">www.aeat.co.uk/</a> ) / EC Environment DG ( <a href="http://europa.eu.int/comm/dgs/environment/index_en.htm">europa.eu.int/comm/dgs/environment/index_en.htm</a> )
<b>Year:</b> 2004
<b>Policy area:</b> Air quality/industry/air
<b>Country/ies:</b> EU <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> both
<b>Abstract:</b> Concern over the health and environmental effects of air pollution have led to major policies being introduced in Europe over the last decade. Similar initiatives have been implemented in the US and other OECD countries. This paper, prepared by way of follow-up to the conference on ‘The Environmental Performance of EU Industry’, compares the legislation in air pollution policy, and looks at how this legislation has been implemented and what effects it had on the industry in terms of trade and competitiveness. The paper also considers the future trends in air pollution in Europe, US and other OECD countries and whether future air pollution policy in Europe might change competitiveness relative to other regions.

<b>CS6 ✕</b>
<b>✕:</b> Short overview, looks at effects, not costs.
<b>Study title:</b> Implementing the Community Strategy to Reduce CO2 Emissions from Cars: First annual report on the effectiveness of the strategy
<b>Study authors/clients:</b> EC /
<b>Year:</b> 2000
<b>Policy area:</b> Climate change/transport/air
<b>Country/ies:</b> <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b>
<b>Abstract:</b> The Community’s strategy to reduce CO2 emissions from passenger cars and improve fuel economy was endorsed by the Council in 1996. It aims at achieving an average CO2 emission figure for new passenger cars of 120 g CO2/km by 2005, and 2010 at the latest. This first report covers the progress made with regard to the commitments made by the automotive industry. Future reports will address as well the other parts of the strategy in more detail, including the requirements laid down in Decision 1753/2000/EC9 as soon as these parts of the strategy are implemented, or significant progress is made. The Commission believes that such a consolidated reporting will allow all interested parties to follow the implementation of the Community strategy in the most efficient way.

<b>CS7 ★</b>
<b>★ :</b> Is not a comparison of measures, but an assessment to determine appropriate air pollution limits based on external benefits of reducing air pollution compared with costs of achieving them.
<b>Study title:</b> Economic Evaluation of Proposals for Emission Ceilings for Atmospheric Pollutants



<b>Study authors/clients:</b> AEA Technology (www.aeat.co.uk/)/ EC Environment DG (europa.eu.int/comm/dgs/environment/index_en.htm)
<b>Year:</b> 1999
<b>Policy area:</b> Acidification & Air quality/industry, transport & agriculture/air
<b>Country/ies:</b> EU <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> AEA Technology, under sub-contract to IIASA, have conducted an economic evaluation of scenarios being explored in the development of further controls on acidification and ground-level ozone. The derivation of these scenarios is described in IIASA's Seventh Interim Report on Cost-effective Control of Acidification and Ground-level Ozone, released in January 1999. The analysis presented here includes quantification of benefits and their comparison with the estimated costs of attaining these scenarios.

CS8 ★★★
<b>Study title:</b> The Auto-Oil II Cost-Effectiveness Study
<b>Study authors/clients:</b> European Commission, Standard & Poor's DRI and K.U.. Leuven (europa.eu.int/comm/dgs/environment/index_en.htm)/ None ()
<b>Year:</b> 1999
<b>Policy area:</b> Air quality/transport/air
<b>Country/ies:</b> Finland, France, Germany, Greece, Ireland, Italy, The Netherlands, Spain, UK <b>Language:</b> English
<b>Availability:</b> electronic copies from <a href="http://europa.eu.int/comm/environment/enveco/auto-oil/">http://europa.eu.int/comm/environment/enveco/auto-oil/</a>
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> The first auto-oil programme marked a new departure in the development of Community environmental policy by involving stakeholders in a technical programme to identify the most cost-effective ways of meeting certain agreed air quality targets. It resulted in two proposed directives setting fuel quality and vehicle emission standards to apply from 2000. A Commission Communication reviews the approach taken and the work carried out within Auto-Oil II programme, and reports on the key results in terms of: emissions and air quality predictions; development of modelling tools for assessing policy options and conclusions on the cost-effectiveness of the policy options studied. The associated reports provide analysis on costs and effectiveness for each of the countries.

CS9 ★
★ : The study looks at estimates of cost, comparing ex-ante and ex-post estimates, but does not compare these with effectiveness or compare cost-effectiveness of particular measures.
<b>Study title:</b> Costs and Strategies presented by Industry during the Negotiations of Environmental Regulations
<b>Study authors/clients:</b> Stockholm Environment Institute (www.sei.se/)/ Swedish Ministry of the Environment (www.sweden.gov.se/)
<b>Year:</b> 1999



<b>Policy area:</b> Acidification, Air quality & ozone depletion/industry & transport/all media
<b>Country/ies:</b> EU and USA <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> It is often argued that the cost of complying with environmental regulations unduly restricts business profitability and competitiveness, reduces economic growth and stifles innovation. The aim of this study is to examine the issue of cost of compliance by considering the arguments and strategies that were mounted by industry during the negotiations of different environmental regulations in Europe and North America and at the global level. The study attempts to determine the extent to which costs estimated by industry during and prior to the negotiation of environmental regulations correspond with the actual costs realised in the implementation phase. In order to examine the strategies that have been promoted by industry during the negotiations of specific environmental regulations a number of case studies of environmental regulations are identified. The five case studies are selected to demonstrate concise examples where industry had stressed a much higher cost of compliance during negotiations prior to the adoption of the regulation in question.

CS10 <i>SR</i>
<i>SR</i> : Need Dutch reader to assess relevance.
<b>Study title:</b> Kosteneffectiviteit natuurbeleid: Methodiekontwikkeling
<b>Study authors/clients:</b> Rijksinstituut voor Volksgezondheid en Milieu (RIVM) ( <a href="http://www.rivm.nl/">www.rivm.nl/</a> )
<b>Year:</b> 1999
<b>Policy area:</b> Biodiversity change/nature
<b>Country/ies:</b> Netherlands <b>Language:</b> Dutch
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ?
<b>Abstract:</b> No English abstract.

CS11 ★★ ★
★★★: Clear-cut application of cost-effectiveness, also looks at the water sector, providing a balance to the majority of air pollution studies.
<b>Study title:</b> Kosteneffectiviteit van Verspreiding naar water (cost-effectiveness of Dutch water policies),
<b>Study authors/clients:</b> Woerd, K.F.. van der, et al / Unknown ()
<b>Year:</b> 2000
<b>Policy area:</b> Water
<b>Country/ies:</b> Netherlands <b>Language:</b> Dutch
<b>Availability:</b> hard copy



<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> The main aims of this study were to describe the method for calculating the cost-effectiveness of different volume and emission control measures within the water quality policy, including the determination of the sensitivity of results to some of the key parameters, and to gather and store information on the costs and effects of environmental measures. To calculate cost-effectiveness a model and database built in Excel were used. The cost-effectiveness ratios allow comparison of measures that address different sectors, pollutants and polluters.

CS12 ★★ (★★★?)
★★ : Looks like application of cost-effectiveness analysis. Could be quite general as looking at a wide range of measures, but still useful. Need to have a Dutch person read it to check whether it may merit 3 stars – but we may have enough Dutch studies anyway
<b>Study title:</b> Cost effectiveness of environmental measures
<b>Study authors/clients:</b> Rijksinstituut voor Volksgezondheid en Milieu (RIVM) (www.rivm.nl/) / None ()
<b>Year:</b> 2000
<b>Policy area:</b> Acidification / industry & transport / air
<b>Country/ies:</b> Presumably Netherlands? (Doesn't say in English abstract) <b>Language:</b> Dutch
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> The main aims of this cost-effectiveness study carried out by the RIVM were to: (1) describe the method for calculating the cost-effectiveness of environmental measures, including the determination of the sensitivity on some of the parameters used for the cost-effectiveness calculations, and (2) to gather and store information on the costs and effects of environmental measures needed to calculate cost-effectiveness. Defined in this study as the costs per unit avoided emission, the cost-effectiveness is relatively high when the costs per unit are low. The calculation method for environmental costs, described earlier in 'Costs and benefits in environmental policy; definitions and computational methods' (a report issued by the Ministry of the Environment in 1998), assumes direct tangible costs only for the individual applying the measure and monetarisation of the direct environmental benefits (saved energy and raw materials). Indirect costs like loss of employment and indirect benefits like damage avoided to buildings and crops were excluded. Costs of the measures were calculated using the annuity method of depreciation and a fixed interest rate of 4% (the real rate on the capital market) for all investments.

CS13 ★★★
★★★ : Recent study, looks at CO2, clear-cut application of cost-effectiveness analysis.
<b>Study title:</b> Milieukosten energiemaatregelen 1990-2010 - Overzicht kosten en mogelijke verbeteringen in de monitoring
<b>Study authors/clients:</b> Rijksinstituut voor Volksgezondheid en Milieu (RIVM) (www.rivm.nl/) / ()
<b>Year:</b> 2004
<b>Policy area:</b> Climate change/energy/air
<b>Country/ies:</b> Presumably Netherlands? (Doesn't say in English abstract) <b>Language:</b> Dutch
<b>Availability:</b> electronic copy

<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> This report presents the costs of reducing CO2 emissions with an emphasis on the environmental costs of savings on fossil energy consumption. First, the principles of calculating costs and cost effectiveness are presented. Then, using a number of data sources on the historic costs of saving measures, the cost effectiveness is estimated for different sectors and the years 1995 and 2000. The cost effectiveness of different measures is also determined for the period up to 2010, using the results of scenarios with and without policy measures. Finally an analysis is presented of the possibilities to determine more structurally the environmental costs in the field of energy policy.

<b>CS14 ★</b>
<b>★ :</b> Efficiency has only been touched upon, but looks at Nature Conservation policy so still worthwhile including as a one star rating.
<b>Study title:</b> Quick scan effectiviteit en doelmatigheid van het natuurbeleid (Quick scan effectivity and efficiency of the nature policy in the Netherlands)
<b>Study authors/clients:</b> Rijksinstituut voor Volksgezondheid en Milieu (RIVM) ( <a href="http://www.rivm.nl/">www.rivm.nl/</a> )/ ( )
<b>Year:</b> 2002
<b>Policy area:</b> Biodiversity/agriculture/nature
<b>Country/ies:</b> Netherlands <b>Language:</b> Dutch
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> This report presents the results of a brief overview of the effectiveness and efficiency of the implemented and proposed measures which are part of the nature conservation policy of the Dutch government. After a short description of a number of (autonomous) trends in society and environment, five policy instruments are evaluated: the National Ecological Network, nature in and around cities, management of small natural elements in rural areas, optimization of environmental conditions for nature areas and legal protection of existing nature areas. For each policy instrument an overview is presented of the objectives, results, and strong and weak points in the process of implementing the instruments. With the data that are currently available it is not possible to systematically assess the efficiency of each of the policy instruments and hence efficiency aspect is only touched upon. The report concludes by discussing a number of alternative options for realisation of the national nature policy objectives.

<b>CS15 ★★</b>
<b>★★ :</b> Cost-effectiveness analysis. Need Dutch reader to see if merits 3 stars and also assess country balance of case studies.
<b>Study title:</b> Beoordeling van de Uitvoeringsnotitie Emissieplafonds verzuring en grootschalige luchtverontreiniging (Evaluation of the Implementation memorandum for emission ceilings, acidification and large-scale air pollution)
<b>Study authors/clients:</b> Rijksinstituut voor Volksgezondheid en Milieu (RIVM) ( <a href="http://www.rivm.nl/">www.rivm.nl/</a> )/ ( )
<b>Year:</b> 2003
<b>Policy area:</b> Air quality/industry & transport/air
<b>Country/ies:</b> Netherlands <b>Language:</b> Dutch

<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> The Dutch Cabinet has set down a national programme, drawn up in the framework of the European Directive on national emission ceilings (the NEC Directive), in an Implementation Memorandum, 'Make it or break it'. On request of the Cabinet, the Netherlands Environmental Assessment Agency (MNP) - RIVM took on the evaluation of the objectives and cost-effectiveness of this programme. Conclusions and recommendations are presented in this report. A major conclusion of the study is the strong probability that the Netherlands will not meet its international emission obligations for 3 out of 4 NEC compounds, SO <sub>2</sub> , NO <sub>x</sub> and NMVOCs. Many of the measures and options for additional measures are not concrete and lack sufficient policy instruments for implementation. The choice made to translate national ceilings into sector targets has not been accepted by any of the sectors. This increases the risks surrounding implementation because of the uncertainty in the results of the policy package. Furthermore, the passage of time may mean that some of the reductions needed cannot be realised, making a declaration of default a very real possibility. In the case of ammonia, current policies may be sufficient to meet the target, although there is still a chance that the emission ceiling will be exceeded. Additional measures proposed are expected to bring the ammonia emissions under the ceiling. It will be possible to update the policy programme in 2006. In the meantime, it still remains to be seen whether 'Make it or break it' has set out the right implementation course for realising the Dutch national emission ceilings.

CS16 
<b>Study title:</b> Interdepartementaal onderzoek naar de kosteneffectiviteit van energiesubsidies
<b>Study authors/clients:</b> MilieuActueel ( <a href="http://www.milieuactueel.nl">www.milieuactueel.nl</a> )/ Ministerie van Economische Zaken ( <a href="http://www.ez.nl">www.ez.nl</a> )
<b>Year:</b> 2001
<b>Policy area:</b> Energy
<b>Country/ies:</b> Netherlands ? <b>Language:</b> Dutch
<b>Availability:</b> ?
<b>Ex post/ante?:</b> ?
<b>Abstract:</b> REQUIRED (still looking)

CS17 ★
★ : Examines how cost-effectiveness can be improved by interrelated emission reduction strategies, thus not a comparison per se of different measures; nevertheless, this is an interesting issue.
<b>Study title:</b> Modelling the cost-effectiveness of interrelated emission reduction strategies: the case of agriculture in Europe
<b>Study authors/clients:</b> Brink, C. ( <a href="http://www.sls.wageningen-ur.nl/enr/staff/brink/">www.sls.wageningen-ur.nl/enr/staff/brink/</a> )/ None ()
<b>Year:</b> 2003
<b>Policy area:</b> Air quality & Climate change/agriculture/air
<b>Country/ies:</b> EU <b>Language:</b> English
<b>Availability:</b> Web

<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> Agriculture is an important source of ammonia, contributing to acidification and eutrophication, as well as emissions of the greenhouse gases nitrous oxide and methane. Technical measures to control emissions of one of these pollutants may have an impact on emissions of others. These side effects, which may be positive or negative, are usually ignored in policy-making. This study investigates interrelations in emission reduction strategies for ammonia, nitrous oxide and methane from agricultural activities in Europe and analyses their impact on cost-effective emission reduction strategies. It presents a modelling framework to identify cost-effective strategies for simultaneous reductions in emissions of various pollutants, considering interrelations such as atmospheric transport from the location of emissions to the location where the environmental effect occurs and the secondary benefits (side effects) of different abatement options.

<b>CS18</b> ✖
<b>✖:</b> This is the terms of reference or the starting point for the main study.
<b>Study title:</b> Auto-Oil II Cost-effectiveness Study
<b>Study authors/clients:</b> European Commission, Standard & Poor's DRI and K.U.. Leuven ( <a href="http://europa.eu.int/comm/dgs/environment/index_en.htm">europa.eu.int/comm/dgs/environment/index_en.htm</a> ) / None ()
<b>Year:</b> 1999
<b>Policy area:</b> Air quality/transport/air
<b>Country/ies:</b> EU <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> This report, released in August 1999, is to form the basis for the final report from the cost-effectiveness analysis group (WG7) to be presented towards the end of AOPII.

<b>CS19</b> ★★
<b>★★:</b> Looks at cost-effectiveness of waste disposal measures, so adds a new sector to the mix of case studies. It could be a candidate for three stars, but as it is in Dutch and as a number of studies from the Netherlands have already been prioritised, it has o
<b>Study title:</b> Verwerking kunststof verpakkingsafval uit huishoudens: Mogelijkheden en kosteneffectiviteit van vermindering van milieu-impact
<b>Study authors/clients:</b> Centre for Energy Conservation and Environmental Technology, Delft ( <a href="http://www.cedelft.nl/index.html">www.cedelft.nl/index.html</a> ) / None ()
<b>Year:</b> 2001
<b>Policy area:</b> Waste / households
<b>Country/ies:</b> Netherlands <b>Language:</b> Dutch
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex post? (could be ex-ante)



**Abstract:** Basic gist of Dutch abstract: In this report a picture is outlined of the next ten years' possibilities for costs and environmental benefits with respect to the processing of household plastic packing waste. Conclusions are drawn regarding the most eco efficient waste processing strategy.

CS20 ★★
<b>Study title:</b> Accelerated introduction of cleaner petrol and diesel engines in the Netherlands: An analysis of emissions reduction potential and cost-effectiveness
<b>Study authors/clients:</b> Centre for Energy Conservation and Environmental Technology, Delft ( <a href="http://www.cedelft.nl/index.html">www.cedelft.nl/index.html</a> ) / None ( )
<b>Year:</b> 2000
<b>Policy area:</b> Air quality
<b>Country/ies:</b> Netherlands <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b>
<b>Abstract:</b> In 2005 the European Union is to introduce tighter environmental standards for road vehicle fuels. In this study, the environmental effects and economic costs of accelerated introduction of these fuels in the Netherlands are investigated. Firstly, the introduction of these fuels will cause a direct reduction of the noxious emissions of all road vehicles running on these fuels. In addition, these fuels will open the door for several new vehicle technologies that require low-sulphur fuels to be effective, such as direct injection lean burn petrol engines or particle traps in heavy duty diesel vehicles. A downside is the higher cost of these fuels and the more energy-intensive production process. When comparing the costs and benefits of earlier availability of these fuels, we found that diesel has the greatest cost-effectiveness: there is a good chance that the environmental benefits are greater than the economic costs. Earlier introduction of petrol is considerably less cost-effective. However, the earlier introduction of only a lower sulphur content might well be a cost-effective measure.

CS21 ✖
✖: Not a study on cost-effectiveness
<b>Study title:</b> Fighting Air Pollution in Southern California by Scrapping Old Vehicles
<b>Study authors/clients:</b> Lloyd Dixon, Steven Garber / ( )
<b>Year:</b> 2001
<b>Policy area:</b> Air quality/transport/air
<b>Country/ies:</b> USA <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> Air pollution damages health and reduces the quality of life in California in general and the Los Angeles area in particular. This report is the ex-ante analysis of an air quality programme involving purchase and destruction of 75,000 older cars and light trucks every year for 10 years. While it is widely acknowledged that key effects of the program could depend crucially on vehicle-market responses, this ex-ante analysis is the first to predict these effects using a framework that accounts explicitly for such reactions.



<b>CS22</b>
<b>:</b> It is an ex-ante study of costs and benefits in order to set policy goals, not ex-post evaluation of cost-effectiveness of different measures. Also in USA, so diminishes importance.
<b>Study title:</b> Cost-Effective Reduction of NOX Emissions from Electricity Generation
<b>Study authors/clients:</b> Resources for the Future (Dallas Burtraw, Karen Palmer, Ranjit Bharvirkar, and Anthony Paul) ( <a href="http://www.rff.org/">www.rff.org/</a> )
<b>Year:</b> 2001
<b>Policy area:</b> Air quality/energy/air
<b>Country/ies:</b> USA <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> This paper analyzes the benefits and costs of policies to reduce nitrogen oxides (NOx) emissions from electricity generation in the United States. The analysis considers three NOx reduction scenarios: a summer seasonal cap in the Eastern States covered by EPA's NOx policy, an annual cap in the same region, and a national annual cap, and all scenarios allow for emissions trading. Although EPA's current policy is to implement a seasonal cap in the region, this analysis indicates that an annual cap in the region would yield about US\$400 million more in net benefits (benefits less costs) than would a seasonal policy, based on particulate-related health effects only. An annual cap in the region is also the policy that is most likely to achieve benefits in excess of costs. Consideration of omissions from this accounting, including the potential benefits from reductions in ozone concentrations, strengthens the finding that an annual program offers greater net benefits than a seasonal program.

<b>CS23 ☒</b>
<b>☒:</b> Replicates CS22
<b>Study title:</b> Uncertainty and the Cost-Effectiveness of Regional NOX Emissions Reductions from Electricity Generation
<b>Study authors/clients:</b> Resources for the Future (Dallas Burtraw, Ranjit Bharvirkar and Meghan McGuinness) ( <a href="http://www.rff.org/">www.rff.org/</a> ) / None ( )
<b>Year:</b> 2002
<b>Policy area:</b> Air quality/energy/air
<b>Country/ies:</b> USA <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> This paper analyses uncertainties surrounding the benefits and costs of a policy to reduce nitrogen oxides (NOx) emissions from electricity generation in the Eastern United States. Under each of 18 scenarios examined, the analysis finds that an annual policy would yield net benefits that are at least as great as those expected under the U.S. Environmental Protection Agency's (EPA) currently planned seasonal policy. Preferred (midpoint) assumptions yield additional benefits of \$724 million per year under an annual policy compared to a seasonal one (1997 dollars). The subset of 11 north-eastern states benefit



the most from an annual policy relative to a seasonal one, but relative net benefits are also positive in the remaining states in the region. An annual policy implemented on a national basis appears to be slightly less cost-effective than the EPA's policy under midpoint assumptions but it is more cost-effective under half of the scenarios we examine.

<b>CS24 ★</b>
<b>★ :</b> An interesting analysis of cost-effectiveness of different instruments, but is more of an academic paper and thus more useful for it's findings than as an example of application of the cost-effectiveness methodology. Too theoretical
<b>Study title:</b> The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a Second-Best Setting
<b>Study authors/clients:</b> Resources for the Future (Lawrence H. Goulder Ian W. H. Parry, Roberton C. Williams III, Dallas Burtraw) ( <a href="http://www.rff.org/">www.rff.org/</a> ) ( )
<b>Year:</b> 1998
<b>Policy area:</b> Air quality/industry, energy and transport/air
<b>Country/ies:</b> USA <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> This paper employs analytical and numerical general equilibrium models to examine the costs of achieving pollution reductions under a range of environmental policy instruments. The study compares the costs and overall efficiency impacts of emissions taxes, emissions quotas, fuels taxes, performance standards, and mandated technologies, and explores how costs change with the magnitude of pre-existing taxes and the extent of pollution abatement. Earlier work on instrument choice emphasised the potential reduction in compliance cost achievable by converting fixed emissions quotas into tradable emissions permits. The results of this study indicate that the regulator's decision whether to auction or grandfather emissions rights can have equally important cost impacts. Similarly, the choice as to how to recycle revenues from environmentally motivated taxes (whether to return the revenues in lump-sum fashion or via cuts in marginal tax rates) can be as important to cost as the decision whether the tax takes the form of an emissions tax or fuel tax, particularly when modest emissions reductions are involved.

<b>CS25 ★</b>
<b>★ :</b> As above. Not sufficiently additionally informative
<b>Study title:</b> The Chesapeake Bay and the Control of NOx Emissions: A Policy Analysis
<b>Study authors/clients:</b> Resources for the Future ( <a href="http://www.rff.org/">www.rff.org/</a> ) ( )
<b>Year:</b> 1998
<b>Policy area:</b> Air quality/industry, energy and transport/air
<b>Country/ies:</b> USA <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> The study explores the effectiveness of efforts to reduce NOx emissions to meet the ambient air



quality standard for ozone. The analysis of possible least cost options shows that the costs of obtaining such reductions can be significantly reduced by rearranging the allocation of emissions reductions to take advantage of source-type and locational considerations. In addition, the authors find that adding consideration of ancillary ozone-related health benefits to the picture does not alter any qualitative conclusions unless a link between ozone and mortality risk is assumed.

CS26 ★★
★★: Compares ex-post cost-effectiveness with ex-ante estimates of costs. USA focus makes it less relevant.
<b>Study title:</b> The Enhanced I/M Program in Arizona: Costs, Effectiveness, and a Comparison with Pre-regulatory Estimates
<b>Study authors/clients:</b> Resources for the Future ( <a href="http://www.rff.org">www.rff.org</a> )/ None ()
<b>Year:</b> 1999
<b>Policy area:</b> Air quality/transport/air
<b>Country/ies:</b> USA <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> Using data from 1995 and 1996, the report analyses the cost and effectiveness of the Arizona Enhanced I/M Program. The paper concludes by comparing the empirical estimates of costs and program effectiveness in the Arizona program with the ex ante estimated Enhanced program costs made by the EPA in the 1992 Regulatory Impact Analysis (RIA). The ex ante EPA analysis appears to have underestimated the costs of achieving the ambitious reductions in emissions hoped for under I/M.

CS27 ✖
✖: Replicates CS26
<b>Study title:</b> Costs, Emissions Reductions, and Vehicle Repair: Evidence from Arizona
<b>Study authors/clients:</b> Resources for the Future ( <a href="http://www.rff.org">www.rff.org</a> )/ ()
<b>Year:</b> 1999
<b>Policy area:</b> Air quality/transport/air
<b>Country/ies:</b> USA <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> The Arizona I/M program provides one of the first opportunities to examine the costs and effectiveness of vehicle emission repair. This paper examines various aspects of emission reductions, fuel economy improvements, and costs of repair, drawing data from over 80,000 vehicles failing the I/M test in Arizona between 1995 and the first half of 1996. Because missing or incomplete cost information has been a serious shortcoming for evaluation of I/M programs, the paper develops a method for estimating the costs of repair when those costs are not reported. The paper summarizes the evidence on cost and emission reduction in the Arizona program, comparing costs and emission reductions for both cars and trucks. Finally, the analysis reports the potential for more cost-effective repair, first through an analysis of



tightening I/M cutpoints, and then by calculating the cost savings of achieving different emission reduction goals when the most cost effective repairs are made first.

<b>CS28 ✖</b>
<b>✖:</b> Too much of a discussion paper rather than a detailed cost-effectiveness study
<b>Study title:</b> SO2 Cap-and-Trade Program in the United States: a "Living Legend" of Market Effectiveness
<b>Study authors/clients:</b> Burtraw, D. and Palmer, K. / ()
<b>Year:</b> 2004
<b>Policy area:</b> Air quality/energy/air
<b>Country/ies:</b> USA <b>Language:</b> English
<b>Availability:</b> hard copy
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> No abstract provided

<b>CS29 ✖</b>
<b>✖:</b> Too much of a discussion paper rather than a detailed cost-effectiveness study
<b>Study title:</b> CFCs: a Look Across two Continents
<b>Study authors/clients:</b> Hammitt, James K. / ()
<b>Year:</b> 2004
<b>Policy area:</b> ozone/industry/air
<b>Country/ies:</b> USA <b>Language:</b> English
<b>Availability:</b> hard copy
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b>

<b>CS30 ★★★ (★★?)</b>
<b>★★★:</b> Useful comparison of ex-ante and ex-post. Although may want to reduce to two stars if copy is hard to obtain, also not sure how much emphasis there is on effectiveness.
<b>Study title:</b> Are the Costs of Proposed Environmental Regulations Overestimated? Evidence from the CFC phaseout
<b>Study authors/clients:</b> Hammitt, James K. / None ()
<b>Year:</b> 2000
<b>Policy area:</b> Ozone/industry/air



<b>Country/ies:</b> USA <b>Language:</b> English
<b>Availability:</b> electronic copy (not free)
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> Benefit-cost and cost-effectiveness analysis are often advocated for decision making about environmental, health, and safety regulations, but there has been little research evaluating the accuracy of prospective (ex ante) estimates of regulatory costs and benefits. This reports compares the prospective estimates of the marginal cost of limiting chlorofluorocarbon (CFC) consumption in the United States, published shortly before and after the September 1987 adoption of the Montreal Protocol with retrospective (ex post) estimates based on realised market prices. Estimates published before international regulations were adopted (in May 1986) substantially overestimate the marginal costs of limiting CFC-11 and CFC-12 consumption but modestly underestimate the costs of limiting CFC-113 consumption. In contrast, estimates published shortly after adoption of the Protocol (in August 1988) appear to underestimate the marginal cost of limiting CFC consumption.

<b>CS31 ★ ★ ★</b>
<b>★ ★ ★ :</b> Clear-cut application of cost-effectiveness analysis, in Eastern Europe (an area not covered by other case studies). Need to ensure we can get a copy.
<b>Study title:</b> Cost efficient reductions of stochastic nutrient loads to the Baltic Sea
<b>Study authors/clients:</b> Elofsson, Katarina ( <a href="http://www.sekon.slu.se/~bkr/ulv00abselo.htm">www.sekon.slu.se/~bkr/ulv00abselo.htm</a> )/ None ()
<b>Year:</b> 2000
<b>Policy area:</b> Other/agriculture/water
<b>Country/ies:</b> Baltic Sea countries <b>Language:</b> English
<b>Availability:</b> To request
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> Nutrient enrichment that leads to eutrophication is one of the major environmental problems in the Baltic Sea region. Uncertainty about annual loads makes it difficult for policy-makers to determine cost-effective policies. The purpose of this paper is to calculate cost-effective solutions to riverine nutrient load reductions to the Baltic Sea. The Baltic Sea region is divided upon 18 regions, which differ in their ecological and institutional properties. The costs of reducing the stochastic loads of nitrogen and phosphorus are computed using a chance-constrained model. Emissions from both point and non-point sources are included, and the cross-effects between measures are modeled explicitly. The model comprises 12 different abatement measures, some of which have an impact on only one of the nutrient loads, and others on both. Furthermore, some of the measures have an impact on the variance of loads, while others only affect average loads. Total and marginal costs for different load reductions are computed, and the implications for the use of economic instruments, such as taxes and the use of trading ratios, are investigated.

<b>CS32</b>
<b>Study title:</b> Cost-Effectiveness Analysis of Final Effluent Limitations Guidelines and Standards for the Offshore Oil and Gas Industry
<b>Study authors/clients:</b> US Environmental Protection Agency ( <a href="http://www.epa.gov/">www.epa.gov/</a> )/ ()
<b>Year:</b> 1993



<b>Policy area:</b> Chemicals/energy/water
<b>Country/ies:</b> USA <b>Language:</b> English
<b>Availability:</b> hard copy - to order
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> Not available without purchase

<b>CS33 ★</b>
<b>★ :</b> Includes a cost-effectiveness analysis. Is a US study no less relevant, also needs to be ordered in hard copy (so difficult to assess importance).
<b>Study title:</b> Economic And Cost-Effectiveness Analysis For Proposed Effluent Limitations Guidelines And Standards For The Landfills Point Source Category.
<b>Study authors/clients:</b> US Environmental Protection Agency (www.epa.gov)/ None ()
<b>Year:</b> 1998
<b>Policy area:</b> Waste/households & industry/soil
<b>Country/ies:</b> USA <b>Language:</b> English
<b>Availability:</b> hard copy - to order
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> The report analyses the impacts of the limits imposed on the effluent discharges from landfills on facilities, firms, foreign trade, community and new sources. The report also includes an analysis of cost-effectiveness, defined as the incremental annual cost per incremental toxic-weighted pound of pollutant removed.

<b>CS34 ✕</b>
<b>✕ :</b> Context is too different to European Policy one
<b>Study title:</b> Indonesian Water Supply Technology Cost Effectiveness
<b>Study authors/clients:</b> US Environmental Protection Agency (www.epa.gov)/ ()
<b>Year:</b> 1995
<b>Policy area:</b>
<b>Country/ies:</b> Indonesia <b>Language:</b>
<b>Availability:</b> _
<b>Ex post/ante?:</b> not relevant
<b>Abstract:</b> This report compares the average incremental costs, in both financial and economic prices, of various options of providing adequate safe water to rural households in Indonesia. The analysis finds that installing improved traditional wells, adding simple piped systems, and rehabilitating large scale piped systems is likely to increase economic welfare, while installing new large scale piped systems may not. A distributional analysis of the different technologies is also used to trace their beneficiaries.



<b>CS35</b>
: Study is old, USA, and only available through hard copy order, doesn't add diversity to existing summaries.
<b>Study title:</b> Financial Cost Effectiveness of Point and Nonpoint Source Nutrient Reduction Technologies in the Chesapeake Bay Basin
<b>Study authors/clients:</b> US Environmental Protection Agency (www.epa.gov)/ None ()
<b>Year:</b> 1993
<b>Policy area:</b> Other/agriculture/water
<b>Country/ies:</b> USA <b>Language:</b>
<b>Availability:</b> hard copy - to order
<b>Ex post/ante?:</b> ?
<b>Abstract:</b> Not available without purchase.

<b>CS36</b>
: Study is old, USA, and only available through hard copy order, doesn't add diversity to existing summaries.
<b>Study title:</b> Cost-Effectiveness Analysis Of Proposed Effluent Limitations Guidelines And Standards For The Pesticide Manufacturing Industry.
<b>Study authors/clients:</b> US Environmental Protection Agency (www.epa.gov)/ ()
<b>Year:</b> 1992
<b>Policy area:</b> Chemicals/agriculture/all mediums
<b>Country/ies:</b> USA <b>Language:</b>
<b>Availability:</b> hard copy - to order
<b>Ex post/ante?:</b> ?
<b>Abstract:</b> Not available without purchase.

<b>CS37</b> ✖
✖: Would not provide much additional info for a fairly out of date study. Also not EU.
<b>Study title:</b> Cost-Effectiveness Analysis Of Proposed Effluent Limitations Guidelines For The Pharmaceutical Manufacturing Industry
<b>Study authors/clients:</b> US Environmental Protection Agency (www.epa.gov)/ ()
<b>Year:</b> 1995
<b>Policy area:</b> Chemicals/industry/air & water



<b>Country/ies:</b> USA <b>Language:</b>
<b>Availability:</b> hard copy - to order
<b>Ex post/ante?:</b> ?
<b>Abstract:</b> Not available without purchase.

<b>CS38</b>
<b>:</b> Study very old, but still interesting as looks at agriculture.
<b>Study title:</b> An Evaluation of the Cost Effectiveness of Agricultural Best Management Practices and Publicly Owned Treatment Works in Controlling Phosphorus Pollution in the Great Lakes Basin
<b>Study authors/clients:</b> US Environmental Protection Agency (www.epa.gov)/ ()
<b>Year:</b> 1986
<b>Policy area:</b> Chemicals/agriculture/water
<b>Country/ies:</b> USA <b>Language:</b>
<b>Availability:</b> hard copy - to order
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> The primary purpose of this study is to analyse the cost-effectiveness of various diffuse water pollution control strategies in the Great Lakes Basin. The first step in this effort was a literature review of agricultural best management practices and critical factors influencing the cost-effectiveness of these practices in controlling sediment and phosphorus were identified. Then a case study was undertaken to estimate the costs and effectiveness of conservation tillage in reducing phosphorus loads in the Honey Creek watershed in Ohio. The third step in the analysis was to identify publicly owned treatment works in the area which have recently been built or upgraded beyond secondary treatment for phosphorus control and estimate the associated costs. Finally a cost-effectiveness comparison was completed for the treatment works and conservation tillage based on the case study.

<b>CS39</b>
<b>:</b> Ex-ante, effectiveness of proposed guidelines, USA, copy difficult to obtain.
<b>Study title:</b> Cost-Effectiveness Analysis Of Proposed Effluent Limitations Guidelines And Standards For The Centralized Waste Treatment Industry
<b>Study authors/clients:</b> US Environmental Protection Agency (www.epa.gov)/ ()
<b>Year:</b> 1995
<b>Policy area:</b> waste/households & industry
<b>Country/ies:</b> USA <b>Language:</b>
<b>Availability:</b> hard copy - to order
<b>Ex post/ante?:</b> ?
<b>Abstract:</b> Not available without purchase.



CS40
<b>Study title:</b> Cost-Effectiveness Analysis For Proposed Pre-treatment Standards For Existing And New Sources For The Industrial Laundries Point Source Category
<b>Study authors/clients:</b> US Environmental Protection Agency (www.epa.gov)/ None ()
<b>Year:</b> 1997
<b>Policy area:</b> Chemicals/industry/water
<b>Country/ies:</b> USA <b>Language:</b>
<b>Availability:</b> hard copy - to order
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> The document supports proposed Pre-treatment Standards for the Industrial Laundries Point Source Category. It compares the total annualized cost of each of the four regulatory options and their effectiveness in reducing pollutant discharge. The effectiveness is evaluated in terms of costs per pound of pollutant removed, weighted by the relative toxicity of the pollutant (toxic weighting factor).

CS41
<b>:</b> Cost-effectiveness part of study not central
<b>Study title:</b> Economic Analysis And Cost-Effectiveness Analysis Of Proposed Effluent Limitations Guidelines And Standards For Industrial Waste Combustors
<b>Study authors/clients:</b> US Environmental Protection Agency (www.epa.gov)/ ()
<b>Year:</b> 1998
<b>Policy area:</b> Air quality & waste/industry/air
<b>Country/ies:</b> USA <b>Language:</b>
<b>Availability:</b> hard copy - to order
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> The report provides a profile of the Industrial Waste Combustors industry and the facility, firm-level, foreign trade, and community impacts of the proposed effluent limitation guidelines and standards. It also includes an analysis of cost-effectiveness, defined as the incremental annual cost per incremental toxic-weighted pound of pollutant removed.

CS42 ★
<b>★ :</b>
<b>Study title:</b> Cost Effective Air Quality Improvement
<b>Study authors/clients:</b> US Environmental Protection Agency (www.epa.gov)/ None ()
<b>Year:</b> 1996
<b>Policy area:</b> Air quality/industry, energy & transport/air



<b>Country/ies:</b> USA <b>Language:</b>
<b>Availability:</b> hard copy - to order
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> The report analyses the cost effectiveness of different options of vehicle and fuel charges by combining data on costs and environmental impact of reformulated gasolines, low emission vehicles (with improved catalysts and fuel preparation systems), and zero emission vehicles. The key parameters in determining cost effectiveness are found to be fuel costs, vehicle costs, and emission factors. The study demonstrates the importance of an integrated analysis and the need to consider decentralised regulatory approaches, such as effluent taxes and marketable permits, when the data are characterised by large uncertainties. The report distinguishes between fixed and variable costs, uses linear programming to minimise the costs of achieving reductions associated with the mandate and performs several sensitivity analyses.

CS43 ☒
☒: More of a discussion paper than a cost-effectiveness study. Cost-effectiveness not discussed in sufficient detail.
<b>Study title:</b> Comparison of the EU and US approaches towards acidification, eutrophication and ground level ozone
<b>Study authors/clients:</b> Milieu Ltd ( <a href="http://www.milieu.be/">www.milieu.be/</a> )/ ( )
<b>Year:</b> 2004
<b>Policy area:</b> acidification/industry/air
<b>Country/ies:</b> EU & USA <b>Language:</b>
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> No convenient summarisation provided.

CS44 ☒
☒: More of a discussion paper than a cost-effectiveness study. Cost-effectiveness not discussed in sufficient detail.
<b>Study title:</b> Comparison of the EU and US experiences with respect to controlling emissions from high emitting vehicles
<b>Study authors/clients:</b> Milieu Ltd ( <a href="http://www.milieu.be/">www.milieu.be/</a> )
<b>Year:</b> 2004
<b>Policy area:</b> Air quality/transport/air
<b>Country/ies:</b> EU & USA <b>Language:</b>
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex post



**Abstract:** No convenient summarisation provided.

CS45 ✖

✖: More of a discussion paper than a cost-effectiveness study. Cost-effectiveness not discussed in sufficient detail.

**Study title:** Comparison of the EU and US approaches towards control of particulate matter

**Study authors/clients:** Milieu Ltd ([www.milieu.be/](http://www.milieu.be/))

**Year:** 2004

**Policy area:** Air quality/industry & transport/air

**Country/ies:** EU & USA **Language:**

**Availability:** electronic copy

**Ex post/ante?:** ex post

**Abstract:** No convenient summarisation provided.

CS46 ✖

✖: On closer inspection, seems to cover only effectiveness, not cost-effectiveness

**Study title:** Evaluating Vehicle Emissions and Inspection Maintenance Programs

**Study authors/clients:** Committee on Vehicle Emission Inspection and Maintenance Programs ([books.nap.edu/books/0309074460/html/index.html/](http://books.nap.edu/books/0309074460/html/index.html/))

**Year:** 2001

**Policy area:** Air quality/transport/air

**Country/ies:** USA **Language:**

**Availability:** WEB

**Ex post/ante?:** ex post

**Abstract:** No convenient summarisation provided.

CS47 ★★★

★★★: EU policy, looks at biodiversity so provides good mix of subject areas for summaries. Looks like solid application of methodology (i.e. Quantitative results on CE).

**Study title:** Cost Effectiveness of Biodiversity Provision

**Study authors/clients:** Macaulay Institute ([www.mluri.sari.ac.uk/](http://www.mluri.sari.ac.uk/))/ Scottish Executive Environment and Rural Affairs Depart ([www.scotland.gov.uk/topics/agriculture](http://www.scotland.gov.uk/topics/agriculture))

**Year:** 2002

**Policy area:** Biodiversity change / agriculture / nature



<b>Country/ies:</b> Scotland, UK <b>Language:</b> English
<b>Availability:</b> To request
<b>Ex post/ante?:</b> ex post
<b>Abstract:</b> The aim of this research was to estimate the cost associated with the provision of biodiversity as a joint product of agriculture and other land uses in the form of the Environmentally Sensitive Area (ESA) Scheme introduced in Scotland in 1987. The ESA scheme adopted a non-discretionary, broad-brush approach to the delivery of biodiversity management incentives. This study sought to demonstrate that cost-effectiveness gains would result from a more targeted approach. This cost-effectiveness analysis is the first undertaken of an agri-environmental scheme in the UK. The management of three habitats was investigated: heather, herb-rich grassland and wetland. Biodiversity was measured as both botanical diversity on field-level plots, and as surrounding habitat or land cover diversity. In the case of farms, cost of habitat management was measured both as the cost to the public exchequer of ESA compensation, and the private cost to the farmer. In the case of non-farms, private costs of habitat management were measured. These cost and biodiversity measures were combined into cost-effectiveness ratios, and compared across farm types, and between farms and non-farms.

CS48 ✖
✖: About pest control, not environmental measures
<b>Study title:</b> Dendroctonus Micans (Great Spruce Bark Beetle) Economic Appraisal Of Control Options
<b>Study authors/clients:</b> / UK Forestry Commission
<b>Year:</b>
<b>Policy area:</b>
<b>Country/ies:</b> UK <b>Language:</b> English
<b>Availability:</b> _
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> This appraisal presents a cost-effectiveness analysis of options to control the effects of the Great Spruce Bark Beetle, or Dendroctonus micans, on spruce forests in Great Britain:

CS49 ★★★
★★★: CEA of water emissions, so adds water to the mix of studies summarised. Quantitative results, recent study.
<b>Study title:</b> Cost Effective Reduction of Copper Pollution in the Humber Estuary
<b>Study authors/clients:</b> Beamont, N. and Tinch, R. (CSERGE) ( <a href="http://www.uea.ac.uk/env/cserge/">www.uea.ac.uk/env/cserge/</a> ) / None ()
<b>Year:</b> 2003
<b>Policy area:</b> Other / industry / water
<b>Country/ies:</b> England, UK <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex ante



**Abstract:** To ensure the reduction of copper inputs to the Humber Estuary in the future is effective and efficient it is essential to understand the economic implications of reducing waste discharges. This paper aims to detail a cost-effectiveness analysis for the reduction of industrial sources of copper to the Humber estuary. All industries which discharge copper to the Humber were identified, and all the abatement options available to them were collated. A detailed analysis of currently available copper abatement technologies, and their associated costs, is undertaken using the Abatement Cost Curve methodology. This economic analysis permits the representation of the copper abatement information in a transparent format, which is readily accessible to environmental decision makers. The development of abatement cost curves highlights the most effective and efficient way of reducing copper discharges, and also provides a valuable insight into the potential for de-coupling environmental degradation from economic development.

<b>CS50 ★</b>
★ : Ex-ante, and problem of availability. This is preparatory work for a cost-effectiveness study, not the study itself (which does not seem to have been commissioned)
<b>Study title:</b> Cost Effectiveness of Noise Reduction Measures, Phase 1
<b>Study authors/clients:</b> AEA Technology ( <a href="http://www.aeat.co.uk/">www.aeat.co.uk/</a> ) / UK Department for Transport ( <a href="http://www.dft.gov.uk">www.dft.gov.uk</a> )
<b>Year:</b> 2001
<b>Policy area:</b> Noise / transport
<b>Country/ies:</b> UK <b>Language:</b> English
<b>Availability:</b> _
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> The purpose of the initial project is to advise on which modelling approach might best be used to assess the relative impacts of different measures to reduce road and rail noise nuisance; what data/information would be required for modelling to be carried out; how we might best assess the optimal balance between action at the EU and local levels; and how to assess the relative merits of different measures at different levels and therefore how to devise the most cost effective policy package.

<b>CS51 ★★</b>
★★ : Ex-ante for target setting rather than for choosing between measures.
<b>Study title:</b> Economic Evaluation of a Directive on National Emission Ceilings for Certain Atmospheric Pollutants
<b>Study authors/clients:</b> International Institute for Applied Systems Analysis (IIASA) & AEA Technology ( <a href="http://www.iiasa.ac.at/">www.iiasa.ac.at/</a> ) / EC Environment DG ( <a href="http://europa.eu.int/comm/dgs/environment/index_en.htm">europa.eu.int/comm/dgs/environment/index_en.htm</a> )
<b>Year:</b> 1999
<b>Policy area:</b> Air quality & acidification / industry & transport / air
<b>Country/ies:</b> EU <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex ante



**Abstract:** The study makes an assessment of what set of national emission ceilings would be most cost-effective in meeting the different possible targets for reducing ozone and acidification. For each target the cost effective set of ceilings was calculated, taking into account differences in abatement costs between member states, and the different impact of pollutants depending on their point of origin. Three scenarios (high, central and low ambition) were examined for meeting ozone targets. Three additional scenarios were examined in which targets were set for both ozone and acidification. For each scenario, the consultants calculated what set of emission ceilings would allow the targets to be met across Europe at least cost. This analysis was performed using a detailed model of emission sources and costs of pollution control technologies (the RAINS model).

<b>CS52 ★ ★ ★</b>
<b>★ ★ ★ :</b> Looks at Finland so adds another country to those reviewed, looks at climate change and is a cost-effectiveness analysis of different technical measures.
<b>Study title:</b> Integrated cost-effectiveness analysis of greenhouse gas emission abatement: the case of Finland
<b>Study authors/clients:</b> VTT Energy ( <a href="http://www.vtt.fi/">www.vtt.fi/</a> )/ None
<b>Year:</b> 1999
<b>Policy area:</b> Climate change / air
<b>Country/ies:</b> Finland <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> In Finland, greenhouse gas emissions are expected to increase during the next decades due to economic growth, particularly in the energy intensive industrial sectors. The role of these industries is very central in the national economy. The emission control according to the Kyoto Protocol will therefore be quite difficult and costly. The study analyses the cost-effectiveness of different technical options for reducing the emissions of carbon dioxide, methane and nitrous oxide in Finland. The analysis is performed with the help of a comprehensive energy system model for Finland, which has been extended to cover all major sources of methane and nitrous oxide emissions in the energy sector, industry, waste management and agriculture. The focus being on technical options, no consideration is given to possible policy measures, emission trading or joint implementation in the study.

<b>CS53 ★ ★ ★</b>
<b>Study title:</b> Options to Reduce Nitrous Oxide Emissions
<b>Study authors/clients:</b> AEA Technology ( <a href="http://www.aeat.co.uk/">www.aeat.co.uk/</a> )/ EC Environment DG ( <a href="http://europa.eu.int/comm/dgs/environment/index_en.htm">europa.eu.int/comm/dgs/environment/index_en.htm</a> )
<b>Year:</b> 1998
<b>Policy area:</b> Climate change / air
<b>Country/ies:</b> EU <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> ex ante
<b>Abstract:</b> This report is one of the final reports under a study completed by AEA Technology Environment

for DGXI on the control and reduction of greenhouse gases and ozone precursors. Four gases were included in the study, the two direct greenhouse gases, methane and nitrous oxide, and the ozone precursors, nitrogen oxides (NOx) and non-methane volatile organic compounds. In the initial phase of the study, inventories of these gases for all Member States were reviewed and updated. In the second phase of the study, measures to control and reduce emissions of these gases were identified, their technical feasibility examined, and wherever sufficient cost and performance data was available, the cost-effectiveness of the measures (in terms of ECU (1995) per tonne of pollutant) was also estimated.

## CS54 ★★

**Study title:** Options to Reduce Methane Emissions

**Study authors/clients:** AEA Technology ([www.aeat.co.uk/](http://www.aeat.co.uk/))/ EC Environment DG ([europa.eu.int/comm/dgs/environment/index\\_en.htm](http://europa.eu.int/comm/dgs/environment/index_en.htm))

**Year:** 1998

**Policy area:** Climate change / air

**Country/ies:** EU **Language:** English

**Availability:** electronic copy

**Ex post/ante?:** ex ante

**Abstract:** This report is one of the final reports under a study completed by AEA Technology Environment for DGXI on the control and reduction of greenhouse gases and ozone precursors. Four gases were included in the study, the two direct greenhouse gases, methane and nitrous oxide, and the ozone precursors, nitrogen oxides (NOx) and non-methane volatile organic compounds. In the initial phase of the study, inventories of these gases for all Member States were reviewed and updated. In the second phase of the study, measures to control and reduce emissions of these gases were identified, their technical feasibility examined, and wherever sufficient cost and performance data was available, the cost-effectiveness of the measures (in terms of ECU (1995) per tonne of pollutant) is also estimated.

## CS55 ★

**Study title:** Retrospective Examination of Demand-Side Energy Efficiency Policies

**Study authors/clients:** Resources for the Future ([www.rff.org/](http://www.rff.org/))/ none ()

**Year:** 2004

**Policy area:** Climate change / air

**Country/ies:** USA **Language:** English

**Availability:** electronic copy

**Ex post/ante?:** ex post

**Abstract:** Energy efficiency policies are a primary avenue for reducing carbon emissions, with potential additional benefits from improved air quality and energy security. We review literature on a broad range of existing non-transportation energy efficiency policies covering appliance standards, financial incentives, information and voluntary programs, and government energy use (building and professional codes are not included). Estimates indicate these programs are likely to have collectively saved no more than 4 quads of energy annually, with appliance standards and utility demand-side management likely making up at least half these savings. Energy Star, Climate Challenge, and 1605b voluntary emissions reductions may also contribute significantly to aggregate energy savings, but how much of these savings would have occurred



absent these programs is less clear. Although even more uncertain, reductions in CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub>, and PM-10 associated with energy savings may contribute about 10% more to the value of energy savings

<b>CS56 ★★</b>
<b>Study title:</b> Examination of Existing Policy Options that have been Chosen by Member States to Implement Directive 76/464/EEC and Assessment of the Financial Impact and Cost Effectiveness of such Options
<b>Study authors/clients:</b> WRC ( <a href="http://www.wrcplc.co.uk/">www.wrcplc.co.uk/</a> )/ Unknown ()
<b>Year:</b> 0
<b>Policy area:</b> Water
<b>Country/ies:</b> EU <b>Language:</b> English
<b>Availability:</b> Unknown
<b>Ex post/ante?:</b> Ex post
<b>Abstract:</b> The collaborative study compared the wide variety of approaches that have been taken across Europe to implement the Directive in terms of the costs to implement the approach and the effectiveness. An important part of the study was the generation of scenarios in order to test the implications of the different policy options for the future. The findings supported decisions about the control of non-IPPC industries in the EU.

<b>CS57 ★★</b>
<b>Study title:</b> The Potential Cost and Effectiveness of Voluntary Measures in Reducing the Environmental Impact of Pesticides
<b>Study authors/clients:</b> eftec ( <a href="http://www.eftec.co.uk/">www.eftec.co.uk/</a> )/ UK Department of the Environment, Transport and the Regions (now <a href="http://www.defra.gov.uk">www.defra.gov.uk</a> )
<b>Year:</b> 2001
<b>Policy area:</b> Chemicals/ agriculture
<b>Country/ies:</b> UK <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> Ex ante
<b>Abstract:</b> The first milestone in the evolution of the Government's pesticides policy was the Food and Environment Protection Act 1985 and its implementing Regulations of 1986. The purpose of this legislation was to safeguard the health of humans and the environment and to ensure that pesticides are safe and effective (OECD, 1996). While it is acknowledged that there are many uncertainties in this context, Government policy has been in favour of taking precautionary action to limit the risks from pesticides use. In addition to this regulatory framework, the Government also considered a pesticide tax (ECOTECH et al, 1998). This study has the following aims: (a) establish the type and structure of a voluntary agreement for pesticides; (b) develop a set of criteria to evaluate the effectiveness of voluntary measures in achieving the Government's objectives for pesticides; (c) identify, evaluate the effectiveness and estimate the cost of additional voluntary measures in achieving the Government's objectives; and (d) conduct a comparative assessment of the package of measures proposed by the Crop Protection Association with alternative voluntary measures.

CS58
: The study does not appear qualified as an example of a CEA.
<b>Study title:</b> Milieubeleidsovereenkomsten per uitvoering van de aanvaardingsplicht
<b>Study authors/clients:</b> Bracke, R. / ()
<b>Year:</b> 2003
<b>Policy area:</b> Waste
<b>Country/ies:</b> Belgium (Flanders) <b>Language:</b> Flemish
<b>Availability:</b> _
<b>Ex post/ante?:</b>
<b>Abstract:</b> The document provides an ex-nunc analysis of different voluntary agreements that are currently being installed in Flemish waste management. The documents discusses in greater depth the voluntary agreements of the following sectors: printing, public relations and advertising, end-of-life cars, tyres, electrical household appliances. For some of these, the evaluation comprises an assessment in how far the agreements have achieved the targets they were supposed to achieve, for others this analysis is lacking. Financial aspects are not covered in depth; there is only a qualitative assessment (+ / -) of whether the costs of measures taken under the agreement are indeed covered by the polluter. However, the costs themselves are not quantified.
CS59
: The study would not qualify as an example of a CEA.
<b>Study title:</b> Gemeenten en de uitbouw van de infrastructuur voor afvalwaterzuivering
<b>Study authors/clients:</b> Van Zele, L. and Leroy, P. / ()
<b>Year:</b> 2003
<b>Policy area:</b> Waste
<b>Country/ies:</b> Belgium (Flanders) <b>Language:</b> Flemish
<b>Availability:</b> _
<b>Ex post/ante?:</b>
<b>Abstract:</b> The study presents a largely qualitative evaluation of Flemish waste water policies. The author discusses the institutional setup for waste water policy in Flanders, the different actors that are involved in it as well as their responsibilities, and the compliance of the Flemish system with EU requirements. On the financial side, the study does not provide costs of the measures undertaken so far, but rather estimates of future investment needs to replace existing sewage networks. Cost estimates are presented as total figures and on a per-capita basis. However, the estimates are not presented in relation to the effects of the measure, but rather to indicate the overall funding need. There is no comparison of alternative options.
CS60
: As the costs of the considered actions are not quantified or treated systematically anywhere in the document, it is not suitable as an example of a CEA.

<b>Study title:</b> Uitvoeringsplan Houshoudelijke Afvalstoffen 1997 – 2001
<b>Study authors/clients:</b> De Bruyn, T., Bacchus, K. & Gysen, J. / ()
<b>Year:</b> 2003
<b>Policy area:</b> Waste
<b>Country/ies:</b> Belgium (Flanders) <b>Language:</b> Flemish
<b>Availability:</b> _
<b>Ex post/ante?:</b>
<b>Abstract:</b> The study presents the historical development and an ex-nunc-evaluation of the Flemish implementation plan on household waste. I comprises a theoretical discussion of concepts, methods and approaches used, as well as a survey of the historic development of the plan and the role of the actors involved. The evaluation covers the targets set by the implementation plan (prevention, recovery and disposal) as well as the actions taken to reach these targets, the policy instruments used to support implementation, and the monitoring of effects. The actual evaluation is mostly done in a qualitative and verbal way, supported by some quantified facts (number of recycling centres, number of household separating waste, total waste load etc.). For some of the targets mentioned above, there is also an analysis whether (and why) targets were reached or not. Costs of the considered actions are only occasionally mentioned, but are not quantified anywhere in the document. Where costs are mentioned, this is done in a qualified way, centred on the distribution of costs rather than their level.

CS61
: Due to the lack of evidence either on costs or on effectiveness, the study cannot effectively serve as an example of a CEA.
<b>Study title:</b> Milieuvergunningverlening in afvalwater- gebonden dossiers: een onderzoek naar het proces en de organisatie van de ambtelijke adviesverlening in (klasse 1-) lozingsdossiers
<b>Study authors/clients:</b> Crabbé, A. and Leroy, P. / ()
<b>Year:</b> 2003
<b>Policy area:</b> Waste
<b>Country/ies:</b> Belgium (Flanders) <b>Language:</b> Flemish
<b>Availability:</b> _
<b>Ex post/ante?:</b>
<b>Abstract:</b> The study discusses the experiences with environmental licenses in the Flemish waster water sector. It puts a main focus on analysing the relations and the cooperation between two main actors in this system, the Department for environmental licenses (AMV) in the Flemish Administration of Environment, Nature, Land and Water Management, and the Flemish Environment Agency (VMM). The study analyses how differences in the approaches of these institutions affect the results of policy implementation, and identifies success factors for effective “licensing committees”. However, the study does not judge on the effectiveness of the system, as it argues that the causality between changes in water quality and changes in the organisational set-up cannot be established. The costs of measures are not discussed.

CS62 ★
<b>Study title:</b> Economic Evaluation of Quantitative Objectives for Climate Change

<b>Study authors/clients:</b> Coherence / EC Environment DG (europa.eu.int/comm/dgs/environment/index_en.htm)
<b>Year:</b> 0
<b>Policy area:</b> Climate change / air
<b>Country/ies:</b> EU <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> Ex ante
<b>Abstract:</b> This study identifies the least-cost packages of specific policies and measures for meeting the Community's quantitative reduction targets for greenhouse gases under the Kyoto Protocol. The study analyses separately carbon dioxide, methane and nitrous oxide emissions, and how the different sectors of the economy (i.e. power production, industry, tertiary-domestic, transport, waste sector and agriculture) could reduce the emissions. Potentials and costs of reduction of methane and nitrous oxide are assessed and the respective cost curves are derived. Energy related carbon dioxide emissions are analysed using the PRIMES energy systems model for EU Member States. The study also analyses the costs and emission reductions of an emissions trade in carbon dioxide for meeting the goals set in the Kyoto Protocol in a cost-effective way. The costs of different trading scenarios in carbon dioxide emissions are analysed using the POLES model, which models global long-term energy consumption.

<b>CS63 ★★</b>
<b>★★:</b> Could possibly be revised when full report is available.
<b>Study title:</b> Review of the Large Combustion Plant Directive
<b>Study authors/clients:</b> entec (www.entecuk.com)/ EC Environment DG (europa.eu.int/comm/dgs/environment/index_en.htm)
<b>Year:</b> 2004
<b>Policy area:</b> Air quality / industry / air
<b>Country/ies:</b> EU <b>Language:</b> English
<b>Availability:</b> ?
<b>Ex post/ante?:</b> Ex ante
<b>Abstract:</b> This report should have been published in September 2004, but so far we have only seen the inception report. To chase up.

<b>CS64 ✕</b>
<b>✕:</b> It either doesn't exist or isn't available
<b>Study title:</b> Economic evaluation of draft Directive on incineration of non-dangerous waste
<b>Study authors/clients:</b> EC Environment DG (europa.eu.int/comm/dgs/environment/index_en.htm)/ ()
<b>Year:</b> 1995
<b>Policy area:</b> Waste



<b>Country/ies:</b> EU <b>Language:</b> English
<b>Availability:</b> ?
<b>Ex post/ante?:</b> Ex ante
<b>Abstract:</b>

CS65 ✖
✖: It's not a cost-effectiveness study - just lots of tables of results with no methodology attached
<b>Study title:</b> Cost-effective control of acidification and ground-level ozone in Europe
<b>Study authors/clients:</b> International Institute for Applied Systems Analysis (IIASA) ( <a href="http://www.iiasa.ac.at/">www.iiasa.ac.at/</a> )/ EC Environment DG ( <a href="http://europa.eu.int/comm/dgs/environment/index_en.htm">europa.eu.int/comm/dgs/environment/index_en.htm</a> )
<b>Year:</b> 1998
<b>Policy area:</b> Air quality
<b>Country/ies:</b> EU <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> Ex ante
<b>Abstract:</b> This report explores possibilities for cost-effective reductions of acidification and ground-level ozone in Europe. It is an interim report for the formulation of the Commission's ozone strategy.

CS66 ✖
✖: This project will not be completed until December 2005
<b>Study title:</b> Evaluating current European agri-environment schemes to quantify and improve nature conservation efforts in agricultural landscapes
<b>Study authors/clients:</b>
<b>Year:</b>
<b>Policy area:</b>
<b>Country/ies:</b> <b>Language:</b>
<b>Availability:</b> ?
<b>Ex post/ante?:</b>
<b>Abstract:</b>

CS67 ✖
✖: It either doesn't exist or isn't available
<b>Study title:</b> Energy management and its potential optimization in the industrial sectors



<b>Study authors/clients:</b>
<b>Year:</b>
<b>Policy area:</b>
<b>Country/ies: Language:</b>
<b>Availability: ?</b>
<b>Ex post/ante?:</b>
<b>Abstract:</b> The European Commission, DG XI, has published an invitation to tender for the completion of a study on energy management and its potential optimization in the industrial sectors. The study will pursue the following objectives: a) Establishment of the direct relation between energy efficiency and environmental impact of the industrial installations through substance emissions, including the calorific discharges (of fluids at non-ambient temperature) in the environment; b) Investigation of the means of production, consumption and recovery of energy, including the recuperation of energy from secondary sources (use of substitution fuels allowing the recovery of the calorific energy of certain substances considered as waste) and the identification of the processes and practices that are most efficient in terms of energy and environment; c) Economic evaluation of the energy processes and practices identified previously (cost-effectiveness analysis); d) Numerical estimate of the possible reductions of industrial emissions in the European Union and of the associated costs. A detailed description of the tasks to be carried out by the contractor is included in the technical annex of the call for tender dossier. The project must be completed within 12 months from the date of signature of the contract.

CS68 ✕
✕: Replicates IMPOL
<b>Study title:</b> The implementation of EU environmental policies: efficiency issues.
<b>Study authors/clients:</b> ASSOCIATION POUR LA RECHERCHE ET LE DEVELOPPEMENT DES METHODES ET PROCESSUS INDUSTRIELS /
<b>Year:</b>
<b>Policy area:</b>
<b>Country/ies: Language:</b>
<b>Availability: ?</b>
<b>Ex post/ante?:</b>
<b>Abstract:</b> Implementation issues are currently high on the political agenda in the European Union given the amount of Directives adopted in the early 90's. This research project deals with the description and the economic evaluation of the implementation processes of EU environmental Directives in the Member States. It attempts to answer questions such as: How are the environmental objectives of an environmental Directive modified during the implementation stage ? What are the key differences between implementation processes of EU Directives in France and the UK ? How does implementation affect the economic efficiency and the environmental effectiveness of a particular environmental policy ? The core of the project is twofold. Firstly, it is based on three case studies of the implementation processes of European environmental regulation: the Directive 89/429 regulating emissions of existing domestic waste incinerators, the Directive 88/609 about emissions of SO <sub>2</sub> and NO <sub>x</sub> by Large Combustion Plants and the Council Regulation 1836/93 on EMAS, the European eco-auditing scheme. For each case, the characterisation and evaluation of their implementation processes will be carried out in 4 EU countries (F, G,



NL, UK). Secondly, two aspects of the efficiency are investigated: the environmental effectiveness and the cost efficiency (administrative costs and pollution abatement costs). This proposal involves the following teams: CERNA, the coordinator (F), CSTM, University of Twente (NL), the Free University of Berlin (G), SPRU (UK). Each team will be responsible for the analysis of the implementation processes of the three case studies in its own country. Next to results related to implementation performances, the expected policy oriented findings are the identification of possible implementation "best practices" and lessons for EU policy making given the diversity in national implementation styles.

<b>CS69 ★★</b>
<b>★★★</b> : Provides critical survey of other studies on cost-effectiveness, looking also at methodological approaches, looks at a variety of countries.
<b>Study title:</b> Ex post evaluations of CO2-based taxes: a survey
<b>Study authors/clients:</b> Tyndall Centre ( <a href="http://www.tyndall.ac.uk/">www.tyndall.ac.uk/</a> )/ No client ()
<b>Year:</b> 2004
<b>Policy area:</b> Climate change / industry & transport / air
<b>Country/ies:</b> Denmark, Finland, Germany, Netherlands, Norway, Sweden, UK <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> Ex post
<b>Abstract:</b> Since 1991 eight countries (Denmark, Finland, Germany, Italy the Netherlands, Norway, Sweden, and the United Kingdom) have introduced CO2-based taxes, which are defined as charges, the rate of which depends mainly, but not only, on the CO2 content of fossil fuels, and which are introduced with the explicit intention of abating CO2 emissions. This paper surveys studies quantifying the effects of the CO2-based taxes which have been introduced, concentrating on the methodological approach used and assessing them against four criteria: environmental effect and effectiveness (where the latter assesses the effect against the objectives of the tax or against other instruments), economic efficiency, stability and quantity of revenues, and distributional effects (in respect of both households and industrial sectors). These criteria are not straightforward to interpret and the paper discusses their meaning, and the approaches that have been used to obtain quantitative indicators for them, in some detail. For those CO2-based taxes that have been evaluated (those of all the above countries except Italy and Germany), their nature and mode of implementation is described, revealing that they bear little relation to textbook examples of optimal environmental taxes, and differ substantially from each other, having been designed to take account of local conditions. Two main types of evaluation methodologies have been employed, modelling and surveys of firms. The differences between the taxes, their complexity, and the facts that they are often introduced as parts of policy packages or changed over time, makes individual ex post evaluation of them very difficult, and comparative evaluation across countries more difficult still.

<b>CS70 ★★</b>
<b>Study title:</b> Effectiveness of waste water policies in selected countries - an EEA pilot study
<b>Study authors/clients:</b> Danish National Environmental Research Institute ( <a href="http://www.dmu.dk/International/">www.dmu.dk/International/</a> )/ European Environment Agency ( <a href="http://www.eea.eu.int">www.eea.eu.int</a> )
<b>Year:</b> 2004
<b>Policy area:</b> Waste / water
<b>Country/ies:</b> Denmark, Netherlands, France, Spain, Poland, Estonia <b>Language:</b> English

<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> Ex post
<b>Abstract:</b> Despite three decades of efforts to clean up surface waters, disparities continue to exist between European states. With this pilot study the European Environment now addresses the issue of effectiveness of waste water policies in order to improve information about implementation shortfalls and our understanding of their reasons.

CS71 ★★★
<b>Study title:</b> Analysis of effectiveness of implementing packaging waste management systems
<b>Study authors/clients:</b> European Topic Centre on Waste and Material Flows ( <a href="http://waste.eionet.eu.int/">waste.eionet.eu.int/</a> )/ European Environment Agency ( <a href="http://www.eea.eu.int">www.eea.eu.int</a> )
<b>Year:</b> 2004
<b>Policy area:</b> Waste / households
<b>Country/ies:</b> Austria, Denmark, Ireland, Italy, UK <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> Ex post
<b>Abstract:</b> The objective of this study is to make an ex-post analysis of the effectiveness of packaging waste management systems in selected countries in terms of their contribution to fulfilling the environmental objectives specified in the packaging directive as well as national targets, if any such targets have been set.

CS72 ★
<b>Study title:</b> Scope for the Use of Economic Instruments in the Implementation of the EC Solvent Emissions Directive
<b>Study authors/clients:</b> Entec ( <a href="http://www.entecuk.com/">www.entecuk.com/</a> ) / UK Department of the Environment, Transport and the Regions (now <a href="http://www.defra.gov.uk">www.defra.gov.uk</a> )
<b>Year:</b> 2000
<b>Policy area:</b> Chemicals / industry
<b>Country/ies:</b> UK <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> Ex ante
<b>Abstract:</b> This report has been produced by Entec UK Ltd in response to the invitation to a tender offered by the Department of the Environment, Transport and the Regions (DETR). It is part of a larger study the principal aim of which is to prepare a Regulatory and Environmental Impact Assessment (REIA) for UK businesses complying with the requirements of the adopted EC Solvent Emissions Directive. That study determines the degree to which the Directive imposes more rigorous limits on solvent use and volatile organic compound (VOC) emissions than existing UK legislation. It also investigates the benefits derived from the reduction of VOC emissions achieved by the Directive. The purpose of this study is to investigate the extent to which economic instruments could be used to achieve compliance with the Directive, and the extent to which compliance via economic instruments could achieve compliance cost savings compared with compliance via other avenues.

CS73 ★★★
<b>Study title:</b> The Large Combustion Plant Directive (88/609/EEC): An Effective Instrument For Pollution Abatement?
<b>Study authors/clients:</b> Eames, M. (Science and Technology Policy Research, University of Sussex) ( <a href="http://www.sussex.ac.uk/spru/">http://www.sussex.ac.uk/spru/</a> ) / EC Environment DG ( <a href="http://europa.eu.int/comm/dgs/environment/index_en.htm">europa.eu.int/comm/dgs/environment/index_en.htm</a> )
<b>Year:</b> 2000
<b>Policy area:</b> Air quality / industry / air
<b>Country/ies:</b> France, Germany, Netherlands, UK <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> Ex post
<b>Abstract:</b> The Large Combustion Plant Directive 88/609/EEC (here referred to as the LCP Directive) was one of the most high profile and controversial pieces of European environmental legislation of the 1980s. First proposed by the European Commission in 1983, negotiation of the LCP-Directive was a long drawn out, highly politicized and contested process. Despite these difficulties, implementation of the LCP Directive has been characterised by a significant degree of over compliance, with the national emission ceilings for sulphur dioxide, in all four of the case study countries examined. However, significant differences in the cost-effectiveness of the various national policy instruments used to implement the Directive were also observed. This paper seeks to explain these findings by reference to the national contexts and implementation processes. A number of key variables are identified including: regulatory context and choice of policy instrument; industrial structure and dynamics; technology choice and path dependency; public and political awareness; and, 'external' (i.e. not related to environmental policy) national specific policy considerations. At the same time, however, the LCP-Directive itself is found to have had little direct impact on the national outcomes obtained. As its name suggests, the project concerned the implementation of EU environmental legislation. It sought to answer questions such as: (a) Does implementation result in the attainment of the environmental goals set out in EU Directives? (b) How does implementation affect the cost effectiveness of a particular environmental policy? The core of the project consisted of the ex post evaluation of the implementation outcomes of selected pieces of EU legislation in four Member States (France, Germany, the Netherlands and the United Kingdom). NOTE - There are separate reports outlining the detail for France, the Netherlands and Germany on the IMPOL website <a href="http://www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html">www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html</a> .

CS74 ★★★
<b>Study title:</b> The Implementation of the Municipal Waste Incineration Directives
<b>Study authors/clients:</b> Centre d'Économie Industrielle (CERNA), École Nationale Supérieure des Mines de Paris ( <a href="http://www.cerna.ensmp.fr/">www.cerna.ensmp.fr/</a> ) / EC Environment DG ( <a href="http://europa.eu.int/comm/dgs/environment/index_en.htm">europa.eu.int/comm/dgs/environment/index_en.htm</a> )
<b>Year:</b> 2000
<b>Policy area:</b> Air quality & waste / population and economy / air
<b>Country/ies:</b> France, Germany, Netherlands, UK <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> Ex post

<p><b>Abstract:</b> The European Union decided to issue two European Directives on the atmospheric emissions from municipal waste incineration in 1989. This report focuses on the implementation and effects of the 1989 Directives. As its name suggests, the project concerns the implementation of EU environmental legislation. It sought to answer questions such as: (a) Does implementation result in the attainment of the environmental goals set out in EU Directives? (b) How does implementation affect the cost effectiveness of a particular environmental policy? The core of the project consisted of the ex post evaluation of the implementation outcomes of selected pieces of EU legislation in four Member States (France, Germany, the Netherlands and the United Kingdom). NOTE - There are separate reports outlining the detail for France, the Netherlands and Germany on the IMPOL website <a href="http://www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html">www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html</a>.</p>
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CS75 ★★
<b>Study title:</b> The Implementation of EMAS in Europe: a case of competition between standards for environmental management systems
<b>Study authors/clients:</b> Centre for Environmental Research Leipzig-Halle (UFZ) ( <a href="http://www.ufz.de/index.php?en=616">http://www.ufz.de/index.php?en=616</a> ) / EC Environment DG ( <a href="http://europa.eu.int/comm/dgs/environment/index_en.htm">europa.eu.int/comm/dgs/environment/index_en.htm</a> )
<b>Year:</b> 2000
<b>Policy area:</b> Environmental management and practices
<b>Country/ies:</b> France, Germany, Netherlands, UK <b>Language:</b> English
<b>Availability:</b> electronic copy
<b>Ex post/ante?:</b> Ex post
<p><b>Abstract:</b> This report describes how the European Eco-management and Audit Scheme (EMAS) was implemented in France, Germany, the Netherlands and the United Kingdom (UK) and explains the varying number of EMAS participants in the four countries as a result of the different implementation processes. Against the background of low participation rates in some Member States, the report also addresses whether EMAS has so far been a successful policy instrument and how the current revision of the EMAS Regulation (EMAS II) will influence the scheme's future. As its name suggests, the project concerned the implementation of EU environmental legislation. It sought to answer questions such as: (a) Does implementation result in the attainment of the environmental goals set out in EU Directives? (b) How does implementation affect the cost effectiveness of a particular environmental policy? NOTE - There are separate reports outlining the detail for France, the Netherlands and Germany on the IMPOL website <a href="http://www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html">www.cerna.ensmp.fr/Progeuropeens/IMPOL/publi.html</a>.</p>

CS76 ✖
✖: This is a CBA
<b>Study title:</b> An Economic Assessment of Particle Filters
<b>Study authors/clients:</b> Environmental Assessment Institute / No client
<b>Year:</b> 2002
<p><b>Abstract:</b> For the last couple of years, several surveys of the risk of solid particle pollution from diesel vehicles in the cities have given rise to an increased pressure on the decision-makers to do something about the problem. It is well known that adding particle filters can abate the health damaging consequences of particles from the diesel vehicles, but at the same time it has been emphasized that this solution will be very expensive for Denmark. However a complete economic assessment of the consequences is lacking. The</p>



analysis in this report show that heavy vehicles are best suited for adding particle filters after fabrication, and that Denmark can save up to DKK 5.5 billion a year over a period of 15 years if all heavy vehicles add filters. The advantages are that fewer people will die too early and fewer people will get sick as a result of the pollution from the heavy vehicles. It is still very uncertain how dangerous the particles really are. However, even with very conservative estimates of the size of the damaging effects, it will be an advantage for Denmark to add filters on the heavy vehicles after fabrication.

<b>CS77</b>
: Need a Danish speaker for prioritisation
<b>Study title:</b> Cost-effectiveness of the DK public pesticide cease
<b>Study authors/clients:</b> Environmental Assessment Institute / No client
<b>Year:</b> 2004
<b>Abstract:</b> In 1998 public authorities in Denmark agreed to phase out the use of pesticides on all public property by 2003. The aim of the agreement was to reduce the risks of bioavailability loss and ground water pollution. Ground water pollution has received a lot of political attention in Denmark, since some 99 % of the potable water production is based on non-filtered ground water. The Environmental Assessment Institute has assessed the economic cost-efficiency of the agreement in four different areas of use, i.e. forestry, sports centres, public farmland, and railways. The present analysis has shown that the stop for pesticides on public areas from an economic perspective is inefficient. The costs of the total stop for using pesticides on the analysed areas (some 10 mill. EURO annually) are considerably higher than alternative reduction costs in private agriculture (1 mill. EURO annually), where similar reductions could have been achieved. The Environmental Assessment Institute recommends that future adjustment to the agreement of facing out pesticides on public property also include economical analysis in the decision process. This could provide a basis for a more economically effective protection of groundwater and biodiversity. In this particular context it could be considered to target the protection towards uses of particular concern as well as towards locations of particular environmental and/or groundwater interests. Efforts defined according to legal ownership will not lead to an economical efficient protection.

<b>CS78</b>
: Need a Danish speaker for prioritisation
<b>Study title:</b> The Danish Cost of Reducing CO2 Emissions
<b>Study authors/clients:</b> Environmental Assessment Institute / No client
<b>Year:</b> 2002
<b>Abstract:</b> The Danish participation in the Kyoto Protocol demands that the emissions of greenhouse gasses, including CO2 are reduced. Environmental Assessment Institute has investigated the possibilities that Denmark has for fulfilling the demands, and how it is ensured that we get the most environment for the money. The investigation shows that Denmark can reduce the emissions by stopping the export of electricity to our neighbouring countries. Doing this would cost 1,6 billion DKK and would fulfil almost 9/10 of the demands. It would not however, ensure the most environment for the money. In general, Danish initiatives are expensive. This can be explained by the fact that Denmark has a long tradition for focusing on reduction of CO2 emissions. Alternatively Denmark can carry out reductions in other countries. This is done by using the flexible mechanisms of the Kyoto Protocol. Hereby the possibility arises for participating in projects that have guaranteed positive effects on the environment.

<b>CS79</b> ✖
✖: This is CBA
<b>Study title:</b> Costs and Benefits of Danish Environmental Aid to Eastern Europe



<b>Study authors/clients:</b> Environmental Assessment Institute / No client
<b>Year:</b> 2003
<b>Abstract:</b> Over the years, Denmark has radically up-scaled and down-scaled its environmental aid to the Central and Eastern European region. From 1991 to 2001, appropriations grew by 340 per cent, when taking inflation into account. Conversely, in just one year - 2001 to 2002 - spending was cut by 58 per cent. All-in-all about 840 million EURO in present-day value have been spent. The report examines the theoretical arguments relating to international environmental aid as an alternative or supplement to national environmental protection measures. Since many environmental problems are of a trans-boundary nature, the solutions to them cannot be limited by national geography. Further, Danish-funded environmental investments in Central and Eastern Europe are likely to yield more environmental benefits per Danish Kroner than similar investments in Denmark. While theoretical arguments favour environmental aid to the Central and Eastern European countries, does the empirical evidence support this position? The study uses years of data, from the relevant, available evaluations, to answer this question. This report finds that projects aimed at controlling air and water pollution have been fairly cost-effective, when compared to similar projects in Denmark. Projects aimed at CO <sub>2</sub> -reductions have not performed too well so far, but a stepped-up attention to cost-effectiveness going forward is likely to improve results in the future. The programmes aimed at nature conservation have not been evaluated, but given the strong theoretical arguments in favour of international measures in this field, future projects are likely to show a positive cost-benefit ratio.

CS80 ✖
✖: Report hasn't been written yet.
<b>Study title:</b> Rethinking the Waste Hierarchy
<b>Study authors/clients:</b> Environmental Assessment Institute / No client
<b>Year:</b> 2005
<b>Abstract:</b> Summary in English not available.

CS81 ✖
✖: This is CBA
<b>Study title:</b> Evaluations of Danish Environmental and Energy Policy in the nineties: Chapter III: Evaluations of Danish Environmental and Energy Policies in the nineties
<b>Study authors/clients:</b> The Danish Economic Council / No client
<b>Year:</b> 2002
<b>Abstract:</b> The influence on the Danish economy of environmental and energy policies increased greatly during the nineties. Such policies have economic value, for example in terms of improvements in public health caused by reduced emissions of pollutants. However, providing public funds for policy measures has an economic cost, for example because increased income taxes lead to a reduction in the supply of labour. Furthermore, environmental taxation and command-and-control regulations are costly for both households and firms. Cost benefit analyses made in the chapter estimate that the most significant energy policy initiatives in the period 1992-99 will create net economic value of approximately DKK 66 billion from 1992 to 2021. Of this amount, some DKK 2 billion arises from the positive effects which the policy has had on the competitiveness of the Danish windmill industry. Most initiatives are found to have negative net economic value. However, the requirements for the installation of air pollution control systems at power plants give rise to a net economic value of DKK 90 billion. This single initiative alone results in Danish energy policy in the nineties giving an economic surplus to society. The Danish experience with using biomass in power plants creates a net economic deficit of about DKK 6 billion.



CS82 <i>GR</i>
<i>GR</i> : Need a Danish speaker for prioritisation
<b>Study title:</b> Economic evaluation of the action plan on the aquatic environment II in Denmark
<b>Study authors/clients:</b> Fødevareøkonomisk Institut / Danish Ministry of Environment
<b>Year:</b> 2004
<b>Abstract:</b> Summary in English not available.

CS83 <i>⌘</i>
<i>⌘</i> : This study is too broad and is too focussed on the design of the burden-sharing scheme and other political questions.
<b>Study title:</b> Renewable Energy Burden Sharing (REBUS) Effects of burden sharing and certificate trade on the renewable electricity market in Europe
<b>Study authors/clients:</b> RISØ National Laboratory, Denmark, Servizi Per L'Energia, Italy, Energy for Sustainable Development, UK / funded under the EU 5th Framework Programme
<b>Year:</b> 2001
<b>Abstract:</b> Creation of an internal market for renewable electricity will involve a political negotiation process, similar to previous EU greenhouse gas negotiations. The Energy Ministers in the EU have agreed on an overall target of 22% of electricity supply from Renewable Energy Sources (RESE) and a distribution of targets over the individual Member States. The REBUS project provides insights in the effects of implementing targets for renewable electricity generation at EU Member State level and the impact of introducing burden sharing systems within the EU, such as a Tradable Green Certificate (TGC) system. Member States can participate in such burden sharing systems to reduce the costs of achieving RES-E targets. The project concentrated on the development of the REBUS model, which quantifies the impact of trade (in green certificates, quotas or targets), the specification of cost potential curves for renewable electricity options in each of the 15 EU Member States and the implementation of different rules to setting targets at individual Member State level. In addition, utilities and consumer organisations were interviewed on their requirements and expectations for an international burden sharing scheme. The main findings of the REBUS project are: <ul style="list-style-type: none"> <li>• Implementation of an international burden sharing scheme makes it possible to separate actual realisation of targets from financial payment for these realisations.</li> <li>• Generally, target setting and burden sharing are regarded political questions, on which governments should decide.</li> <li>• Stakeholders emphasise that it is of vital importance that ambitious targets are supported by a reliable trading system. The role of governments in providing a good monitoring system is stressed; double counting should be avoided.</li> <li>• There is a general preference for an obligatory over a voluntary target system.</li> <li>• The general feeling is that international trade between different systems cannot be successful. Doubts are expressed regarding trade between voluntary and obligatory systems. Reciprocity conditions are considered important to prevent for subsidy flows between countries.</li> <li>• For an international trading system to be successful, harmonisation of the definition of RESE is regarded essential, and clarity on the definition underlying the current targets is required.</li> <li>• When asked for their preferences regarding burden sharing options, many stakeholders tend to consider what is most favourable for their own country. There are differing opinions on what is a 'fair' division of targets.</li> <li>• The design of the TGC system can largely influence the volatility and uncertainty in the interaction between certificate and power prices. Costs and potentials of meeting renewable electricity targets</li> <li>• The methodology developed for definition of costs and potentials of RES-E technologies in the internal EU electricity market supports comparability of costs across Member States and a sound estimation of the potentials for RES-E that can actually be deployed in the target year. The comparability is especially important when comparing the effects of implementing EU-wide policies for supporting RES-E across Member States.</li> <li>• In an EU-wide international trading scheme, the equilibrium price of a green certificate will be 6.2 euroct/kWh in 2010 (additional to the reference electricity price of 3 euroct/kWh). The calculated certificate price excludes the transaction costs of the</li> </ul>

system for monitoring, verification, issuing of certificates etc. • The total production costs of meeting the 2010 RES-E targets from the EU Draft Directive will be 17.6 billion Euro. The total value of the certificate market will be 41 billion Euro. • Introduction of trade induces 15% cost saving or even more, depending on the target setting. • Individual countries might save up to 40% of their costs (targets as proposed in Draft Directive).

<b>CS84 ☒</b>
☒: General discussion of policy evaluation, mostly neglecting cost-effectiveness
<b>Study title:</b> Evaluation of environmental policy instruments: A case study of the Finnish pulp & paper and chemical industries
<b>Study authors/clients:</b> Finnish Environment Institute / Finnish Environment Ministry
<b>Year:</b> 2002
<b>Abstract:</b> This research-based evaluation of environmental policy Instruments in Finland is focussed on regulatory instruments based on the Water Act, the Air Pollution Control Act and the Chemicals Act, on electricity taxation and on voluntary environmental management systems. The examined policy instruments have had several positive effects. They have directed major industrial point source polluters towards solving environmental problems. The transparency has been an important factor ensuring the success of the policy instruments and in avoiding the regulatory capture that could have thrived in a system largely based on negotiations between operators and authorities. The transparency has made it easy for Finnish firms to adopt environmental management systems and an open attitude to environmental reporting. The permit conditions have not directly resulted in innovations, but they have contributed to the diffusion of end-of-pipe technology and have contributed to innovations by expanding the market for environmentally better technical solutions. The permit systems have also indirectly contributed to innovations by creating a demand for environmental experts and environmental education.

<b>CS85 ☒</b>
☒: This is not a cost-effectiveness study
<b>Study title:</b> Is it as bad as it sounds or as good as it looks?: Experiences of Finnish water discharge limits
<b>Study authors/clients:</b> Mickwitz, P. / No client
<b>Year:</b> 2003
<b>Abstract:</b> The waste water discharges of Finnish industry have mainly been regulated by permits. The permits contain limits and requirements individually set for each plant, taking into account the ecological characteristics of the specific site as well as the technological and economic features of the plant. Despite great increases in production, discharges into water by the Finnish pulp and paper industry have decreased markedly in recent decades. For example, the total biochemical oxygen demand of discharges in 1997 was less than 10% of the corresponding figure for 1982. This paper examines the development of the limits included in the permits and their effects on the discharges of the entire Finnish pulp and paper industry. Statistical analyses of mill level data are combined with the results of thematic interviews. The results show that permit conditions are only one of several factors responsible for the reduced discharges. In some cases clear effects of permit limits can be identified, whereas in other cases they have had no effect. The study shows that more information can be gathered by combining quantitative and qualitative research methods than by using these methods separately.

<b>CS86 ☒</b>
☒: Cost-effectiveness is not explicitly addressed.
<b>Study title:</b> Evaluation of the Dutch Manure and Fertiliser Policy, 1998-2002

<b>Study authors/clients:</b> van Grinsven, H., van Eerdt, M., Willems, J. and Mulleneers, E / No client
<b>Year:</b> 2004
<b>Abstract:</b> In 2003/2004 five instruments of the Dutch manure and fertiliser policy were evaluated: the Mineral Accounting System (MINAS, the core of Dutch manure policy), the system of manure transfer contracts and the system of production quota and two additional instruments. A great number of data sources and research and evaluation tools were used. The evaluation showed that MINAS was for important sectors within agriculture both an effective and efficient policy instrument. The system of manure transfer contracts did not add to the effect of the system of production quota and therefore was not efficient. MINAS has contributed to a reduction in the use of chemical nitrogen fertilisers by 25% and phosphate fertilisers by 10-20%. Since 1998 the nitrogen surpluses in dairy farming have been steadily reduced by an amount of 15-30 kg ha <sup>-1</sup> yr <sup>-1</sup> , and present surpluses average about 150 kg ha <sup>-1</sup> yr <sup>-1</sup> . Although nitrate concentrations in groundwater have decreased substantially since 1990, the target value of 50 mg L <sup>-1</sup> is exceeded on at least 60% of all farms on sandy soils. So, the environmental goals of Dutch government have not yet been achieved.

<b>CS87</b> ✖
✖: In Finnish
<b>Study title:</b> Potential and cost-effectiveness of reducing methane and nitrous oxide in Finland (Suomen metaani- ja dityppioksidipäästöjen rajoittamisen mahdollisuudet ja kustannustehokkuus)
<b>Study authors/clients:</b> Pipatti, R. (VTT Technical Research Centre of Finland, Espoo) / No client
<b>Year:</b> 1997
<b>Abstract:</b> Abstract not available.

<b>CS88</b> ✖
✖: Don't yet have a copy
<b>Study title:</b> Reducing Nutrient Loadings of Marine Waters. A Cost Effectiveness Analysis
<b>Study authors/clients:</b> Paaby, H., Jensen, J.J., Kristensen, P., Møller, F. & Skop, E.
<b>Year:</b> 1996
<b>Abstract:</b> Abstract not available.