Decision Support Methods for Climate Change Adaptation

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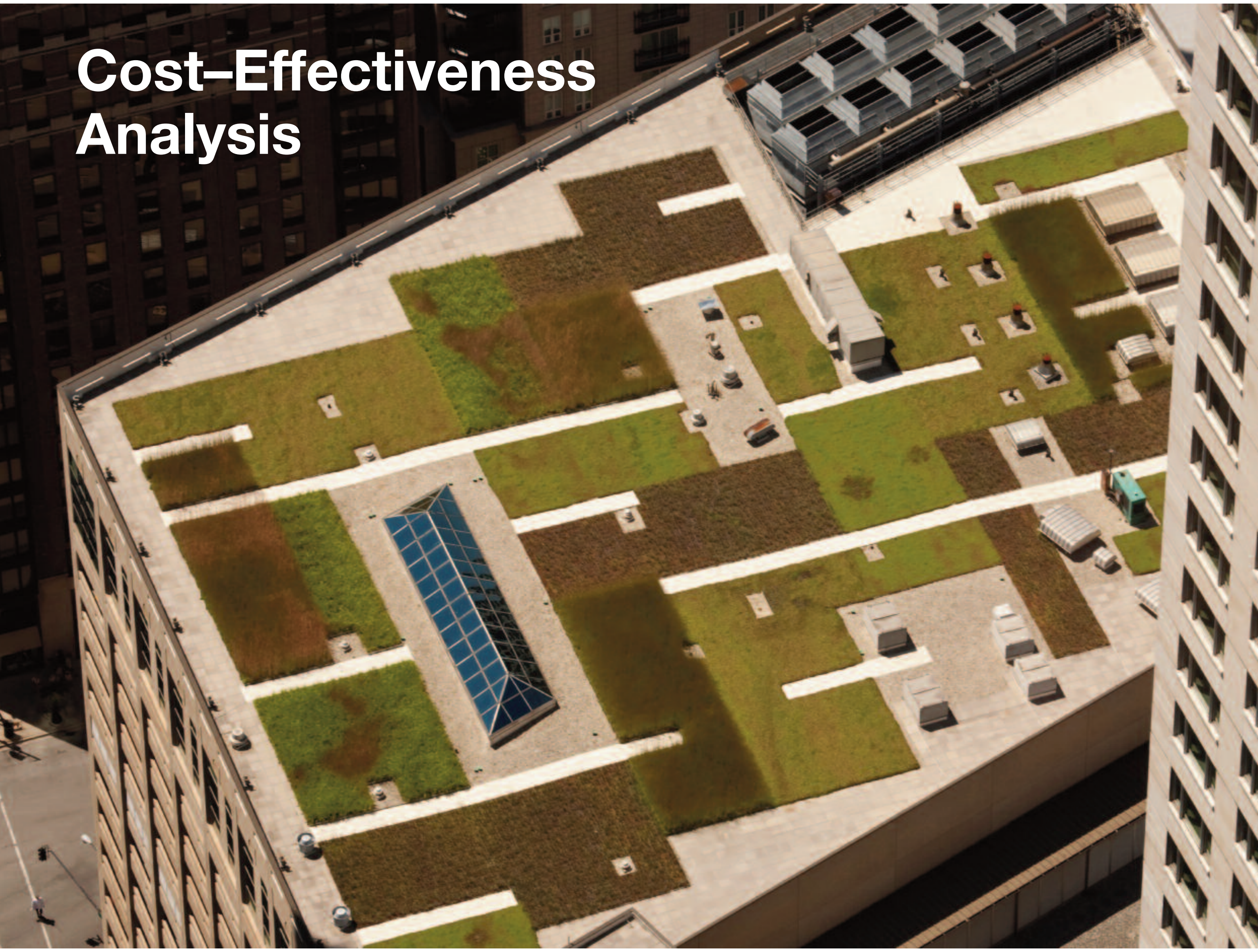


Cost–Effectiveness Analysis

Summary of Methods and Case Study Examples from the MEDIATION Project

SEVENTH FRAMEWORK PROGRAMME

Mediation

Key Messages

- There is increasing interest in the appraisal of options, as adaptation moves from theory to practice. In response, a number of existing and new decision support tools are being considered, including methods that address uncertainty.
- The FP7 MEDIATION project has undertaken a detailed review of these tools, and has tested them in a series of case studies. It has assessed their applicability for adaptation and analysed how they consider uncertainty. The findings have been used to provide information and guidance for the MEDIATION Adaptation Platform and are summarised in a set of policy briefing notes.
- One of the tools that has been widely applied to climate change mitigation, and is also being considered for adaptation, is **Cost-Effectiveness Analysis (CEA)**.
- CEA can be used to compare and rank the relative attractiveness of different options, and to identify the least cost combination of options to achieve pre-defined targets using cost curves.
- CEA has been widely used in climate change mitigation. However, the MEDITION review highlights the application to adaptation is much more challenging. This is because adaptation is a response to many local, regional or national level impacts, rather than to a single global burden, i.e. there is no single common metric. The application of CEA to adaptation is therefore much more demanding, in terms of analysis detail and resources.
- A key issue for CEA is the choice of cost-effectiveness metrics. The MEDIATION review has identified a set of potential metrics by sector, however, it is stressed it can be difficult to pick these, especially when considering complex or cross-sectoral risks.
- Further, most applications of CEA do not consider uncertainty, working with single cost curves. However, the use of central estimates for future climate change is not recommended. For adaptation, uncertainty has the potential to alter the ranking of options and the overall cost curve, and thus needs consideration.
- The review has considered the strengths and weakness of the approach for adaptation.
- The key strength of CEA is that it avoids valuation of economic benefits, and can thus be used where valuation is difficult or contentious (e.g. ecosystems). The approach is also relatively easy to apply, and the results are concise and easy to understand.
- The potential weaknesses relate to the use of a single common metric and the consideration of uncertainty, both critical issues for adaptation. Further, CEA tends to focus on technical options, and often omits capacity building and non-technical options, while the linear sequencing adopted contradicts the adaptation focus on portfolios of options and inter-linkages.
- Previous applications of CEA to adaptation have been reviewed, and a case study is presented for the biodiversity in Finland.
- The review and case studies provide useful information on the types of adaptation problem types where CEA might be appropriate, as well as data needs, resource requirements and good practice lessons.
- The review identifies CEA is most useful for near-term assessment, particularly for identifying low and no regret options, in areas where monetary valuation is difficult. It is most applicable where there is a clear headline indicator and where climate uncertainty is low.
- A number of good practice lessons are highlighted. The most important of these are to ensure that adaptation CEA does not focus only on technical options, and that it considers uncertainty through multiple cost curve analysis. Furthermore, the need to consider all attributes of options is highlighted. Finally, it is considered good practice to undertake CEA within an iterative plan, to capture enabling steps, portfolios and inter-linkages, rather than using the outputs as a simple technical prioritisation.

Introduction

There is increasing policy interest in the appraisal of options, as adaptation moves from theory to practice. At the same time, it is recognised that the appraisal of climate change adaptation involves a number of major challenges, particularly the consideration of uncertainty. In response, a number of existing and new decision support tools are being considered for adaptation.

The European Commission FP7 funded MEDIATION project (Methodology for Effective Decision-making on Impacts and AdaptaTION) is looking at adaptation decision support tools, in line with its objectives to advance the analysis of impacts, vulnerability and adaptation, and to promote knowledge sharing through a MEDIATION Adaptation Platform (http://www.mediation-project.eu/platform/). To complement the information on the Platform, a series of Policy Briefing Notes have been produced on *Decision Support Methods for Climate Change Adaptation*.

An overview of all the decision support tools reviewed is provided in *Policy Briefing Note 1: Method Overview*, which summarises each method, discusses the potential relevance for adaptation and provides guidance on their potential applicability. The methods considered include existing appraisal tools (cost-benefit analysis, cost-effectiveness analysis and multi-criteria analysis), as well as techniques that more fully address uncertainty (real options analysis, robust decision making, portfolio analysis and iterative risk (adaptive) management). It also includes complementary tools that can assist in adaptation assessment, including analytical hierarchic processes, social network analysis and adaptation turning points. Additional information on each method is presented in a separate *Policy Briefing Notes (2 – 10)*.

This *Policy Brief (Note 2*) provides a summary of **cost-effectiveness analysis**. It provides a brief synthesis of the approach, its strengths and weaknesses, the relevance for adaptation, how it considers uncertainty, and presents case study examples. It is stressed that this note only provides an overview: more detailed information is available in MEDIATION deliverables, and sources and links on the MEDIATION Adaptation Platform.

Description of the Method

Cost-Effectiveness Analysis (CEA) is a widely used decision support tool. It compares alternative options for achieving similar outputs (or objectives). In this regard it is a relative measure, providing comparative information between choices. It has been widely used in environmental policy analysis, because it avoids monetary valuation of benefits, and instead quantifies benefits in physical terms.

At the technical or project level, CEA can be used to compare and rank alternative options. It does this by assessing options in terms of the cost per unit of benefit delivered, e.g. cost per tonne of pollution abated. This identifies those options that deliver highest benefit for lowest cost (i.e. the most cost-effective). As well as ranking different options, such an analysis can be used for benchmarking, see box.

At the project, policy or programme level, where combinations of options are needed, CEA can be used to assess the most cost-effective order of options, and so identify the least-cost path for achieving pre-defined policy targets. This is

Box 1. Benchmarking using CEA

Cost-effectiveness analysis can be used to benchmark options, i.e. by setting thresholds. This approach is often used in considering new treatments in health service provision (e.g. in the UK), where the clinic effectiveness of new interventions are compared against a cost-effectiveness threshold, measured as the cost (£) per Quality Adjusted Life Year (QALY). New treatments or drugs are considered cost-effective if they are lower than £20 000 to £30 000 per QALY (NICE, 2010). Such an approach is needed because publicly funded healthcare systems cannot pay for every new medical treatment that becomes available. As there are limited resources, choices have to be made, cost-effectiveness analysis helps provide the largest benefits with the available resources.

Box 2. Comparing Mitigation and Adaptation

Cost-effectiveness analysis has become the primary appraisal method for mitigation. However, adaptation is very different to mitigation, for the following reasons:

Mitigation involves a single, common metric for benefits, i.e. tonnes of GHG emissions. This metric relates to a global burden, so a reduction in a tonne of GHG emissions is treated the same, irrespective of the technology, sector or location. This means a tonne of CO_2 abated from road transport in an urban area has the same benefit (and unit of effectiveness) as a tonne abated from the electricity sector in a rural location. This allows equivalent cross-economy analysis of options using €/tCO_2.

In contrast, adaptation is a response to a local, regional or national level impact, rather than to a global burden, and involves different types of risks in different sectors. There is therefore no common single metric which allows cross-sectoral cost-effectiveness analysis. Furthermore, there are often many risks even within a single sector, which can make even sectoral CEA studies challenging: for example, adaptation to sea level rise (SLR) can involve protecting people from flood risk, reducing coastal erosion, conserving coastal ecosystems, etc. all of which involve different metrics. Finally, the analysis of impacts in adaptation (rather than burdens in mitigation) means that technology, location and time period are important: for adaptation, it makes a different how, where and when cost-effectiveness is assessed.

undertaken through the use of marginal abatement cost (MAC) curves. The approach can also identify the largest benefits possible with the available resources, and can even be used to help set targets, by selecting the point where cost-effectiveness falls significantly (i.e. where there are disproportionately high costs for low benefits).

Cost-effectiveness analysis has been widely used in European and Member State policy appraisal, and was previously the main approach used for air quality policy (Watkiss et al, 2007). Air quality concentration or deposition target levels were set on a scientific basis, and the costs of alternative ways of achieving these targets (or progressing towards them) were assessed using CEA.

It has also been used in risk-based flood protection assessment, particularly for coastal zones (e.g. RIVM, 2004) assessing the cost-effectiveness of achieving flood protection targets (defined as a level of acceptable risk, such as protection against a 1 in 10000 year return period).

Most recently, cost-effectiveness analysis has become the main appraisal technique used for climate change mitigation, as it allows the comparison and ranking of greenhouse gas (GHG) abatement options, using the cost-effectiveness metric of cost per tonne of GHG abated (€/tCO_2). There has also been widespread use of marginal abatement cost curves for mitigation. These show the relative ranking of options in order of cost-effectiveness, and can be used for identifying the least cost way of achieving emission reductions including cross-economy targets (e.g. CCC, 2008).

Because of the widespread use of CEA for climate change mitigation, many commentators have also highlighted its potential use for climate change adaptation. However, the application of CEA to adaptation involves a number of major differences, see Box 2.

Cost-effectiveness analysis involves a series of common methodological steps.

- Establish the effectiveness criteria.
- Collate a list of options.
- Collect cost data for each option – noting this involves the full costs over the lifetime of the option, including capital and operating costs – and thus requires all values to be expressed on a common economic basis (in equivalent

terms using discount rates and either an equivalent annualised cost or a total present value).

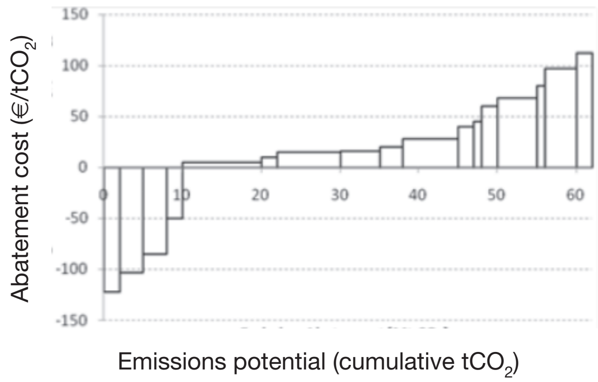
- Assess the potential benefits (effectiveness) of each option. In many but not all, these are expressed as an annual benefit, relative to a baseline or reference case.
- Combine these to estimate the cost-effectiveness, by dividing the lifetime cost by the lifetime benefit (or annualised costs by annualised benefit).

At this point, all the options can be expressed in equivalent terms, as a cost per unit of effectiveness. This allows the ranking of measures, identifying the most cost-effectiveness options, i.e. those that deliver high benefits for low costs.

This information can then be used as an input to form a marginal abatement cost curve. Cost curves have been used for many decades in policy (and mitigation) analysis. In graphical terms, they are often presented as cumulative bar charts.

In simple terms, a cost curve presents all options in order of unit cost-effectiveness analysis, starting with the most cost-effective. At the same time, it also assesses the total cumulative effectiveness of each option, as it is added. When considered together, this allows the estimation of the least-cost way to achieve a plan, programme or policy target /objective.

An example is included below, showing a typical mitigation cost curve. Each bar represents a specific option. The options are arranged in order of cost-effectiveness (left to right), as measured on the vertical axis by the cost per unit of abatement – €/CO_2. The width of each bar indicates the total abatement potential of each option (i.e. the total effectiveness, in tonnes of CO_2) – noting this could be for a local plan or a national level analysis. Wider bars show options that can achieve larger total benefits, i.e. which reduce more emissions. In the example, the marginal abatement costs of some cost-effective options are negative, showing these achieve benefits at negative cost, so called no regret options (e.g. energy efficiency).



Example cost curve.

To undertake a policy CEA, a target level of total effectiveness is first set and the cost curve is generated. As the graph presents options in order of cost-effectiveness, it estimates the cumulative least-cost pathway to achieve the target, because it implements those options that have high benefits for low cost first. By contrast, if the least cost-effective options were implemented first (those on the right of the figure), it would cost far more to achieve the same target level.

The combination of options needed to achieve the target can thus be read off the graph. A similar approach can be used to derive the total costs of different levels of ambition. In practice, CEA is more involved, and further checks are needed to ensure that options can be implemented together, and to consider other criteria.

The Application to Adaptation

Cost-effectiveness is already used in many sectors that are relevant to adaptation, such as health and flooding, and therefore has potential for appraising options to address future climate change. The MEDIATION project has reviewed the application of CEA to adaptation, including existing case studies in the academic and grey literature.

The first issue that the review has identified is the choice of cost-effectiveness metrics for adaptation, and the related sector policy objectives. This recognises there are a wide range of potential risks, across and between sectors that could be considered. As part of the review, MEDIATION has identified possible by sector, presented in Table 1.

Table 1. Possible cost effectiveness metrics / objectives for adaptation.

Sector	Possible Metric	Issues
Health	Cost per DALY, cost per fatality or cost per life year saved (impact metrics).	Different cost per life year used across Europe.
	Health thresholds (maximum occupational temperatures, comfort levels)	Consistency issues with other sectors where health a part of wider risks (e.g. floods, transport)
Sea level rise	Cost per reduction in land area at risk or number of people at risk (exposure metric) or e xpected annual damages (economic metric)	Land area and ha only covers a sub-set of SLR impacts. Issue of non-market values, loss of biodiversity and ecosystem services.
	Cost per ha. For the measure relative to value of land protected per ha (impact metric).	
	Pre-defined acceptable risks of flooding as objective / threshold level for adaptation.	Very different levels of acceptable risk and protection across Member States
Floods	As above.	As above.
Agriculture	Impact based metrics include cost per unit of crop yield, production or land value, but depends on risk (e.g. could be reduction in water stress).	Issue of capturing wider environmental and multi-functionality of agriculture.
	Possible headline indicator is cost per change in value added as a result of adaptation measures.	Highly aggregated and only one element of potential impacts.
Water resources	Impact metrics for water availability (household) and cost per M^3 of water provided.	Issues with wider attributes of water including quality (environmental).
	Possible thresholds in terms of environmental quality (Directives) or acceptable flows. Possible thresholds for risk of supply disruption.	Issue of multi-functionality and multiple users and sectors (agriculture, industry, etc.)
Ecosystems and Biodiversity	Critical targets (sustainable levels) and standards (overall objective).	Issue if standards are available (and complex and contentious to set).
	Possible cost per unit of ecosystem services.	
Business & industry	Possible headline indicator is cost per change in value added as a result of adaptation measures. Could also include acceptable risk levels for infrastructure or service supply.	Broad nature of sector and potential risk.
Extreme Events including to infrastructure	Possible metric in terms of cost per level of risk reduction, or pre-defined acceptable levels of risks as objective	Very different levels of acceptable risk and protection across Member States Variability in risk acceptability across different extremes, and for different infrastructure.

Sources used in compiling the table: Nicholls et al (2006); Boyd et al, 2006: Rosenzweig and Tubiello (2007): Watkiss, Hunt and Markandya (2009); UNFCCC (2009).

This does highlight a particular issue for the application of CEA to adaptation, namely that it can be often be difficult to identify a single common metric for analysis, because there are many types of risks across and even between sectors. In the case of sea level rise for example, using a headline metric of the number of people at risk, or an objective of acceptable levels of risk, will omit consideration of coastal erosion and coastal ecosystems. This means such a CEA will not consider all relevant costs and benefits for coastal adaptation and may not identify the most holistic option. For this reason, CEA is less suitable for complex or cross-sectoral risks.

The second key area identified in the application of CEA to adaptation is the consideration of uncertainty, one of the key areas of investigation in the MEDIATION review.

Most previous CEA applications, e.g. in areas such as environmental policy and mitigation, ignore uncertainty, presenting single cost curves. Early applications of CEA to adaptation have also followed this approach, largely presenting individual cost curves, or at best, a few cost curves (each representing a central estimate for a different emission scenario, or a central and high scenario). As highlighted in *Policy Note 1*, the use of central estimates for future climate change assessments can often provide misleading results for adaptation.

Indeed, the range of climate model outputs for a given scenario, whether from the degree of temperature change, or for precipitation projections where even the sign of the change is uncertain, will alter the cost-effectiveness of options, their relative CEA ranking, and their total effectiveness and the cost curve. It is possible to address this by sampling across multiple scenarios/model outputs, or using stochastic approaches, but this has resource implications.

Strengths and Weaknesses

A key part of the MEDIATION project has been to identify the strengths and weaknesses of different approaches.

The key strength of CEA is that it avoids valuation of economic benefits, enhancing applicability where valuation is difficult or contentious (e.g. ecosystems). The approach is also relatively simple to apply, and the communication of results is concise and easy to understand – helped by the widespread use of CEA in mitigation.

The potential weaknesses relate to the need to choose a single common cost-effectiveness metric and the consideration of uncertainty (see previous section). These are both critical issues for adaptation. It is also highlighted that the analysis of adaptation benefits (effectiveness) is

Key strengths

Benefits expressed in physical terms, therefore does not require monetary valuation of benefits. Increases applicability to non-market sectors.

Relatively simple approach to apply and provides easily understandable ranking and outputs that easy to understand.

Frequently used for mitigation, and thus approach widely recognised and has resonance with policy makers.

Use of cost curves can assess different policy targets and how to achieve these at least cost, look at how to achieve greatest benefits for available resources, or look at the cost implications of progressively more ambitious policies.

Potential weaknesses

Optimises to a single metric, which can be difficult to pick. Less applicable for cross-sectoral or complex risks.

The focus on a single metric omits important risks, and does not capture all costs and benefits (attributes) for option appraisal.

Tends to work best with technical options, and can therefore omit or give lower priority to capacity building and soft (non-technical) measures. Sequential nature of cost curves ignores portfolios of options and inter-linkages.

Does not lend itself to the consideration of uncertainty and adaptive management, tending to work with central tendency.

location and technology specific, often requiring analysis of (local) impacts, which change for each baseline and for each scenario considered. These impacts – and the resulting benefits of options – also vary over time, and thus multiple cost curves are needed to address different time periods. All of this means that the application of CEA to adaptation has much higher resource needs for adaptation than for mitigation.

Finally, CEA tends to focus on technical options, because these can be easily assessed in terms of costs and benefits (effectiveness). However, adaptation is now seen as a process as well as an outcome, and capacity building and non-technical (soft) options are considered an important and early priority. Such non-technical options do not lend themselves easily to the quantitative analysis in CEA, thus they tend to be given lower priorities (or omitted). This issue is compounded by the strict linear sequencing adopted in cost-effectiveness analysis, where options are considered as discrete options implemented in turn: this contradicts the emphasis in the adaptation literature for portfolios of options and the need to explicitly consider inter-linkages.

A summary of some of the key strengths and weakness of the approach is presented below.

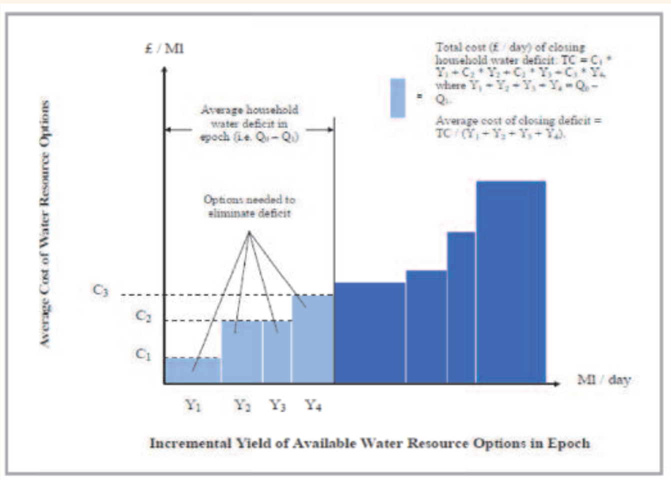
Case Studies

The MEDIATION study has applied CEA to a number of adaptation case studies, as well as reviewing existing literature examples. A number of these case studies are summarised in the box below.

Box 3. Case Studies

Boyd et al (2006) undertook a detailed application of cost-effectiveness analysis for the South-East of England, looking at the impact of climate change (including potential scenarios of reduced precipitation) and socio-economic growth (increased demand) on water resource zones and the potential adaptation response to address household water deficits. The study undertook detailed basin modelling for the water catchment (Wade et al, 2006) and assessed baseline 30-year average household water deficits in three future time periods (2011-2040, 2041-2070 and 2071-2100) for four separate climate-socioeconomic scenarios.

The cost of addressing the projected water deficits was analysed through a cost-effectiveness analysis, looking at a range of options for managing public water supply (including options that reduced demand and options that increased supply). Detailed cost-yield curves (cost-effectiveness curves) were produced to estimate how to eliminate the household water deficit at minimum cost, providing cost curves for each scenario, for each of the three future time periods in an inter-linked analysis. This addresses many of the issues raised above, by working with multiple projections and multiple time periods. An example of one of the cost curves is presented below.



Source: Boyd et al (2006)

Case Study 2: Cost-effectiveness analysis for biodiversity in Finland (MEDIATION)

Semi-natural grasslands and wooded pastures are among the most species-rich habitats in Finland and include numerous red-listed species. However, intensification of agriculture and abandonment of traditional management practices have reduced the area of valuable grasslands and their biodiversity. Climate change is projected to cause additional challenges, as species may need to shift their ranges to follow the changes in climatically suitable areas. However, the success of species moving to new areas depends on their dispersal ability and the availability of suitable habitats.

The Mediation case study investigated thee impacts of climate change on grassland biodiversity through a case study on grassland butterflies, which are a key indicator species group as well as having a high amenity value. The study compared the sufficiency of habitat in the areas projected to be climatically suitable in the future or where ecological corridors might be constructed to aid dispersal, and then considered alternative adaptation options to enhance grassland biodiversity in Finland under a changing climate.

The analysis first looked at future bio-climatic envelopes to explore which areas would be simultaneously suitable for various species, considering a range of climate outputs and a series of different modelling methods to explore their uncertainty. The model predictions show large variations in the suitable areas for many species, (see figure below), as a consequence of different modelling methods and climate scenarios being used. However, a common finding is that the current extent of grassland habitats in Finland is far lower than the target level estimate required to sustainably support current populations, as well as to secure species dispersal.

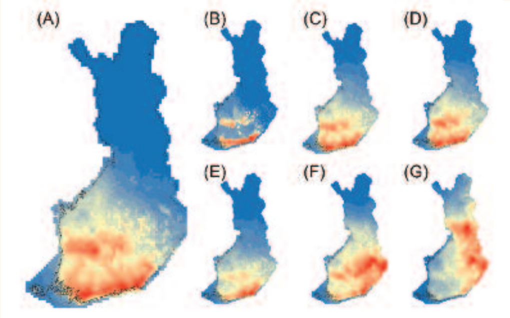


Figure 1. Projected suitability of future climate for the Parnassius mnemosyne butterfly averaged over the time slice of 2051-2080. The red colour indicates the most suitable areas.

The projections are based on bioclimatic envelope models developed with three different modelling methods (GAM, GLM, GBM) and five different climate scenarios.

The study then considered alternative conservation measures (adaptation options) which could maintain the biodiversity of Finnish semi-natural grasslands under a changing climate. Three major adaptation options were considered: agri-environmental scheme (AES) measures (which are already used in Finland), construction of ecological corridors, and species translocation. The results show that management of traditional biotopes by cattle grazing is the most efficient measure for butterflies, but when costs are taken into account buffer zones appear to be the most cost-effective AES measure.

Cost-effectiveness of Agri-Environmental Scheme Measures.

AES Type	Total PVC	Effectiveness (Y)	CE measure (PVC/Y)
Environmental Fallow	710	0,7	1014
Buffer Zone	944	1,16	858
Traditional biotope	2520	2,29	1096

The analysis was complemented with a farmer survey to understand farmer attitudes to biodiversity conservation and how different factors affect farmers' willingness to implement different AES measures, thereby providing useful complementary information on the attractiveness of management options and the possible barriers to implementation.

Source: Tainio et al. (2013).

Discussion and Applicability

The review and case studies provide a number of practical lessons on the application of cost-effectiveness analysis to adaptation. They provide useful information on the types of adaptation problem types where CEA might be appropriate, as well as data needs, resource requirements and good practice.

CEA is considered most useful for near-term adaptation assessment, particularly for identifying low and no regret options. The approach can be applied to both market and non-market sectors, but it particularly relevant for areas that are difficult to value in monetary terms, e.g. biodiversity, health. The use for long-term assessment is considered most appropriate when used as part of an iterative adaptive management analysis, rather than as a tool on its own.

It is most applicable (and relevant) where there is a clear headline indicator and a dominant impact – and less applicable for cross sectoral and complex risks, because it works with a single metric. It is thus more applicable when there is already agreement on sectoral objectives and effectiveness criteria. It is more appropriate where climate uncertainty is low, and good data exists for cost/benefit components.

The key data inputs vary on the use of the tool, i.e. whether a cost-effectiveness ranking (cost per unit benefit) or a full policy analysis. An initial ranking of options can often work with generic data on burdens to identify promising options. However, a full policy analysis usually requires some form of scenario-based impact outputs, to assess unit effectiveness accurately, and total effectiveness against a baseline. Full cost data is needed (capital and operating costs, expressed in equivalent economic terms) as well as data on unit effectiveness. For policy applications, additional information is needed in the form of baseline risks and the total potential for each option.

In considering the application of CEA to adaptation, a number of good practice lessons are highlighted:

- A good starting point for an adaptation CEA is to consider the cost-effectiveness of options to current climate variability, and then to assess cost-effectiveness in a number of defined future periods.
- The application of CEA to adaptation will ideally be context and location specific. It is important to identify appropriate sector and risk specific metrics, and stakeholder consultation can help this step.
- The application of CEA to adaptation should consider non-technical options and capacity building as well as technical options, noting these are more difficult to quantify.
- The application of CEA to adaptation needs to consider uncertainty. This should involve a sampling (multiple cost curves) across a range of socio-economic and climate model projections (even if low/high ranges). The use of single central estimates and single cost curves should be avoided. To capture the issues of timing and dependencies, analysis is likely to require a minimum of two future time periods.
- The CEA baseline should take account of current conditions and existing and planned policy. Future baseline projections should consider socio-economic as well as climate change, and ideally autonomous adaptation and existing/planned adaptation measures.
- The analysis of inter-dependencies between options is important, i.e. how one option might affect another. It is also preferable to undertake CEA within an iterative plan, to capture enabling steps and portfolios of options, rather than using outputs as a simple technical prioritisation.
- Due to the focus on a single metric, there is a need to assess wider attributes of options, i.e. their wider environmental, social and economic characteristics, as well practicality, acceptability, etc. These should alter the ranking of options.
- Recent applications of CEA have tried to apply the cost curve concept to adaptation using full cost-benefit analysis. The MEDIATION review does not recommend such an approach. More details are provided in the box.

Finally, due to the widespread application of cost-effectiveness analysis in the mitigation domain, some more advanced lessons have been identified. These are summarised in the box.

Box 3. More Advanced Lessons from Mitigation Cost-Effectiveness Analysis

A number of lessons of relevance for adaptation have emerged from the widespread use of CEA in mitigation.

- CEA tends to work with technical costs, omitting important policy and/or transaction costs, which need to be factored in when moving to policy implementation. For this reason, they underestimate the costs of options (and overestimate the relative cost-effectiveness). These policy costs should be factored into analysis.
- Cost curves can be divided into expert-based and model-derived curves. Expert-based curves assess the cost and reduction potential of each single abatement measure, while model-derived curves are based on a range of partial- or general-equilibrium models. For adaptation, most initial assessments are likely to be expert based, but there may be potential for modelling in some future areas.
- Cost-effectiveness usually optimises to one attribute, but in practice, policy options need to consider many elements, whether expressed in monetary or non-monetary terms. There have been some applications of CEA which seek to build in ancillary effects, either through the use of cost-effectiveness adjustments or through multi-optimisation analysis. These involve a step change in complexity and resources, but do provide much more robust results.
- A key area of discussion has centred on discount rates, and whether to use a social or private sector discount rate. Recent examples have undertaken sensitivity analysis with both to examine whether this alters the ranking and overall costs of compliance.
- Baseline assumptions, including the technology and reference costs (e.g. future energy prices), have a significant impact on the cost-effectiveness analysis. Such socio-economic drivers are known to be as important as climate drivers for adaptation, and need to be taken into account in analysis.
- Most MACC assessments have limited feedback between sectors or even time periods. Furthermore, they are defined with respect to a certain year. These issues are more important for adaptation.
- There has also been a debate around learning curves and innovation, which are important in determining the balance of current versus future options. This is something which requires consideration in the adaptation domain, albeit in more complex assessments.

Building Adaptation Cost Curves Using Economic Valuation

- A number of recent assessments of adaptation have taken the marginal abatement cost curve concept used for mitigation, but used monetary values to define effectiveness. In essence, this just undertakes cost-benefit analysis, but presents results so that they look like a mitigation cost curve.
- The MEDIATION project has reviewed this approach and does not recommend it for adaptation.
- This is because the approach tries to force adaptation to fit a decision framework targeted for mitigation. It does not solve any of the issues raised above on cost-effectiveness analysis, i.e. it treats adaptation as a simple linear process, focused on technical options, and most importantly, it has little consideration of uncertainty.
- Furthermore, it introduces a new problem with respect to the challenge in estimating monetary values for many sectors of interest to adaptation (health, ecosystem services), as well as capacity building and non-technical options, which are a priority for early adaptation.

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Further Reading and Reference Sources

MEDIATION Policy Briefing Note 1: Method Overview.

Further information

These notes provide a brief introduction to traditional and novel approaches to assess options to adapt to climate change, covering their strengths and weaknesses, conditions for applicability, case study examples and suggestions for further reading. The full set can be found at http://mediation-project.eu/.

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To find out more about the MEDIATION project, please visit:
http://mediation-project.eu/

For further information on the MEDIATION project: contact Rob Swart at
rob.swart@wur.nl

For further information on economic decision support tools, contact Paul Watkiss
paul_watkiss@btinternet.com

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SEVENTH FRAMEWORK PROGRAMME

Mediation