Cost-Effectiveness Analysis

Summary

- Cost-Effectiveness Analysis (CEA) is a methodology used to compare different approaches to achieve pre-defined adaptation targets. CEA can be used to analyse both technical or project oriented work and policy or programme approaches, providing comparisons and rankings of options with the same adaptation objective, or identifying the least cost combination of options.
- The biggest advantage of CEA is that it does not require the economic valuation of benefits. This is hugely important in the adaptation context, where it can often be difficult to assign monetized values of benefits.
- CEA does not explicitly deal with uncertainties as the method relies on cost curves assuming climate stability. The use of multiple cost curves can help overcome that limitation. Approaches, such as scenarios and sensitivity analysis, can be used to better consider the potential of different future climate change impacts.
- Another disadvantage of CEA is its reliance on a single metric when comparing options. The selection of such a metric can prove difficult in adaptation decision-making as climate change impacts are very diverse.
- 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. It is also 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.

What does Cost-Effectiveness Analysis do?

Cost-effectiveness analysis is a methodology used to compare different options aiming to achieve similar outcomes. It is particularly attractive in the adaptation context because it allows for benefits to be valued in non-monetary terms, opting for quantification in physical terms instead.

At the technical or project level, CEA is useful in comparing and ranking alternative options, which it achieves by assessing options in terms of the cost per unit of benefit delivered, e.g. cost per tonne of pollution abated. This identifies options that deliver highest benefit for lowest cost (i.e. the most cost-effective).

At the project, policy or programme level, where combinations of measures are needed, CEA is useful in determining the most cost-effective order of implementation, identifying the least-cost path to reach pre-defined policy targets. This is undertaken through the use of marginal abatement cost curves. The method can also identify the largest benefits possible using 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).

When should I use Cost-Effectiveness Analysis?

Cost-effectiveness analysis is generally most useful for short-term adaptation assessment, for example when ranking low and no regret options. This is because CEA does not explicitly deal with uncertainty and aims to optimise the selection of adaptation interventions against a single objective usually under one climate scenario. This can be addressed by testing across multiple scenarios/model outputs, or using more complex stochastic approaches, but this has resource implications.

Because effectiveness does not need to be quantified in monetary terms, CEA is also a helpful tool when dealing with sectors which include significant non-market dimensions such as biodiversity protection. However, a major challenge presented by CEA is the need to use a common metric across all options to allow for comparison. For example, when looking at sea level rise, one could consider using a headline metric of the number of people at risk, but this will omit consideration of coastal erosion and coastal ecosystems. CEA is less suitable for handling complex or cross-sectoral risks.

CEA is less useful when considering non-technical or “soft” options, as their effectiveness is more difficult to evaluate. This can present some issues in the adaptation field, where a large combination of diverse options may be needed to best deal with future conditions and where soft options are important (e.g. in combination with technical adaptation options).

What are the key strengths and limitations of Cost-Effectiveness Analysis?

Key strengths

- Does not require monetary valuation of benefits. Increases applicability to non-market sectors.
- Provides easily understandable rankings of measures.
- Frequently used for mitigation, and thus approach known by policy makers.
- Can look at the cost implications of progressively more ambitious policies.

Potential weaknesses

- Optimises to a single metric, which can be difficult to choose. Focus on a single metric may omit important risks, and may not capture all costs and benefits for option appraisal.
- Less applicable for cross-sectoral or complex risks.
- May give lower priority to non-technical measures such as capacity building and soft.
- Does not lend itself to the consideration of uncertainty and adaptive management.

What does it involve?

The methodology for CEA aims to provide a comparison and ranking of the relative cost-effectiveness of various options to achieve pre-determined targets. It involves a series of common methodological steps:

- Establish the effectiveness criteria, such as the reduction in the number of people at risk of affect by floods
- 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 non-monetary metric. Generally, 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)

Following these steps, all the options can be expressed in equivalent terms, as a cost per unit of effectiveness. This allows the ranking or prioritising of measures, identifying the most cost-effective options, i.e. those that deliver highest benefits at lowest cost. In Econadapt, a review of the use of non-monetary metrics in CEA has been done.

This information can then be used as an input to form a marginal abatement cost curve. In graphical terms, they are often presented as cumulative bar charts.

At a basic level, cost curves present all options in order of unit cost-effectiveness analysis, beginning with the most cost-effective. Cost curves also assess the total cumulative effectiveness of each option, as it is added. When considered together, this allows the estimation of the least-cost path to achieve a plan, programme or policy target.

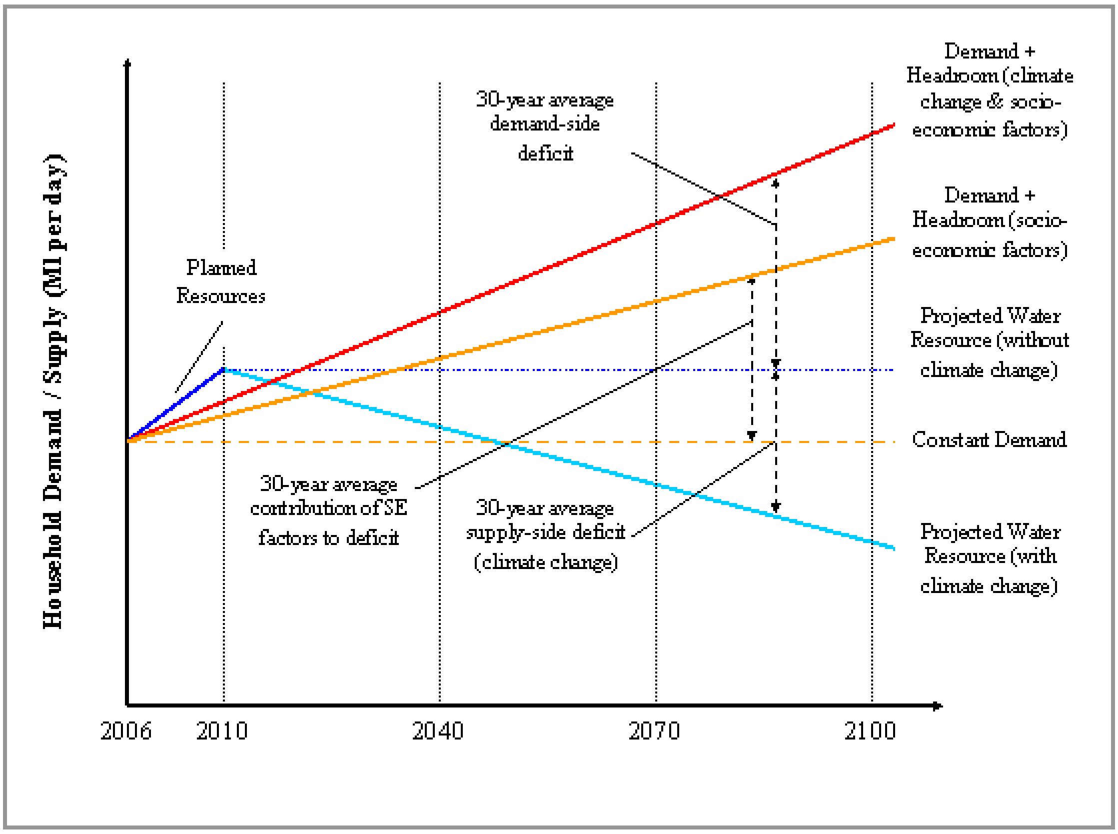
In the case of a policy CEA, first the target level of total effectiveness is determined and then the cost curve can be generated. The approach help produce the cumulative least-cost options pathway to reach the target.

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 requires more in depth work, particularly on a policy level to ensure that options can be implemented together, and to factor in elements that may not be considered in the actually analysis.

Case Study: Cost-effectiveness analysis of adaptation options for public water supply

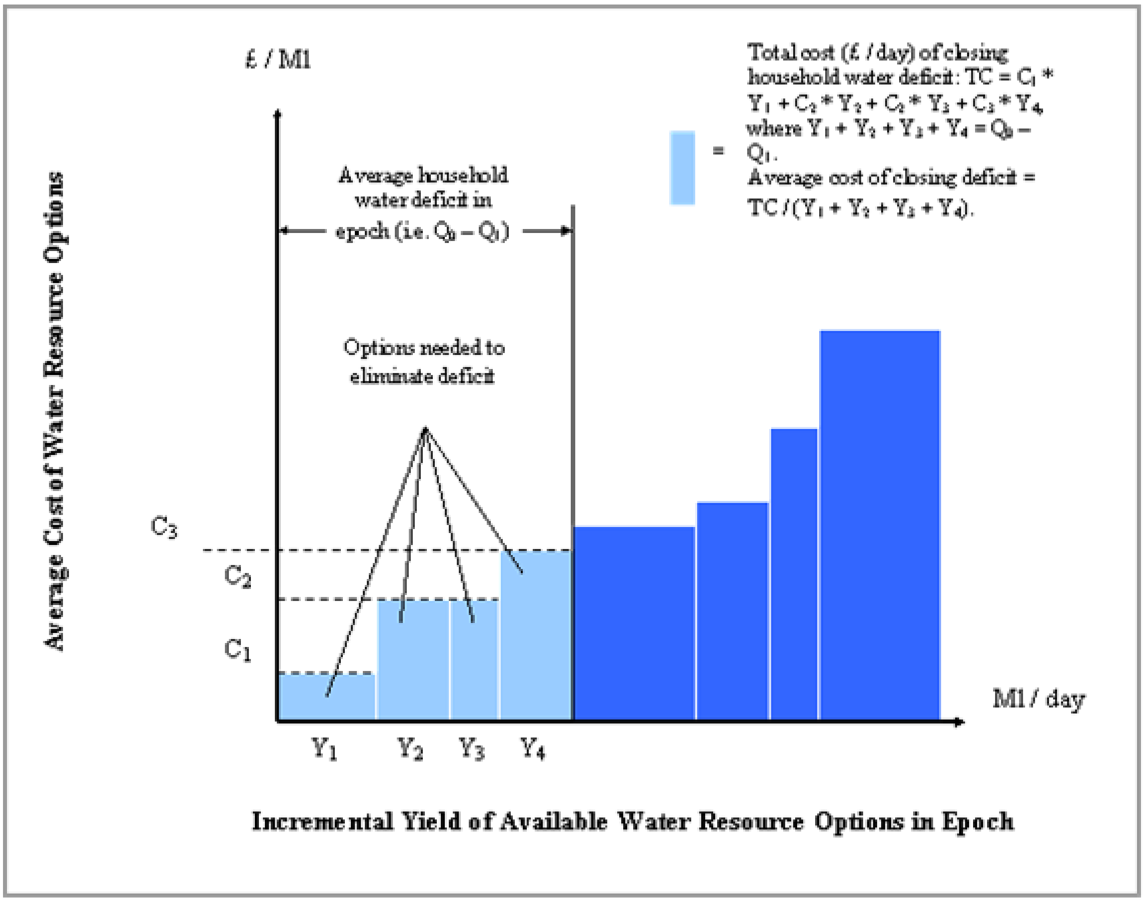
This study carried out a cost-effectiveness analysis of adaptation options against growing water scarcity in South East England and South East Scotland. It estimated the incremental costs of adapting to household water deficits. It is assumed that the objective of the decision-maker is to eliminate household water deficit at minimum cost. The approach involved two principal steps.

Firstly, the 30-year average household water deficit was estimated for three periods (2011-2040, 2041-2070, 2071-2100) under four climate scenarios. The Figure below illustrates the process of developing household water deficits. Projected climate change reduces yields from planned resources. Household demand for water over time is affected by socio-economic change, with the assumption that water demand increases. Climate change also increases household demand for water. Rising demand for water combined with decreasing availability lead to increasing deficits over time.



The second step of the methodology involved estimated the cost of addressing the water deficit. The study looked at a variety of water management options which either reduce demand or increase supplies. The options were first examined to determine in what timeframe and socio-economic scenario they may or may not be available. Based on the information available for all the options, indicative cost-yield curves were created under the various timeframes, scenarios and assumed costs. These curves show by how much the water deficit can be reduced by each individual measure, and at what cost.

An example of one of these curves is presented in the Figure below. The measures are ordered from the lowest cost options on the left to the higher cost options on the right. These cost-yield curves are applied to both the SE England and SE Scotland case studies. It is assumed that the household water deficit is entirely eliminated in each period, or epoch. Thus, in this example, implementation of options 1 – 4 is sufficient to eliminate the household water deficit. These options were likely to include waste-water re-use and retrofit of toilets. Examples of more expensive options included the construction of new reservoirs and water metering in households.



Further information: Metroeconomica (2006), Climate Change Impacts and Adaptation: Quantify the Cost of Impacts and Adaptation. Report to Defra, London.

Econadapt insights

[The Use of Non-Monetary Metrics to Assess Adaptation Actions: Cost-Effectiveness Analysis (CEA)]

[Integrated uncertainties and risk management for robust decision making]

[Uncertainties and causes of uncertainties in climate change adaptation]

[Uncertainties and risk analysis in climate change adaption]

[Assessing flood risk management: the Netherlands]

[Sourcing and using climate information for economic assessments of adaptation]