The Coalition of Finance Ministers for Climate Action

# Risk–opportunity analysis: policy appraisal in contexts of structural change, uncertainty, and diverse interests

## S-Curve Economics

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**Cost–benefit analysis is often used by Ministries of Finance to compare the value of different policy options, or to determine whether or not to proceed with a proposed policy.** The method can be useful, but as UK Treasury guidance has noted, it is a marginal analysis technique, generally most appropriate in situations where economic structures can be assumed to be unchanged by the intervention, and it works less well outside this domain (HM Treasury, 2018).

**Risk–opportunity analysis (ROA) is a generalization of cost–benefit analysis,** appropriate for use in contexts where change is structural, important outcomes are uncertain, and diverse interests are affected. These conditions apply to many of the policy decisions governments make in the context of the low-carbon transition. For example, when a government considers supporting the first deployment of a zero-emission technology, the aim is structural change (advancing the low-carbon transition); interests as diverse as innovation, budget management, employment, energy security, consumer prices, air quality, and emissions reduction may be affected; and the outcomes in many of those dimensions are usually uncertain.

**In the UK, subsidies for the first deployment of offshore wind were not strongly supported by cost–benefit analysis.** In 2015, offshore wind generated electricity at around three to four times the market price (Tovey, 2017; Jennings et al., 2020). It was criticized as being "among the most expensive ways of marginally reducing carbon emissions known to man" (*The Economist*, 2014). At that time, burning biomass was a cheaper way to reduce emissions (Department of Energy & Climate Change, 2013). Risk–opportunity analysis supported the case for investing in offshore wind rather than biomass. The data for onshore wind, a very similar technology, suggested potential for cost reduction through learning-by-doing and economies of scale (see Way et al., 2022). Market analysis suggested offshore wind had better opportunities for job creation than biomass, while lifecycle assessments showed biomass had significant environmental risks. Within a decade, the UK's targeted subsidies drove the cost of offshore wind power down to below the market price of electricity. The sector now supports around 32,000 jobs in the UK, and its long-term contracts for electricity generation are increasingly subsidy negative (The Crown Estate, 2024).

**ROA cannot provide simple and definite answers about which course of action is the best. It is for use in situations of complexity and uncertainty where no simple answers exist.** Its purpose is to assess options in a well-structured way, providing high-quality information to inform a decision.

ROA has three components: a dynamic assessment, a multi-dimensional assessment, and an uncertainty assessment.

## Dynamic assessment: considering how policy options could affect processes of change in the economy

ROA assesses the likely effects of policies on *processes of change* in the economy, as well as expected outcomes at specified moments in time. This is distinct from CBA, which is limited to assessing outcomes at fixed moments in time.

Assessing the effect of policies on processes of change in the economy involves first understanding the dynamics of the economic system of interest and then identifying how a policy will likely affect those dynamics. Systems mapping with causal loop diagrams is a well-established method for doing this. The key steps in this method are the following (Barbrook-Johnson and Penn, 2022):

- Determine an appropriate system boundary: this encompasses all variables that are important to the problem at hand.
- Identify the direction of causal relationships between pairs of variables within the system of interest.
- Identify the positive (amplifying) and negative (dampening) feedbacks that arise from closed loops between sets of variables. The behavior of the system can be understood as arising from these feedback loops.

- Assess the effect of policy options in terms of how they would strengthen, weaken, create, or break feedback loops.

This method can be used to distinguish policies that will likely be self-amplifying, accelerating change in a desired direction, from those that will likely be self-limiting. It can also be used to identify combinations of policies that are mutually reinforcing, as distinct from those that are mutually offsetting.

In the context of the low-carbon transition, it can be useful to consider which policies are likely most effective in driving the positive feedbacks of clean technology development and diffusion, and which mutually reinforcing policy packages are best able to achieve a cost-effective transition.

If there are a desire to quantify the dynamic effects of policy options and sufficient time and resources, simulating models (such as system dynamics or agent-based models) can be used for this purpose.

## Multi-dimensional assessment

ROA presents outcomes in multiple dimensions, instead of converting all outcomes into one metric, as is done in CBA. This is appropriate in situations where the diversity of actors, interests, and policy outcomes is highly relevant to achieving the policy objectives.

The limitation of aggregating outcomes in a single metric is that there is no single method for converting outcomes in different dimensions (e.g., industrial competitiveness, public health, reduced risks from climate change) into the metric of money. Many such methods have been developed, and the choice of which method to use—a choice which determines the relative weighting the analysis gives to outcomes in different dimensions—is, unavoidably, to some degree arbitrary.

In ROA, the expected (or possible) policy outcomes in each dimension are presented in the metric most natural to that dimension (e.g., tonnes of $CO_2$ for avoided emissions, or numbers of people for avoided deaths from air pollution). This avoids confusion between the analytical and the political: the relative value of outcomes in different dimensions can be considered explicitly instead of assumed implicitly.

A well-established method for assessing and presenting outcomes in different dimensions is multi-criteria decision analysis (MCDA). This part of ROA can be done in a similar way, but without the final step of assigning scores and weightings to different outcomes, which in MCDA reintroduces the element of arbitrariness that has the drawbacks described above.

In this component of the analysis, it is also important to consider whether policy objectives are primarily concerned with the expected (most likely), worst-case, or best-case outcome in each dimension. For example, in policymaking on power sector reform, the expected value may be most important for the outcome of electricity prices, while the worst case may be most important for the outcome in relation to security of supply, and the best case may be most important for outcomes in relation to innovation.

In some dimensions of interest to policy, it may not be possible to quantify the expected (or worst-case/best-case) outcomes. These opportunities and risks that cannot be confidently quantified should be assessed, as well as quantifiable costs and benefits, in a structured way and on an equal basis, instead of limiting the analysis to the latter.[1] The important principle is to use the best available information in each case.

1 When CBA is used to assess the "economic case" for policy, it is sometimes accompanied by a separate assessment of the "strategic case", which includes consideration of unquantifiable factors. This distinction presents difficulties in contexts where the outcomes of the policy in relation to its main economic objectives are not confidently quantifiable (for example, in the low-carbon transition such objectives could be to incentivize industry investment, accelerate innovation, or build competitiveness in clean technologies). If the primary economic policy objectives are left outside the economic assessment, then the analysis becomes either irrelevant or misleading.

Key steps in this component of the analysis are:

- Identify outcome dimensions of significant importance to policy
- Determine whether policy is primarily concerned with the expected, worst-case, or best-case outcome in each dimension
- Assess the expected, worst-case, or best-case outcomes of policy options in each dimension, using the best available information (as is done at the equivalent stage of CBA)
- Present the outcomes of each policy option in each dimension using the metric that is most natural to each dimension (without conversion into a common metric).

## Uncertainty assessment

The purpose of this component of the analysis is to consider how policy outcomes may be affected by factors outside the control of the decision-maker. Scenario analysis is a well-established method for doing this.[2]

Key steps in the method are:

- Identify critical uncertainties, i.e., factors that are highly uncertain and could have a large impact on the performance of policy options under consideration.
- Cluster critically uncertain factors, grouping together those that are connected to each other, to produce two or three main categories of uncertainty. From these, choose a small number of scenarios that are the most relevant and challenging to policy objectives.
- Develop a narrative for each scenario, describing a plausible path from the present to the future, incorporating any available knowledge of how relevant factors could develop.
- Consider how each policy option would perform under each scenario. From this, determine whether each policy option is robust against uncertainties (successful in all scenarios), resilient (easily adaptable), or contingent (representing a strategic bet on a particular future).

## Combining the three components of assessment.

The three components of assessment described above are interdependent, so this description should not be taken to imply that they are three discrete steps to be followed sequentially. Any one part of the assessment could influence the understanding of the others, meaning a certain amount of iteration may be needed.

Once the three components have been completed, policy options can be compared in terms of their:

- Expected, worst-case or best-case outcomes in different dimensions relevant to policy objectives
- Dynamic effects, i.e., whether their effect in each dimension is likely self-amplifying, self-limiting, or neutral
- Performance under uncertainty: whether they are robust, resilient, or contingent, with respect to critical uncertainties.

While the concept of ROA as presented here may not be familiar to governments, it is important to note that each of its three components can be carried out using methods that are already well established. Consequently, while detailed ROA implementation guidance is forthcoming,[3] there is

2 See for example the scenarios of the Network for Greening the Financial System and the recommendations of the Task Force on Climate-Related Financial Disclosures on how organizations should use scenarios to assess the implications for their strategies of physical climate risks and transition risks.

3 Detailed implementation guidance for ROA is under development by the Innovation hub of the C3A program and will be made available at www.scurveeconomics.org/publications-and-resources.

nothing to prevent MoFs putting it into practice already. The technique of systems mapping with causal loop diagrams can be learned with a modest amount of training, and the basic approaches described above for the multi-dimensional assessment and uncertainty assessment require no more specialist skills than does CBA.[4] The greater difficulty lies in acquiring or bringing together high quality subject-matter knowledge, on which the usefulness of any analysis, produced with any framework, ultimately depends.

Like CBA, ROA is an approach to organizing information to inform a decision. The results of detailed quantitative modeling can be an input to ROA—for example, sector-specific simulation models can be used to support the dynamic assessment of policy options, and macroeconomic models can be used to assess outcomes in some of the dimensions of interest. However, the use of such models is not essential on every occasion. The important principles are to use the best available information, and to ensure the time and resources devoted to analysis are proportionate to the decision that it aims to inform.

## Resources

The policy brief by Sharpe et al. (2020) provides a more detailed comparison of CBA and ROA, including an illustrative example of how the two approaches can arrive at different conclusions, as well as further explanation and examples of policy problems of non-marginal change.

Mercure et al. (2021) set out the theoretical basis for ROA.

The report by Grubb et al. (2021), from the Economics of Energy Innovation and System Transition project, looks at some of the most outstanding successes achieved in low-carbon transitions so far in the UK, China, India, and Brazil, and considers the application of CBA and ROA in relation to the policies that were central to those successes.

The policy brief by Kim (1992a) gives examples of systems mapping with causal loop diagrams applied to typical systems change problems, along with notes on potential approaches to solutions. See also Kim (1992b).

Detailed implementation guidance for risk-opportunity analysis is under development and will be made available at www.scurveeconomics.org/publications-and-resources

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4 Scenario analysis is ideally done as a highly participatory process, and facilitating this process is a specialist skill. However, it is also possible for small groups of analysts and policymakers to carry out the steps above without specialist support, as may be necessary when time and resources are limited.

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