

# Cost-Benefit Analysis and the Environment

FURTHER DEVELOPMENTS AND POLICY USE

2018

HIGHLIGHTS



# Cost-Benefit Analysis and the Environment: Further Developments and Policy Use

## *Preface*

Cost-benefit analysis has long been a core tool of public policy. The systematic process of calculating the benefits and costs of policy options and projects is now widely regarded as an essential step in the policy process. It helps decision makers to have a clear picture of how society would fare under a range of policy options for achieving particular goals. This is particularly the case for the development of environmental policy, where cost-benefit analysis is central to the design and implementation of policies in many countries.

The OECD has a long tradition of promoting the use of cost-benefit analysis in environmental policy development. This work has covered a wide range of topics, from the evaluation of environmental damages in monetary terms to the role of discounting to case studies of the application of cost-benefit analysis. The 2006 OECD publication *Cost-Benefit Analysis and the Environment: Recent Developments* has been a reference publication for more than a decade.

This report, *Cost-Benefit Analysis and the Environment: Further Developments and Policy Use*, provides a timely update on recent developments in the theory and practice of cost-benefit analysis. Many important theoretical developments have taken place over the last decade, not least in relation to the economics of climate change and to the treatment of uncertainty and discounting in policy or project assessments. For example, increasing attention has been devoted to assessing the social costs of carbon (SCC). Since carbon emissions have global impacts that vary across time and space and occur in many different sectors, the calculation of the SCC is complex, requiring inputs from many different disciplines. This book explains the underpinnings of the SCC and reviews the different approaches and uncertainties in its estimation, addressing key questions that will influence the policy relevance of such calculations: What path will emissions take? How will emissions affect temperatures? How will temperature changes cause damages?

The report also updates the technical and practical developments in the key issue of discounting. While the theory of social discounting shows clearly how the social discount rate should be defined, in practice numerous questions arise, especially when considering actions with implications for generations in the far distant future: intergenerational projects and policies. In such contexts, there is strengthening theoretical and empirical support for the use of discount rates that decline with time. But this has important implications for the policy debate around major environmental issues such as climate change, air pollution and water management.

The book presents new information on the current use – or lack of use – of cost-benefit analysis in different *ex ante* and *ex post* contexts. There are large variations in the extent to which cost-benefit analysis is being used in environmental policy development across countries. There are also wide differences in the extent to which various environmental impacts are being taken into account in these analyses, across economic sectors and across analytical contexts. For example, in general, energy sector investments and policy proposals are relatively well covered in cost-benefit analyses. But there is often far narrower coverage of non-climate environmental impacts in those assessments than in assessments of investment projects in, for example, the transport sector.

The political economy dimensions of the use of cost-benefit analysis are also explored in the book. While cost-benefit analysis provides extremely valuable information for decision-makers, it necessarily forms just one part of the complex set of considerations that must be taken into account when dealing with challenging environmental issues. How cost-benefit analysis is used in practice, and the constraints and challenges in this use, is critical to ensuring that decision makers have a full understanding of the “use and abuse” of cost-benefit analysis. Clearly, providing decision makers with the flexibility needed in order to “act politically” or meet other policy objectives is essential. But this will shape the nature of the use of cost-benefit analysis in particular ways. Throughout this, the role of CBA remains one of explaining how a decision should look if an economic approach is adopted.

This book is the result of a strong collaboration between leading academics and the OECD countries, working under the auspices of the OECD Environment Policy Committee. We stand ready to support countries in the implementation of the practices and tools detailed in this study. I am confident that this work will significantly enrich the understanding of cost-benefit analysis and strengthen its use in both OECD and non-OECD countries in tackling our many shared environmental challenges.

**Anthony Cox**, Deputy Director, OECD Environment Directorate

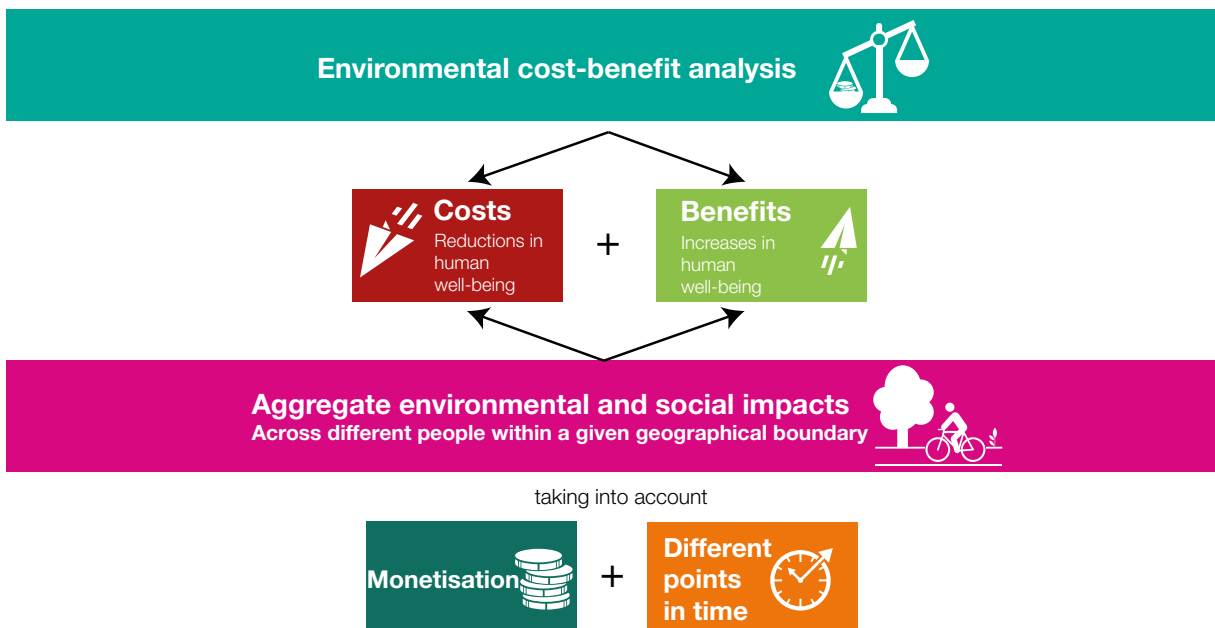
# 1 The framework

## What is environmental cost-benefit analysis?

**Environmental cost-benefit analysis (CBA) is the application of CBA to projects or policies that have the deliberate aim of environmental improvement or actions that somehow affect the natural environment as an indirect consequence. In 2016 the OECD published a highly consulted first edition titled *Cost-Benefit Analysis and the Environment: Recent Developments*. This brochure summarises more than one decade of updates in presented the 2018 follow-up publication.**

Imagine a choice between energy project options which involve investing in a coal-fired power plant or a renewable energy investment, such as in wind turbines. In choosing between these options (or deciding not to invest in either), one analytical tool that decision-makers and practitioners might use is cost-benefit analysis (CBA). This requires understanding what these options provide in terms of benefits (defined as increases in human well-being) and costs (defined as reductions in human well-being). Although it sounds simple enough, some way must be found to aggregate environmental and social benefits and costs across different people (within a given geographical boundary) and finding some means of monetising these, accounting for different points in time when the impacts occur. For one of these projects to qualify on cost-benefit

grounds, its social benefits must exceed its social costs. In the past decade, there have been many new theoretical developments and considerable expansion in the uses of CBA and in its policy and investment applications, yet uptake is not as widespread as it could be despite its ongoing usefulness for environmental policy and investment decision-making. *Cost-Benefit Analysis and the Environment: Further Developments and Policy Use* explores the latest theoretical developments, as well as the political economy surrounding the practical applications of such analyses. The book also presents the results of a survey about current use of *ex ante* and *ex post* CBA analyses of investment projects with large potential environmental impacts, and of similar analyses of different public policies.



# 2 Key developments

## Climate economics and the treatment of impacts in the distant future

**The social cost of carbon (SCC) is the central concept for the inclusion of climate change damages in the CBAs of public policy and public investments. It measures the present value in monetary terms of the damages incurred when an additional tonne of carbon (or any other Greenhouse gas) is released into the atmosphere. The SCC can be added as a cost item for projects that induce carbon emissions, and as a benefit item for projects which induce a net reduction in carbon emissions.**

Most public projects have an impact on carbon emissions, but energy, transport and agriculture are key areas of concern where it will be important that the SCC is taken into account. In environmental policy, the SCC informs the optimal carbon price and the optimal level of emissions abatement. Implementation of an explicit carbon price (e.g. via a tax or permit system) will provide incentives for reduced carbon emissions across all sectors of the economy. Many countries now recognise the importance of the SCC and, as a result, have their own approaches to the estimation of the SCC. The 2018 edition, *Cost-benefit Analysis and the Environment: Further Developments and Policy Use*, explains the theoretical underpinnings of the SCC, and elaborates upon the different approaches to the estimation of the SCC.

Since emissions of carbon have global impacts, which vary across time and space, and in many different sectors, calculation of the SCC is complex, requiring inputs from many different disciplines, ranging from

climate science, to agronomy, to social sciences, including economics.

There are also considerable uncertainties at every stage of the process through which carbon causes damages. Three important questions which make the calculation of the SCC difficult are:

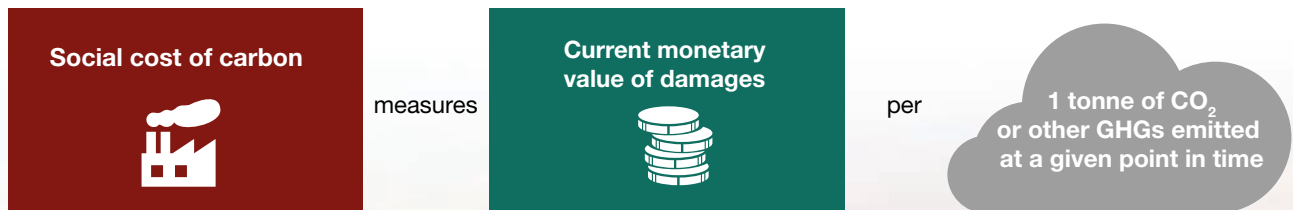
- What path will emissions take?
- How will emissions affect temperatures?
- How will temperatures cause damages?

There are considerable uncertainties at each step of this calculation, which are compounded by the potential for “threshold effects” and catastrophic outcomes. Yet the importance of climate change as a global problem, and the need to implement policies in line with commitments under international agreements, means that many countries have already implemented carbon taxes or use SCC estimates routinely in their regulatory analysis. Some of the difficulties and disagreements on the issue are highlighted in the book, and examples of current international practice on using the SCC in the CBA of public policy are explained.



Work in this area has also increased the focus on how to value costs and benefits that occur far into the future. Discounting of such impacts is both a critical and pervasive issue in CBA, and this is nowhere more so than in environmental applications. On the one hand, this is a technical matter arising from the standard assumption in CBA that the social or shadow price of a unit of consumption in the future is lower than the price of a unit of consumption today. While the theory of social discounting shows clearly how the social discount rate should be defined, in practice numerous questions arise, especially when considering actions with implications for generations in the far distant future: intergenerational projects and policies. Not only do the assumptions underpinning conventional discounting become problematic but also the ethical underpinnings of discounting become extremely important and influential. The 2018 edition discusses how the parameters of the discount rate for social CBA are determined as well as their ethical and practical content. This involves a discussion of the problems introduced to the conventional discounting approach by intergenerational impacts such as climate change and the strengthening of theoretical and empirical support for schedule of discount rates that decline with time.

Many environmental policy issues are also characterised by a high degree of uncertainty, for example regarding the size of changes in different environmental outcomes in response to various policy or project alternatives. Methods of dealing with uncertainty – specifically probabilistic risks – in CBA have typically focused on expected utility theory which provides a strong theoretical basis for deviating from the simple use of expected values in a deterministic framework, towards estimating welfare corrections for use in CBA. However, estimating the certainty equivalent values requires assumptions about the nature of society’s utility function, and some demanding estimates of the probability distributions of the risky quantities associated with any given project. Even so, practitioners are increasingly prepared to use these methods, given emerging evidence about the errors associated with simpler approaches. Nor should a focus on formal economics ignore the fact that there are many other principles that could be applied in CBA to make decisions in the face of uncertainty, such as “safety first” and “precaution”.



# 3 : Key developments

## The extension of valuation techniques to ecosystems

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**The valuation of ecosystem services has become a crucial element (perhaps the crucial element) in quantifying the contribution of ecosystems and biodiversity to human well-being. While the evidence base is broad and – at least for some ecosystem services – deep, reflections on this progress indicate a need for greater understanding of ecological production, especially as it relates to spatial variability and complexities in the way that such services are produced. This is a truly interdisciplinary task, given the need for natural science to inform the stages of this analytical process. There is considerable debate remaining also about how to conduct decision analyses in those contexts where valuation and understanding of the natural world is likely to remain relatively uncertain. These challenges need to be viewed in context.**

A growing number of large-scale ecosystem assessments have shown how the empirical record can be put to use in an informative and policy-relevant way. These developments could be crucial in translating valuations into meaningful policy analysis.

The notion of “sustainable development” has permeated significant parts of policy discourse about the environment. This reflects a number of (related) concerns, including the development path that the broader economy is on and specifically the way in which (changes in) natural wealth affects this path. It is important that CBA speaks to those concerns especially as policy and investment projects have the potential to shift a development path (perhaps because of non-marginal actions or the cumulative

effect of smaller decisions). There are a few implications of this but one of the most prominent (as well as far-reaching) is to circumscribe CBA by having it live within sustainability constraints, perhaps based on ecological criteria. This places greater emphasis on a single appraisal within the context of a portfolio of policies or projects. That is, the constraint is that this portfolio, on balance, maintains the ecological status quo with practical applications of this approach including biodiversity offsetting. This raises important issues. On the one hand, there is a benefit to avoiding irreversible damage to (possibly) critical resources. On the other hand, there are opportunity costs to applying the shadow projects approach that need still to be considered.



# 4 Key developments

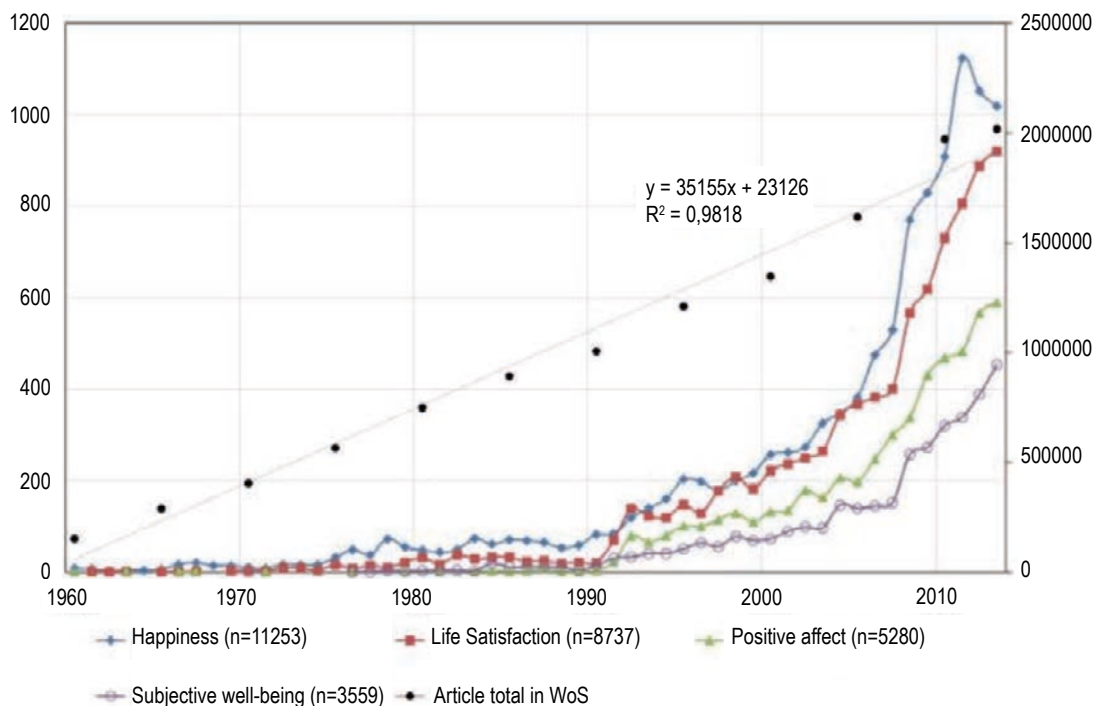
## The application of subjective well-being approaches

**Subjective well-being (SWB) valuation is a newly developed method that differs from other non-market valuation methods (such as revealed preference [RP] methods, and stated preference [SP] approaches, such as contingent valuation and discrete choice experiments). In SWB, values are based on how non-market goods impact on self-reported measures of well-being, such as life satisfaction. In other words, the values are based on experienced utility rather than decision utility. Much less is known about the limitations and biases of this nascent SWB valuation approach than RP and SP methods that have a much longer history of research and applications in economics.**

The SWB approach offers a promising new way of valuing non-market goods, and as future research and applications unfold. This field has opened up a new frontier for helping to monetise values for environmental impacts of policies and investment projects, for example in terms of extracting many (non-market) environmental goods and services implicitly traded in markets by better establishing causal inference between the transaction for a market good (e.g. buying a house

or accepting a job) and the implicit price of an (non-market) environmental good (e.g. air quality in a neighbourhood or the workplace). The influence of behavioural economics has also been useful in environmental economics, recasting what is known about valuation biases and response anomalies, as has been the rise of online surveys, enabling more extensive applications and further testing of biases and their resolution.

Figure 1. **Published articles on subjective well-being in absolute numbers**



Source: Kullenberg and Nelhans (2015).

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## Key developments

### The continued refinement of health valuation

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**The valuation of health risks is a long-standing area of both research and policy application. Increasing evidence of the global burden of disease and especially the role of environmental pollution as a determinant of this burden has added a further urgency to this work.**

Considerable strides have been made in recent years in terms of clarifying both the meaning and size of the value-of-a-statistical-life (VSL). One key issue has been how to “transfer” VSLs taken from one country to another where life expectancy of those people who are the object of policy and investment project proposals differs. This still requires that applications are done with care and judgement. In some areas, the literature offers firmer guidance here than in others. Notably, age may or may

not be relevant in valuing immediate risks – the literature is arguably ambiguous with regards to the empirical relationship. That said, in terms of practical guidelines, the empirical record has been important in translating findings in base or reference levels for health values for use of policy or project appraisal, for example via the use of meta-studies. This has established “reference values” for important categories of health impacts such as mortality risk that can be readily used in practical assessment.







# 6 Political economy of CBA

## There is substantial use of CBA across OECD countries

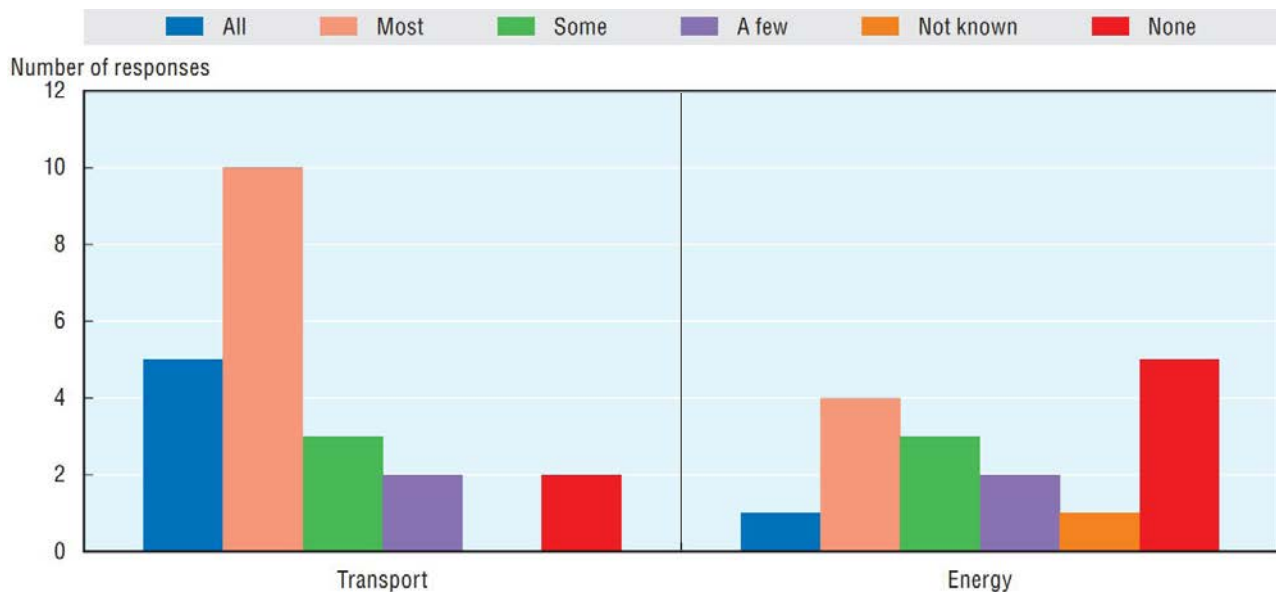
**Cost-Benefit Analysis and the Environment: Further Developments and Policy Use** discusses the current use of CBA in OECD countries across policy sectors such as energy, transport and environmental policy, via questionnaire responses. It finds that there are large variations in the extent to which CBA is being carried out, and the extent to which various environmental impacts are being taken into account in these analyses, across economic sectors and across analytical contexts.

Energy sector investments and policy proposals are relatively well covered in CBAs, but there is far narrower coverage of non-climate environmental impacts in those assessments than in assessments of investments in the transport sector.

Cataloguing the use of CBA is important, but of course, it does not of itself provide answers to

inevitable questions about why CBA is used in one context but not another. Nor did the responses provide a clear picture of the influence of CBAs on the final decisions. It must also be recognised that use and influence are moving targets in the sense that both are probably evolving reasonably rapidly given developments in environmental CBA.

Figure 2. Which share of CBAs in the last 3-5 years has included impacts on GHG emissions?



Source: OECD (2018), Cost-Benefit Analysis and the Environment: Further Developments and Policy Use, OECD Publishing, Paris, <https://doi.org/10.1787/9789264085169-en>.



Questions about why patterns of use and influence are how they are bound up with political economy, necessitating a richer understanding of the policy formulation process. If, in the extreme, all decisions were to be made on the basis of CBA, decision makers would have no flexibility to respond to the various influences that are at work, demanding one form of policy rather than another. In short, CBA, or, for that matter, any prescriptive calculus, compromises the flexibility that decision makers need in order to “act politically” or meet other policy objectives. Unsurprisingly, this constrains use or shapes the nature of use in particular ways. The theory of political economy then seeks to explain why the economics of the textbook is rarely embodied in actual decision-making and, related to this, policy-formulation processes. But explaining the gap between actual and theoretical design is not to justify the gap. So while it is important to have a far better understanding of the pressures that affect actual decisions, the role of CBA remains one of explaining how a decision should look if the economic approach is adopted

The policy process is characterised by a complicated set of institutions and it is important to place questions about actual use of CBA in that context. Interestingly, the sorts of institutional developments that might be proposed as part of this political economy approach are actually happening in the broader reform of regulatory frameworks across many national jurisdictions and supranational groupings of countries. The institutional architecture surrounding how environmental CBA is done (and when it is done) has involved the setting up of public (and often independent) bodies that could facilitate a more prominent role for CBA, for example by adding a further tier of scrutiny by in effect scrutinising or “peer-reviewing” official appraisals. The Regulatory Scrutiny Board of the European Commission is a prominent example of this.

Generally, the role of environmental CBA is to act as the instrument to consider the case for (social) efficiency for decisions within the broader policy process. It is the primary objective of this book to assess recent advances in environmental CBA theory and to illustrate the practical use of CBA in policy formulation and in appraisal of investment projects.

## MORE INFORMATION

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For further reading on the application of cost-benefit analysis to environmental policy see the report on which these *Highlights* are based:

OECD (2018), *Cost-Benefit Analysis and the Environment: Further Developments and Policy Use*, OECD Publishing, Paris, <https://doi.org/10.1787/9789264085169-en>.

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<http://oe.cd/cost-benefit>