MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Which analytical tools are suited to transformative change?

New Zealand Government

MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Authors

Chief Economist Unit

Sharon Pells, sharon.pells@mbie.govt.nz

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Abstract

In New Zealand and elsewhere, addressing long-term challenges like climate change has increased attention on forward-looking and transformative policies involving changes to the structure of the economy – 'transformative change'. Analytical tools suited to transformative change include ones that reflect its features – goal-oriented, future-focused, systemic, involving risk and uncertainty etc. Cost-benefit analysis, while a valuable policy appraisal tool in general, has significant limitations in the context of transformative change. While these limitations may be remedied to some extent, other tools may be more suitable in this specific context and could be upweighted.

JEL classification

Keywords

Executive summary

- **Climate change and other long-term challenges and opportunities have led to a growing focus on systemic, forward-looking and transformative policy.** This paper uses the term 'transformative change' as a shorthand for this type of policy focus and associated structural changes. For example, climate change will likely involve significant changes to where and how New Zealanders live, the infrastructure that is built, how people are transported around and so on. Policy needs to shape and support this transformation in a way consistent with New Zealand's climate goals.

- **Questions are being raised about which analytical tools are most suited to transformative change, and in particular about the role of Cost-Benefit Analysis (CBA)**. These questions provide the motivation for this paper. The paper considers analytical tools that may help inform policy decisions about transformative change. The paper is based on a literature review and discussions with some New Zealand government agencies. The aim is to stimulate debate about the selection of appropriate tools and to support efforts to improve analytical capability.

- **Analysing transformative change is extremely difficult and may require a strong focus on the strategic aspects of the policy process.** Transformative change generally involves complex processes which unfold over time and entail much risk and uncertainty. In such a context, it is challenging to assess the impacts of policy options in advance. Partly in recognition of these challenges, some argue that particular attention should be paid to the strategic aspects of the policy process, such as the problem definition and intervention logic, case for change, and anticipated process of change.

- **When considering which analytical tools to use in policy about transformative change, analysts might consider tools that reflect its features and:**
    - are goal-oriented
    - help when thinking creatively about the future
    - analyse complex systems
    - deal with risk and uncertainty.

- **CBA is a valuable tool which is widely used *across a range of contexts*.** CBA is a policy appraisal tool used for comparing policy options in terms of their efficiency impacts. In New Zealand, CBA is used for budgetary purposes, in major regulatory changes and elsewhere. CBA has a number of strengths, can be applied in many contexts, and is generally seen as the dominant analytical tool in the policy toolkit.

- **However, CBA has major limitations *specifically regarding transformative change*:**
    - a status quo bias
    - a tendency to underplay environmental and other non-market impacts which may be the very goal of transformative change

- o a narrow focus in general, which may fail to identify the potential of a sum of multiple projects to collectively achieve transformative change.

- **Analysts might question whether CBA is the most suitable tool in the toolkit for this particular job.** While techniques are available to make CBA more suited to transformative change, these techniques tend not to be used much in practice, and some question the extent to which they overcome CBA's limitations in the context of transformative change. Overall, CBA seems ill-suited to situations where fundamental relationships in the economy might be changing. CBA is more concerned with static efficiency (the efficient allocation of resources at a point in time), whereas transformative change is more concerned with dynamic effectiveness (achieving a goal over time).

- **However, there is no silver bullet.** Each analytical tool has strengths and weaknesses. Some tools relevant to transformative change are new and unproven but are attracting attention. Others have been around for a while but are not used much. As with techniques to overcome CBA's limitations regarding transformative change, the lack of use of some tools raises questions about reasons for the low take-up.

- **Analysts might consider the full suite of tools at their disposal.** Multiple tools, and triangulation across a range of evidence and data sources, are probably needed to gain as full a picture as possible and inform a complex and high stakes area like transformative change. Also important is a consideration of who has standing in the analysis. As well as the features of transformative change, tools should reflect te Tiriti.

- **Much deeper capability might be needed,** as analysing transformative change is challenging, analytical capability in New Zealand has been found to be limited, selecting the right tool for the job requires knowledge of diverse tools, and perspectives on specific tools are deeply held and may be hard to shift. There is no quick fix to building deeper analytical capability. Such an investment is likely to be a costly and is not without risks.

- **Implications for improving analyses about transformative change include:**

  - o broaden the toolkit and explore newer/under-utilised tools

  - o weight more heavily tools most suited to transformative change

  - o improve analytical capability.

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1 Introduction

1.1 Background and motivation

In Aotearoa New Zealand and elsewhere, there is a growing policy focus on long-term, complex and systemic challenges and opportunities. This focus is reflected in the Public Service Act (2020), which includes "pursue the long-term public interest" in the purpose of the public service, identifies system leadership among the roles of chief executives, and introduced interdepartmental executive boards that support policy alignment on complex, cross-cutting issues, as well as long-term insights briefings that provide information about medium- and long-term trends, risks, and opportunities for New Zealand.[1]

This paper uses the term 'transformative change' to describe the extreme of this type of policy focus. By transformative change we mean a major change in the structure of the economy brought about by deliberate policy efforts aimed at supporting specific long-term environmental, social, economic or other goals, or in response to climate change and other relevant long-term trends. Clearly, there is, and always has been, a continuum of very marginal policy decisions, such as minor regulatory changes or small policies, to very transformative ones, like major policy programmes aimed at achieving a significant long-term goal. While this paper focuses on the latter, many of the analytical tools identified here are relevant to other parts of this continuum.

Achieving climate goals is a prominent example of where transformative change might be needed. Reducing emissions and limiting global warming requires a very significant, and rapid, transformation in the structure of global economic activity (Krogstrup and Oman 2019; Stern and Valero 2021). This transformation spans energy systems, transport systems, building systems, production processes and other parts of the economy (IPCC 2022). As well as reducing emissions, achieving climate goals involves adapting to the effects of climate change. Climate change adaptation involves transformation to the built environment and the resilience of communities (New Zealand Government 2022b).

Markets on their own do not tend to manage large structural transformations well, for reasons including that resources must move out of old sectors into new one (Stern and Stiglitz 2023). However, developing effective policies about transformative change is challenging. Transformative change involves action today in a world in which future preference sets, risks and opportunities are fundamentally unknown.

If transformative change is the goal, policymakers and analysts need to be able to select and use appropriate analytical tools to inform policy decisions. This paper considers relevant analytical tools. In this paper, 'analytical tool' generally means a tool that is used *ex ante* (in advance) or to inform the early parts of the policy cycle. The motivation is that questions are being raised, both internationally and in New Zealand,

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[1] https://www.legislation.govt.nz/act/public/2020/0040/latest/whole.html#LMS356994

about which analytical tools can best help inform policy decisions about transformative change.

This paper pays particular attention to the role of Cost-Benefit Analysis (CBA). One reason for this attention is that CBA is widely seen as the dominant tool for policy analysis in developed countries (Abelson 2022; Martens 2011; Mercure, et al. 2021). Another reason is that the suitability and role of CBA in transformative change is increasingly being questioned (see for example: Mercure, et al. 2021; Smith, McDonald and Harvey 2016; UCL Institute for Innovation and Public Purpose 2020; Sharpe, et al. 2020). In this paper, CBA generally means the underlying method and core principles of CBA, although Treasury's CBAx tool and other ways in which CBA is operationalised are also considered.

The paper is based on a literature review and discussions with colleagues in government agencies (see Appendix 1).

1.2 Questions and purpose

This paper examines, and is structured around, the following questions:

1. What is transformative change, and what are the implications for analyses?

2. Which analytical tools are suited to transformative change?

3. How well suited is CBA to transformative change?

4. What else needs to be considered in analyses of transformative change?

The ultimate purpose is to stimulate debate about the selection of appropriate analytical tools and to support efforts to improve analytical capability.

2 Transformative change

Transformative change tends to involve deep systemic changes which unfold over a long time and have a non-linear pattern. Achieving (and analysing) transformative change is hard. One way of thinking about analyses is to consider the features of transformative change – goal-oriented, future-focused, systemic.

2.1 Transformative change involves complex processes

'Transformation' is generally defined as a marked change in form or nature. The definition of transformative change in section 1 involves change to the structure of the economy. This type of transformation is not new – the structure of the economy is always changing and has always undergone periods of significant change such as in the Industrial Revolution etc. What *is* new is the pace of structural change that is happening, or needs to happen, in response to anthropogenic climate change, biodiversity loss and other planetary stresses (Raworth 2012; Stern and Valero 2021).

Transformative change involves a process of *transition* from the current to a desired future state. Transitions are generally deep systemic changes which unfold over a long time and have a distinctively non-linear and chaotic pattern (Silvestri, Diercks and Matti 2022). These transition dynamics can be described by two interrelated patterns: patterns of breakdown and patterns of build-up – see Figure 1.[2]

Figure 1: X-Curve of transition dynamics
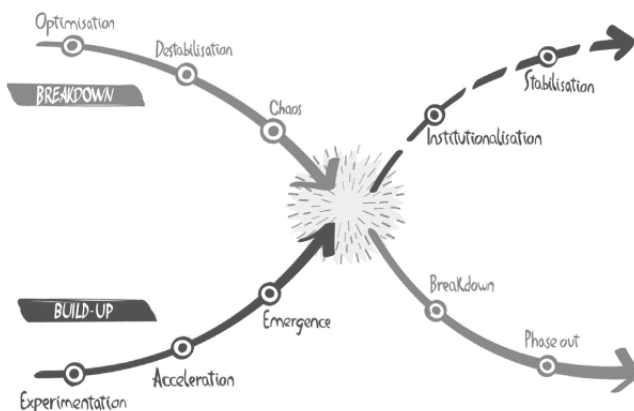
Source: Silvestri, Diercks, & Matti (2022)

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[2] The Figure draws insights from the Multi-Level Perspective Framework (see Geels and Schot 2007), as well as the 'S-curve' of innovation diffusion (see Rogers 1962)

Innovation plays a key role in the build-up process. Technological niches and novelties emerge which challenge the status quo. Over time these alternatives become cheaper, more visible, better understood and organised, and the process of diffusion accelerates.

But forces such as path dependence and vested interests work to preserve the status quo. The more that is invested in the status quo, the more difficult it is to change.

Disruption is therefore a feature of transition as new ideas, technologies, products and interests clash with old ones. Implications for analysis include that simple extrapolation from past experience will fail to foresee the way that a system may behave during a period of transition (HM Treasury 2022).

2.2 Government plays a role in shaping the transformation

Achieving transformative change and co-ordinating its transition is challenging. Rather than instigate and control transitions, policy can act as an enabler, set the direction of and shape transitions, and help avoid system failures (Kanger, Sovacool and Noorkõiv 2020). Policy can also play a role in making sure there is something new to replace the old as the old is retired, as this is not something that necessarily happens by itself, or if it does it can take longer than is desirable (Meade 2021). One example is the availability of new energy systems to replace fossil-fuel based ones in the transition to a low-emissions economy.

Government has many levers that can support transformative change. But government is also part of the incumbent system, and prescriptive regulations and standards etc may stifle innovation and work towards preserving the status quo (Geels and Schot 2007). This raises questions about whether government faces the right incentives to manage transformation. In addition, government failure, or unintended consequences arising from government action, is an important risk of policy work about transformative change.

One implication for analysis is the need to question our own status quo and other biases. One example of these biases is provided in a study about the take-up of new ideas within the OECD (see Diercks 2019). The study found that persistent cognitive and other sticking points made the OECD close down around well-known approaches and limited the take-up of new ones.

2.3 The features of transformative change have important implications for its analysis

Table 1 below provides a breakdown of some of the features of transformative change and the implications of those features for its analysis. The table highlights that analysing transformative change is extremely challenging.

Table 1: Feature of transformative change and implications for analysis

Features		Implications for analysis
Goal-oriented	Our definition of transformative change assumes deliberate action towards specific goals	Relevant analytical tools are those that are goal-oriented
		As well as intended goals, analyses need to include other impacts including unintended consequences
Long-term and future-focused	Transformative change involves long-term, complex processes If policy work in this context is effective, the future may look very different from the past	Simple extrapolations using historic data, and tools that impose the existing economic structure, may be of limited use Accounting for time preference is important eg choice of discount rates and time horizon of impacts Relevant tools are those that factor in uncertainties by identifying a range of plausible futures, disruptive change, blind spots etc
Systemic	Transformative change has widespread effects, and intervention points, across systems	Analysis and decisions should focus on what *mix* of policies may best suit, not just individual policies Relevant tools are those that deal with complex systems such as those that aim to incorporate feedback effects, tipping points, irreversibilities and the behaviours of agents in systems; note that assessing tipping points etc *ex ante* is extremely challenging
Risk and uncertainty	The future is unknown and involves risk (which can be assigned a probability), and uncertainty (which cannot) The further out the change or goal, the greater the uncertainty	It is important to be clear about the degree of uncertainty in analyses Ranges and sensitivity analyses can be helpful Analyses need to be conducted throughout the transition to enable learning and adaptation. This includes *ex post* evaluations to compare with *ex ante* appraisals Relevant tools are those that deal with risk and uncertainty, and allow for flexibility in decisions
Innovation	Innovation plays a key role in transformative change	Innovation's features (cumulative, highly risky, subject to occasional large discontinuous shifts, systemic) make it challenging to analyse Relevant tools are those that deal with complex (innovation) systems, risk and uncertainty
Path dependence	Past events or decisions may constrain later ones; history matters	(Up to a point or threshold) Historic trends offer some insight about the future Analysts need to consider their own status quo (and other) biases Relevant tools are those about behavioural biases

Source: Author based on various studies including: HM Treasury (2022); Hallegatte, et al. (2012); North (2005); Smith (2006)

3 Tools suited to transformative change

Many analytical tools are relevant to transformative change. Each tool has strengths and weaknesses. Analysts might want to pay particular attention to strategic considerations like the underlying problem definition and case for change, and to think broadly about the range of tools available and which ones to use when.

3.1 The strategic aspects of the policy process are highlighted

HM Treasury's (2022) Green Book, a widely-cited guide to policy appraisal, argued that transformational change is hardly ever brought about by individual projects or programmes, and instead requires strategic portfolios of programmes.[3] Therefore, significant transformational changes need to be researched, appraised, designed etc in the context of the strategic level of the policy decision hierarchy (see Figure 2). This includes a focus on the underlying problem definition and intervention logic, the case for change, assumptions, and anticipated process of change. This focus reflects that a lack of clear problem definition at the strategic stage of the policy process means that any subsequent tool or approach to assess interventions is likely to fail.

Figure 2: The policy hierarchy: The Five Case Model

Source: Author based on HM Treasury (2022)

The Green Book authors identified some tools relevant to transformational change – System Dynamics, Real Options Analysis and Scenario Analysis. Regarding CBA, the authors argued that where social value is not amenable to direct valuation in isolation from the wider strategy, the best approach is to use Cost-Effectiveness Analysis.

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[3] The Green Book contains an appendix about 'transformational change'. While 'transformative' and 'transformational' have similar meanings, we use the former as 'transformative' is generally seen to cause transformation and therefore potentially better reflects active policy processes.

3.2 Some analytical tools seem particularly suited to transformative change

This sub-section considers analytical tools that have specifically been identified as relevant to transformative change. These tools include those suggested in HM Treasury's (2022) Green Book (see above), and some other tools that appear to be most promising and/or have attracted policy attention in the context of transformative change. Essentially, these analytical tools respond to the features of transformative change discussed in section 2 – goal-oriented, future-focused, systemic etc.

The relevant analytical tools are examined in detail in Appendix 2. Table 2 provides a summary. Note that Table 2 is not comprehensive; many other analytical tools, frameworks, techniques etc are likely to be relevant to transformative change.[4]

Also note that Table 2 covers some *general* strengths and weaknesses of each analytical tool. These strengths and weaknesses may or may not be especially relevant in the specific context of transformative change. However, the reason each tool, with the possible exception of CBA which is discussed in detail in section 4, appears in the table at all is because it has been identified in the literature as relevant to transformative change and so has some strengths in this specific context.

Table 2: Analytical tools relevant to transformative change

Feature of transform-ative change	Relevant analytical tools			
	Tool (including brief outline)	**General strengths**	**General weaknesses**	**Relevance to transformative change**
Goal-oriented (includes unintended conseq-uences)	**Multi-Criteria Decision Analysis** (ranks options based on how well they satisfy stated criteria)	Broad scope, flexible, participatory, takes account of wide-ranging (incommensurable) impacts	May lack transparency, stakeholders may exert undue influence, subject to arbitrary weights	Appraise policy options where impacts are hard-to-quantify/ monetise eg climate change policy
	Cost-Effectiveness Analysis (identifies least-cost options for achieving a defined benefit/ goal)	Avoids monetising benefits, simple, fairly easy to use	Ignores wide-ranging benefits	Appraise policy options where there is a pre-defined goal eg reducing greenhouse gas emissions
	Cost-Benefit Analysis (quantifies the benefits and costs of a policy)	Well proven, systematic, uses a common metric, takes account of unintended consequences	Seeks to 'price the priceless', ignores equity considerations, overplays monetisable impacts	Appraise policy options, especially where impacts are quantifiable/ monetisable

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[4] Note that the tools selected are generic ones. They therefore exclude specific tools and approaches like the Social Investment approach of the previous National coalition government.

Long-term and future-focused	Scenario analysis (describes alternative ways the future might unfold)	Broadens decision-makers' thinking, can help identify blind-spots/ disruptive change	Qualitative processes may be hard-to-reproduce/ opaque	Understand the future policy context
Systemic	System Dynamics (models complex dynamic systems)	Allows decision-makers to experiment/ understand complex systems	Complex, opaque to outsiders	Understand complex systems
Risk and uncertainty	Real Options Analysis (per CBA but incorporates risk/uncertainty)	Similar to CBA but incorporates risk/ uncertainty, takes account of timing and flexibility of investment decisions	Similar to CBA but more complex/data intensive	Appraise policy options in the face of risk/ uncertainty eg large infrastructure projects
	Portfolio Analysis (analyses portfolios based on risk/ return or other objectives)	Considers options in combination, can provide a structured way of spreading risk	Can be challenging to identify a simple objective function, or (if the objective function is complex) has high information needs	Appraise a range of policy options in combination in the face of risk and uncertainty
	Robust Decision Making (analyses multiple strategies over multiple future scenarios)	Allows decision-makers to test different strategies/ scenarios, combines qualitative (participatory) and quantitative data	Formal application has high information needs and may be time consuming and costly, otherwise may be subjective	Appraise policy options in the face of risk/ uncertainty
	Risk-Opportunity Analysis (assesses the risks and opportunities of a policy)	Explicitly considers opportunities (including from innovation), otherwise similar strengths to Multi-Criteria Decision Analysis	New, unproven, otherwise similar weaknesses to Multi-Criteria Decision Analysis	Appraise policy options in the face of risk/uncertainty
Innovation	See tools in 'systemic' and 'risk and uncertainty' rows			
Path dependence	Behavioural insights (uses insights about human behaviour to assess/influence individual choices)	Draws from a range of disciplines, combines qualitative/ quantitative techniques, more realistic than 'rational' behaviour	One of the main techniques ('nudging') may be seen as paternalistic/ manipulative	Fine-tune and improve policy implementation and compliance, plus could be used for problem definition

Source: Author based on a range of studies including: Browne and Ryan (2011); Watkiss, Hunt, Blyth and Dyszynski (2014)

3.3 All analytical tools have strengths and weaknesses

Table 2 highlights that each of the analytical tools identified has strengths and weaknesses. There is no panacea.

For example, Multi-Criteria Decision Analysis is often seen as an alternative to CBA for option appraisal when impacts are not easily quantifiable. But Multi-Criteria Decision Analysis is criticised for being subjective, lacking transparency and suffering from arbitrary weights (Watkiss, et al. 2014; Treasury 2015). Similarly, Robust Decision Making is a tool which at first blush seems highly suited to transformative change, but this tool tends to be very time consuming and costly (Hallegatte, et al. 2012).

When assessing the strengths and weaknesses of each analytical tool, it is worth noting that most studies about analytical tools tend to advocate for (or against) a specific tool, rather than discuss the tool's practical use in decision-making. Even case studies of historic transformations tend to apply the preferred tool retrospectively. In general, it is not clear which tools were actually used to inform decisions about major economic transformations at the time decisions were made. This probably reflects that decision-making is a complex, political process involving a blend of evidence and judgement (see section 5).

For example, Mercure, et al. (2021) examined case studies of low carbon transformational policies in Brazil, China, Europe, India and the UK. The authors argued that these case studies provide support for Risk-Opportunity Analysis, and against CBA. However, Risk-Opportunity Analysis was not actually used to inform key decisions about these policies, and it is not clear about the extent to which CBA was either, or indeed which tools *were* actually used. Having said that, the authors do offer some insights into the decision-making processes. In the case of offshore wind technology in the UK, the authors commented that decisions were made on the basis of strategic considerations. In the case of the wind energy sector in Brazil, there is evidence to show that the Brazilian Development Bank used a portfolio approach.

The fact that there is no silver bullet analytical tool suggests that, for a complex and large-scale policy issue like transformative change, there may be a need to draw from a comprehensive toolbox and triangulate evidence from a range of different sources. However, such an approach is likely to be resource-intensive and costly; the benefits of any broadening of the toolkit and evidence base need to be weighed against the costs.

3.4 Different tools are relevant in different contexts

Hallegatte, et al. (2012) commented in the context of investment under deep uncertainty that no single analytical tool is appropriate across the board. Instead, a menu of methods is needed. We considered the suitability of different analytical tools to different contexts, partly based on Watkiss, et al. (2014):

- those that can be used **early** in the policy process (eg Scenario Analysis, System Dynamics and possibly Risk-Opportunity Analysis), and those relevant once specific options have been identified (many of the others)

- those that cover **portfolios or multiple programmes** (eg Portfolio Analysis), and those focused on appraising specific projects and policy options (eg CBA, Cost-Effectiveness Analysis, Real Options Analysis and others)

- those that have greater **flexibility** in their applicability (eg Multi-Criteria Decision Analysis and Risk-Opportunity Analysis), and those that require economic valuations (CBA, Cost-Effectiveness Analysis and Real Options Analysis)

- those focused on satisficing and that seeks decisions **likely to perform well over a wide range of plausible futures** (eg Scenario Analysis and Robust Decision Making), and those focused on optimisation (eg CBA and Cost-Effectiveness Analysis)

- among (the growing set of) risk/uncertainty tools, those that are **risk-sensitive** requiring estimates of probability (Real Options Analysis and Portfolio Analysis), and those where probabilistic information is low or missing (eg Robust Decision Making).

The key implication overall is to carefully consider the selection, mix, and weighting of tools. One example of a blended approach is that being adopted by the Ministry of Transport in its new value for money model (see Beca and HKA 2022). This model uses various qualitative and quantitative measures of efficiency and effectiveness to determine value for money. The Ministry of Transport has also used a Generational Investment Approach, broadly based on Multi-Criteria Decision Analysis (Ministry of Transport Forthcoming).

3.5 There seems to be a need to broaden the toolkit

Some of the tools in Table 2 are new and therefore have not been used much to date. One example is Risk-Opportunity Analysis, recently developed by the Economics of Energy Innovation and System Transition (EEIST) in the UK (see: Mercure, et al. 2021; Grubb, et al. 2021). This tool is attracting policy attention in New Zealand and elsewhere, and is one of the few that considers both opportunities as well as risks. While this tool is relatively untested, it may be worth exploring.

As well as using new tools, greater use could be made of existing ones. Some promising-looking existing tools appear not to have been used much in policy in general, let alone specifically for transformative change (see Appendix 2). Examples include Robust Decision Making, System Dynamics and Portfolio Analysis, all of which seem relevant to transformative change. However, there may be good reasons for their lack of take-up. It would be useful to better understand barriers to the uptake of some of these tools.

Overall, there seems to be a need for analysts to broaden their horizons when considering the selection of relevant analytical tools. Our engagement with agencies identified a seeming lack of awareness of the range of analytical tools potentially relevant to transformative change, and deeply-held views on specific analytical tools. This suggests a possible need to strengthen analytical capability and encourage pluralism in the use of analytical tools (see section 5).

3.6 The selection and use of analytical tools should uphold te Tiritii

Under the Public Service Act (2020), the public service must support the Crown in its relationships with Māori under te Tiriti o Waitangi by developing and maintaining the public service's capability to engage with Māori and to understand Māori perspectives. Here we consider some relevant considerations for analyses about transformative change.

Treasury's (2022) CBAx guidance briefly refers to He Ara Waiora (Treasury's framework about Māori perceptions of wellbeing), [5] as well as the Living Standards Framework. The guidance suggests that these frameworks can help identify wellbeing impacts to be included in CBA. However, some CBA practitioners (see for example Clough and Bealing 2022) argued that none of Treasury's frameworks are yet at the stage of easy operationalisation, and even if they could be readily and consistently applied, there would still be a process of translating Māori values and preferences into economic values to give Māori values due weight. Clough and Bealing (2022) commented that incorporating Māori perspectives is a much bigger task than mere valuation – it is an issue that goes to the heart of how economists think about research.

Some of these tensions are highlighted in Sense Partners' recent report for MBIE (see Eaqub 2022). Eaqub identified commonalities and differences between Ngāi Tūhoe (Tūhoe)'s interpretation of the economy and other 'orthodox' approaches like the Treasury's Living Standards Framework.

The key differences for Tūhoe are:

- Greater focus on **collective** aspects. Greater acknowledgement of history and future generations, meaning the collective is across space and time.

- The future is **not discounted**. We value decisions for how they affect us, rather than how decisions today affect future generations. While we stand at today and look forward, Tikanga asks us to look back from 100 years out. Time has a different meaning, with implications for prioritisation of actions.

- Hierarchy of rights appears inverse, with greater focus on responsibilities/stewardship. The latter is supported though a different **culture and spirituality** vs legal limits.

- Potentially less **fungibility** of trade-offs within economy (cannot pollute then restore), using sanctity/spirituality.

- Not a flow perspective (Profit & Loss in accounting speak) but a **stock** (Balance Sheet) one.

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[5] https://www.treasury.govt.nz/information-and-services/nz-economy/higher-living-standards/he-ara-waiora

Eaqub (2022) concluded that: "Using a formula, rather than programme, approach to investments made through this [Tūhoe and Crown] relationship would enable Crown agencies to explore how prioritisation and decision-making is applied through a Tūhoe Tikanga lens. This home-grown understanding may lead to further evolution of orthodox models such as the Living Standards Framework, and shed insights into alternative approaches to cost benefit analysis for assessing policies that support transformative change". This implies an opportunity to better understand how Tūhoe uses the principles above in the iwi's decision-making, in order to provide insights for analytical tools tailored to New Zealand.

Somewhat similarly, Reid (2021) found that Māori thinking offers a lens to think differently about trade-offs in budgeting processes. The author argued that Māori approach to wellbeing offers a holistic perspective that encourages budget expenditure decisions that generate increasing flows of symbiotic 'gifting' from one capital stock to others based on an intergenerational time horizon. However, it is not clear from the analysis how this might work in practice.

The main implication is that more work is likely to be required to make analytical tools align with te ao Māori and support te Tiriti. New analytical tools may be needed. An example of a somewhat similar tool is Kapasa, the tool developed by the Ministry for Pacific Peoples (2021). Kapasa is based on a generic policy process but includes three overlays: 1) Pacific peoples' information and evidence, 2) Pacific peoples' values, strength and diversity and 3) Pacific peoples' engagement.

In the meantime, Western analytical tools that are broad in scope and well placed to incorporate wide-ranging Māori perspectives and values, such as Multi-Criteria Decision Analysis, seem relevant to transformative change. Also important is the weighting given to different tools and types of evidence, as monetary valuations per CBA tend to elevate Western values (Clough and Bealing 2022).

4 Cost-benefit analysis

CBA is a policy appraisal tool for comparing policy options in terms of their efficiency impacts. At its core, CBA is about measuring the benefits and costs of a policy, based on individual preferences, using money as the key metric. While CBA is a very valuable analytical tool in general, it has some specific limitations in the context of transformative change.

4.1 CBA is the main analytical tool for comparing policy options

CBA is the primary method for comparing policy options in terms of their efficiency impacts (Vining and Weimer 2006), and is generally seen as the dominant method of evaluation of policies in developed economies (Abelson 2022; Martens 2011; Mercure, et al. 2021).

CBA is used at the option appraisal stage of the policy cycle. CBA compares the benefits and costs associated with a policy. Benefits and costs are defined in terms of changes in human welfare or utility and are measured by individuals' willingness-to-pay for a benefit and willingness-to-accept a cost (Hwang 2016). If benefits exceed costs, the policy is potentially worthwhile.

The theory behind CBA is welfare economics and economic efficiency. CBA is based on the concept of Pareto efficiency – the allocation of resources is said to be 'Pareto efficient' if it is impossible to make someone better off without making anyone else worse off (Vining and Weimer 2006). The Kaldor-Hicks compensation principle extends this idea and states that a change increases social welfare if the winners could in theory compensate the losers. Individuals' preferences are revealed through markets, with money being used to measure willingness to pay. Key assumptions of CBA include that the sum of individual utilities should be maximised and that it is possible to trade off utility gains for some people against utility losses for others (Vining and Weimer 2006).

CBA is fundamentally a partial equilibrium approach, which means that analysis is generally undertaken on a single market (and closely related markets where relevant) and secondary (or indirect) effects in the wider economy are ignored. This is relevant in the context of transformative change, where the 'everything else held constant' assumption in partial equilibrium analysis is unlikely to hold true.

In simple terms, CBA involves (Jensen 2019, cited in Jensen and Thompson 2020):

- identifying impacts (benefits and costs) widely, including establishing a clear 'counterfactual' (what would happen in the absence of the intervention)

- quantifying impacts to the extent possible, relative to the counterfactual

- monetising the significant impacts where possible.

However, CBA can be operationalised in many different ways. Considerations include the extent to which non-monetary or qualitative data and analyses are included, and whether or not other tools are integrated into CBA. In New Zealand, CBA can be operationalised through the use of Treasury's CBAx tool, discussed further below. But government agencies and other organisations undertake CBA in a variety of ways. This variation probably reflects CBA's long history and evolution over time (Abelson 2022).

4.2 There are wide-ranging views on the pros and cons of CBA

There is a very wide literature on the *general a*dvantages and disadvantages of CBA. Building on Table 2, we cover a few of the main arguments here.

Proponents of CBA argue that it is a long-established, well-proven tool with strong theoretical underpinnings (see for example: Treasury 2015; Dobes, Leung and Argyrous 2016). The process of undertaking a CBA requires policymakers to be systematic and robust in their policy thinking (Jensen and Thompson 2020). Using a common metric – money – allows different types of costs and benefits to be aggregated. Allocating costs and benefits through time and discounting them reflects society's time preferences and allows impacts to be translated to a single time period. Analysing the full range of impacts helps identify unintended consequences. Taking account of the opportunity cost of a policy recognises the trade-offs involved and helps ensure the best possible use of limited public resources.

General criticisms of CBA range from ethical to practical ones (see for example: Lave 1996; Ackerman and Heinzerling 2002). Some object to CBA on philosophical and ethical grounds – that CBA seeks to 'prices the priceless' and/or is fundamentally inequitable. On the latter, through its emphasis on market transactions, CBA implicitly weights more heavily those who spend more, and may exclude groups like volunteers and future generations. Other critics question the practical challenges of CBA, in particular regarding the meaningful valuation of non-market goods.

Similarly, our discussions with agency colleagues revealed wide-ranging perspectives, and deeply-held views, on CBA, both in general and regarding transformative change. At one end of the spectrum, some contend that CBA has many advantages, there are many techniques and add-ons to remedy the limitations of CBA in the context of transformative change, and CBA is much superior to (unproven) alternatives. At the other end of the spectrum, some question the underlying economic paradigm within which CBA fits and argue that this paradigm has contributed to existential problems like climate change and biodiversity loss.

These arguments raise important questions about societal – and analytical – values. CBA elevates values relating to efficiency, markets, and quantitative analysis. The primacy of these values is questioned by Mazzucato (2021), Raworth (2012) and others, and warrants further debate. Such a debate, while worthwhile, is outside the scope of this present paper.

4.3 CBA has significant limitations in the context of transformative change

Building on some of the general points above, some specific limitations of CBA have been identified in the context of transformative change (see for example: Mercure, et al. 2021; Smith, McDonald and Harvey 2016; UCL Institute for Innovation and Public Purpose 2020; Sharpe, et al. 2020).

Probably the main limitation of CBA in the context of transformative change is that CBA tends to be **status quo-biased**. Arguments include that CBA:

- through the use of discounting and related considerations, focuses on net present value rather than future value

- tends to analyse marginal changes to the underlying system rather than major ones

- tends to impose a constant structure on the economy, and so is of limited use in assessing major structural change

- tends to be static rather than dynamic, and so may underplay the benefits of innovation for example

- like many other analytical tools, uses historic data, which is less relevant if the future looks quite different to the past

- tends to assume business as usual, and so does not capture the changing economic context or the potential role of government in active market shaping.

CBA's inherent status quo bias has been noted in relation to climate goals in particular. For example, the Parliamentary Commissioner for the Environment argued that the use of discount rates in CBA potentially distorts the appraisal of environmental initiatives whose benefits tend to accrue over longer timeframes. In the UK, EEIST suggested that policies that supported recent transitions to clean energy technologies were generally implemented despite, not because of, the predominant economic analysis such as CBA (see Mercure, et al. 2021).[6] A key reason for this conclusion is CBA's status quo bias, including that the benefits of innovation tend to be under-estimated.

A second limitation, which is especially relevant to transformative change focused on environmental goals, is that **CBA tends to underplay important non-monetary impacts**. One issue is what is known as the McNamara Fallacy – or more formally, the quantitative fallacy – the risk of according "'what can be counted' more weight than 'what may count'" (Grubb, et al. 2021). For example, the Parliamentary Commissioner for the Environment (2021) argued that, given the challenges of measuring environmental impacts, it is very likely that more direct, quantifiable and monetisable impacts will be more persuasive. Another issue is the inherent incommensurability of some impacts. For example, the diverse values of nature can be measured using a wide

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[6] Note that EEIST does not make it clear about the extent to which CBA was or was not actually used in the UK's decision-making about clean energy technologies.

range of biophysical, monetary and socio-cultural indicators, but these indicators are challenging to combine (Pascual, et al. 2022).

A third limitation is the relatively **narrow scope** of CBA, which tends to be on individual projects or investments or on minor regulatory changes. CBA may therefore fail to identify the potential of a sum of multiple projects, or a policy mix, to collectively achieve the overarching strategic objective of transformative change (see for example Grubb, et al. 2021).

Note the use of the words 'tends to' in the limitations above. This reflects that these limitations are generally based on the core principles and features of CBA. However, proponents of CBA argue that the limitations above are not insurmountable and that CBA can be operationalised in ways to overcome them. For example, CBA does not necessarily have to be applied to small or marginal decisions, but can equally be applied to any decisions, no matter how transformational or wide in scope. Some modelling techniques like Dynamic Computable General Equilibrium models can be used to bring in a dynamic and whole-of-the-economy element to CBA. A range of techniques are available to account for impacts for which there are no market prices, reflecting that much practical policy-related CBA is about trying to measure externalities, where markets fail, or non-market outcomes. Some relevant techniques are discussed below.

Also note that CBA is not the only analytical tool which has limitations in the context of transformative change. Many of the tools discussed in section 3, like CBA, use backwards-looking data. Few tools are able to incorporate dynamic effects and tipping points etc. This highlights the inherent uncertainty of transformative change and that it is extremely challenging to analyse in advance.

4.4 Treasury's CBAx tool has some features relevant to transformative change

New Zealand agencies are expected to undertake *ex ante* CBA in a regulatory impact assessment for legislative change, a business case, a budget funding proposal, and as required by governing legislation (eg for resource management policies) (Jensen and Thompson 2020).

But, in New Zealand and elsewhere, the use of CBA is patchy (Dobes, Leung and Argyrous 2016) and compliance is low (Sudiana 2010). This partly reflects data, time, and resource constraints, as well as political or policy concerns (Abelson 2022). Some New Zealand agencies have undertaken CBA for many years, for example, in the transport sector (Dobes, Leung and Argyrous 2016). But in other agencies the use of CBA is more limited and/or more variable.

To help New Zealand agencies conduct CBAs, Treasury has developed the bespoke CBAx tool including guidance on how to undertake a 'Social' Cost Benefit Analysis (see Treasury 2022). CBAx is a spreadsheet model with a database of values to monetise impacts, including environmental values and subjective wellbeing values (WELLBYs).

While these dollar values are useful for aggregating impacts, it is important to know how they are derived, as this provides much of the value of the exercise; some agencies suggested this is currently unclear.

Key features of CBAx in the context of transformative change include that guidance:

- suggests that wellbeing impacts can be identified using the Living Standards Framework and Treasury's Māori wellbeing framework, He Ara Waiora

- encourages the identification of a wide range of impacts – those that can be monetised, those that can be quantified, and those that cannot

- identifies approaches that derive monetary values for people's willingness to pay or accept an impact, or reverse analysis (discussed further in the next sub-section)

- provides some guidance on distributional analysis which looks beyond CBA's standard approach of addressing the question: *Who gains and who bears the costs of the proposal?*

- encourages the use of sensitivity analysis and ranges eg the use of sensitivity analysis to test assumptions for non-monetised impacts in order for an initiative to break-even

- uses a 5% default discount rate and 2% for sensitivity analysis.

4.5 Some techniques may make CBA more suited to transformative change

One option to improve analyses to support transformative change is to think about CBA slightly differently to normal and make greater use of techniques that make CBA more suited to transformative change.

1. **Lower discount rates and consider the time horizon of impacts.** Transformative change involves impacts with a long time horizon. Discounting is the rate at which society is willing to trade off present for future benefits – a high (low) discount rate prioritises present (future) benefits. In theory, the discount rates used in CBA can be zero or even negative in order to prioritise the future.[7] However in practice, the default discount rate in CBAx is 5% which is at the high end of the spectrum, and, unlike many countries, New Zealand does not have a separate (lower) discount rate for long-term investments (Parliamentary Commissioner for the Environment 2021). Also important is the time horizon over which impacts are estimated and how discount rates are applied through time.

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[7] There are two broad ways in which to think about discount rates for climate change and other investments with long time horizons – one which assumes that such investments must compete with those in other areas and which yields a high rate (see Nordhaus 2006), and one which argues from a philosophical standpoint to treat all generations equally and which yields a low rate (see Stern 2006).

2. **Use non-market valuation methods.** As noted above, CBA may underplay non-market (non-monetary) benefits and costs which may be the focus of transformative change. Treasury's (2022) CBAx guidance identifies relevant techniques to help address this issue. These techniques include revealed preferences (uses market data eg housing and labour market to derive a value for noise pollution), stated preferences (uses surveys of willingness to pay) and subjective wellbeing (uses big data sets to derive coefficients for changes to reported life satisfaction). These techniques have been around for a while but tend not to be used that often in New Zealand. Reasons include concerns about the usefulness of these techniques, and that studies tend to derive localised estimates that are not readily generalisable (Clough and Bealing 2018).

3. **Use reverse or break-even analysis**. Another approach for tackling hard-to-monetise benefits is to use reverse analysis. A reverse analysis means approaching CBA from the viewpoint of 'what would it take to make the proposal worthwhile?' or generate a return on investment of one with societal benefits outweighing costs (Treasury 2022). In its CBAx guidance, Treasury advocates for the use of reverse analysis when very little information or evidence is available. However, reverse or break-even analysis tends not to be used much in practice in New Zealand agencies (Hogan, Clough and Yeabsley 2018).

4. **Rethink 'BAU'.** Transformative change tends to be based on the assumption that, even in the absence of intervention, the future is uncertain and likely to look quite different to the past. However, CBA tends to be based on a comparison with 'BAU'/the status quo or a consideration of past trends as the counterfactual. Instead, analyses need to reflect the inherent uncertainty of transformative change, via the use of sensitivity analysis and ranges for example. One approach suggested by the New Zealand Infrastructure Commission (2022) as part of feasibility studies (broadly CBA) is that agencies should analyse how infrastructure will perform under a range of future scenarios, reflecting that infrastructure investment involves long-term planning. Similarly, scenario approaches have been embedded in the Dutch approach to CBA to respond to uncertainty arising from impacts with long time horizons (O'Mahony 2018). Another approach is to use Monte Carlo Analysis, a technique to quantitatively characterise the uncertainty and variability in estimates of exposure or risk, and identify key sources of variability and uncertainty. However, Monte Carlo Analysis tends to be under-utilised in CBAs (Abelson 2022).

5. **Weight relevant non-monetised benefits more heavily.** Treasury's CBAx guidance suggests that the full range of impacts be covered, including those that are hard-to-monetise or hard-to-quantify such as environmental ones. If the focus of transformative change is on such impacts, then this suggests that analysts should weight them more heavily in CBA write-ups and de-emphasise easy-to-monetise but less relevant impacts.

The points above highlight that while many techniques are available for making CBA more suited to transformative change, and while some agencies indicated that they use them, some of the techniques tend not to be used much in practice. This possibly

suggests a need to lift capability to conduct CBAs. But there may be other reasons/barriers for the lack of uptake and it would be useful to understand them.

Critics of CBA question the extent to which these techniques can meaningfully address the limitations of CBA in the context of transformative change (see for example: Spash and Hache 2022; Pascual, et al. 2022). For example, while a CBA may include non-monetised and qualitative information, this information may not be seen by decision-makers on a level footing to 'hard' monetary or quantitative data. This reflects that the core principles of CBA are measuring the gains and losses to individuals in society, based on individual preferences, using money as the measuring rod (Abelson 2022).

4.6 Overall, we conclude that analysts should question whether CBA is the most suitable tool in this context

All analytical tools have limitations and analysing transformative change is hard. However, CBA seems ill-suited to transformative change. For example, HM Treasury (2022) stated that CBA "is a 'marginal analysis' principally employed to consider changes between alternative options, and compare alternative options based on a static model of the world". If fundamental relationships in the economy are changing, CBA may not be suitable and may in fact work to preserve existing economic structures. While CBA can be operationalised in ways to help remedy this, at its core the broad goal of CBA is static allocative efficiency, whereas the goal of transformative change is dynamic effectiveness (Sharpe, et al. 2020). Other analytical tools may be more suited than CBA to option appraisal regarding transformative change.

We therefore conclude that, broadly speaking, the more transformative the policy, and the less amenable the impacts to monetisation/quantification, the more that CBA's role should be questioned.

5 General considerations

Policy decision-making is an idiosyncratic, social, and political process relying on a blend of evidence and judgement. Improving analyses to support transformative change might involve carefully considering the weighing given to different analytical tools and types of evidence (including who has standing in the analysis), increasing transparency of analyses, and lifting analytical capability.

5.1 Recognise the role of analyses in the decision-making process

Section 3 highlighted that it is challenging to determine which analytical tools have actually informed policy decisions about transformative change. To shed further light on this issue, it is constructive to consider the findings from studies that have considered the practical role of analytical tools in the policy process. These studies include overseas ones (see: Mouter 2017; Hallegatte, et al. 2012; Mouter 2017) and New Zealand ones (see: Dobes, Leung and Argyrous 2016; Jensen and Thompson 2020). These studies generally involved interviews or surveys of politicians and senior decision-makers, and mainly related to CBA and the policy decision-making process in general rather than specifically about transformative change. Common themes include:

- **A lack of use of analytical tools in decision-making**. This includes a lack of analyses per se (eg CBAs not being undertaken on important decisions), and, when analyses are undertaken, a lack of their actual use in decisions. Decision-makers may instead prefer to form their opinions based on conversations and on intuitive heuristics developed from experience.

- **Tools not being used appropriately.** This includes a lack of transparency in how CBAs are used and reported, and decision-makers disagreeing with normative choices made by analysts.

- **A lack of capability.** This includes a lack of capability to both undertake and utilise CBAs, and weak analytical capability more generally within agencies. As noted above, while some agencies have extensive experience in conducting CBAs, others do so infrequently and so struggle to build capability.

- **The use of analyses to justify decisions that have already been made.** For example, politicians may use CBAs as 'political ammunition' or to make themselves and their decisions look more rational. CBAs may be received too late in the decision-making process to influence decisions in a material way. By the time analyses are undertaken, key decisions may have already been made and options already eliminated.

These findings highlight that policy decision-making is an idiosyncratic, social, and political process relying on a blend of evidence and judgement. The point about using analyses to justify decisions already made emphasises the importance of the principles of free and frank advice and political neutrality in the Public Service Act (2020). To exert influence in the decision-making process, analysts need to provide early and well communicated advice and be clear about the analytical choices they have made; this requires strong capability. One of the aims of early advice is to keep as many options open as possible, as there seems to be a tendency for decision-makers to quickly close down on preferred options. Keeping options open is especially relevant to policy around transformative change, as transformative change evolves over a long period of time and involves considerable uncertainty.

5.2   Consider the weighting of evidence and who has standing in the analysis

The previous sections have highlighted the importance of considering the relative weight given to different tools and different types of evidence.

The weighting of evidence is discussed in a recent study about valuing nature (see Pascual, et al. 2022). The authors argued that a restricted set of values of nature, as currently used in policy decision-making, has contributed to climate change, biodiversity loss and other environmental degradation. Putting sustainability at the heart of decision-making would require i) reducing the dominance of values related to individualism and materialism, while mobilising values that are consistent with living in harmony with nature; and ii) reducing the dominance of market-based (or monetary) values, while mobilising relational, intrinsic and non-market values. Doing this would involve addressing power asymmetries, including giving more emphasis to the values of indigenous communities. This seems relevant to New Zealand in terms of incorporating perspectives from te ao Māori and mātauranga Māori, as well as drawing on narratives and qualitative data which tend to be favoured by Māori.

An important consideration therefore is: who has standing in the analysis? The recent review of Pharmac (see Pharmac Review Panel 2022) provided an interesting example. Pharmac currently uses cost-utility analysis (broadly similar to CBA but with benefits measured in quality-adjusted life years rather than money) in its decision-making. The Review Panel found that this approach means that equity considerations are not given due weight in Pharmac's investment decisions, resulting in inequitable outcomes for Māori, Pasifika, disabled people and other groups. The Review Panel's recommendations included that Pharmac should develop an integrated analytical framework that incorporates enhanced CBA with strengthened distributional elements and strengthened equity analysis.

The key implication is to weight more heavily analytical tools most relevant to transformative change per section 3. Also important is incorporating a broad range of evidence, ideas, analyses etc, and considering who has standing in particular tools and types of evidence.

5.3 Increase transparency of analysis

The importance of transparency comes through strongly in assessments of different analytical tools and of studies about the decision-making process. Being clear about data inputs, assumptions, and how critical choices and judgements have been made, is vital to provide confidence in analyses. These assumptions and judgements need to be clearly documented to assist decision-makers (Babian, et al. 2021).

Transparency is often seen as a benefit of quantitative tools such as CBA, and a weakness of tools based on qualitative data and stakeholder input such as Multi-Criteria Decision Analysis. But this is not a given. CBAs can lack transparency if assumptions etc are not clear, and qualitative methods can be carefully explained to increase their transparency.

The implication is that, whatever tool is being used, the approach should be clearly explained. Transparency is important in general, but especially for a complex area like transformative change.

5.4 Lift capability

Some studies have raised concerns about a lack of capability in New Zealand to select and use appropriate analytical tools (see for example: Dobes, Leung and Argyrous 2016; Jensen and Thompson 2020), albeit not specifically in the context of transformative change.

For example, NZIER was commissioned by the Treasury to review the quality of advice provided by agencies to support 50 budget initiatives from 2015-2018 (see Hogan, Clough and Yeabsley 2018). NZIER found that the quality of advice improved following the introduction of CBAx. However, NZIER also found that agencies needed more support in the use of CBAx. Examples most relevant to transformative change included more support for break-even or reverse analysis which can be employed in place of a CBA using uncertain values.

The wide-ranging analytical tools relevant to transformative change tend to be advanced ones, reflecting that transformative change is at the challenging end of the analytical spectrum. This raises questions about how a small country like New Zealand can develop deep capability across the full span of tools. Considerations include: 'make' v 'buy' expertise?; specialise in specific tools by agency, or build capability across agencies?; build New Zealand capability or draw from overseas? These are perennial considerations, but they seem especially relevant to a complex and multi-faceted area like transformative change.

In addition, we found strongly-held views among agencies about specific analytical tools, and that some seemingly-useful tools and techniques may be under-utilised. This suggests that encouraging pluralism, innovation and learning in the use of analytical tools may be a key component of capability building. However, encouraging pluralism is not without risks. Investing in capability across a range of tools is likely to be resource-intensive and costly, and risks doing many things poorly rather than one thing well.

5.5 Exert strong judgement

Strong judgement is needed for analysing an ambiguous area like transformative change. For analysts, judgements include ones about the choice of analytical tools and frameworks, the weighting given to different types of evidence, and the interpretation of the evidence base.

Leadership is needed around policy for transformative change, as transformative change involves dealing with the unknown and relying on incomplete information. To a certain extent, taking action will require a leap of faith or taking a bet. While this is mainly the purview of politicians, analysts can also show leadership in the advice they provide.

One New Zealand example of such leadership is the rollout of ultra-fast broadband (UFB). The large spend was approved despite no CBA being undertaken, and instead was informed by a number of other analyses including from overseas.[8] The decision was made on the basis of trying to get ahead of competing countries and in recognition of the transformational impacts of UFB. Subsequent research has found that the adoption of UFB is positively associated with exporting behaviour (Sanderson, Wright-McNaughton and Yashiro 2022), and, when combined with complementary measures, with firm productivity (Fabling and Grimes 2016).

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[8] https://www.nbr.co.nz/no-treasury-cost-benefit-analysis-of-ufb-joyce/

6 Conclusions

Improving analyses about transformative change might involve broadening the policy analytical toolkit, weighting more heavily tools most suited to transformative change, and improving analytical capability. This reflects that the scale and complexity of transformative change probably warrants the use of diverse analytical tools. Analysts might consider the full array of analytical tools at their disposal, which tools are relevant when, and the weighting given to different tools and evidence.

The Green Book's advice to pay particular attention to the strategic aspects of the policy process seems sensible. Early engagement with decision-makers on these strategic aspects helps keep as many options in play as possible, and so paves the way for meaningful analyses of options. Focusing on the strategic parts of the policy process involves thinking broadly about the underlying problem (or opportunity), and carefully explaining the case for change and assumed process of change.

CBA may be used to appraise options once these strategic aspects have been analysed. But overall, the findings in this paper imply that analysts might want to question whether CBA is the most appropriate analytical tool in the toolkit for informing policy decisions about transformative change. This reflects CBA's major limitations in this specific context. While these limitations may be remedied to some extent, other tools may be more relevant than CBA to option appraisal in this context. And some other tools are relevant to other early parts of the policy cycle about transformative change, such as tools which help imagine alternative plausible futures, understand complex systems and assess risk and uncertainty. These tools could be upweighted.

Greater long-term investment in analytical capability might be needed for policymakers and analysts to become more familiar with, and possibly use, new or under-utilised tools. Greater investment might also be needed in developing or refining the underlying tools themselves, especially regarding tools that reflect te ao Māori, as this is a widely recognised gap. Encouraging pluralism and innovation might also be helpful, as perspectives on specific analytical tools seem to be deeply held.

However, there may be some shorter-term opportunities to improve analyses about transformative change. These opportunities include:

- investigate which analytical tools have proven most practically useful in progressing Europe's climate change policy, as this is not clear from the literature

- work with iwi to better understand their decision-making processes, as this could provide insights into developing analytical tools that reflect te ao Māori

- explore new tools such as Risk-Opportunity Analysis which are attracting policy attention

- lower discount rates in CBAx guidance, and/or introduce a separate discount rate for long-term investments as used in many other countries, to prioritise future impacts.

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Appendix 1: Agencies involved in this paper

We thank colleagues from other agencies who provided input in meetings and in feedback on an earlier draft of this paper. The agencies involved were:

- Treasury
- Ministry of Transport
- Ministry for the Environment
- Productivity Commission
- Ministry for Primary Industries
- Ministry of Social Development
- XRB

Appendix 2: Specific analytical tools

This Appendix considers in more detail the analytical tools to support transformative change discussed in this paper.

Multi-Criteria Decision Analysis (MCDA) is useful for filtering policy options before applying more detailed quantitative analysis, or to compare options where impacts are not easily quantifiable (Infrastructure Australia 2021). MCDA is a participatory approach which involves 1) a given set of alternatives provided by the decision-maker; 2) a set of criteria for comparing the alternatives; 3) the assigning of weights to criteria; and 4) a method for ranking the alternatives based on how well they satisfy the criteria (Browne and Ryan 2011).

One of the main benefits of MCDA is its broad scope – it enables decisions to be considered against broad criteria and it can include a broad range of impacts (Watkiss, et al. 2014). Other benefits of MCDA include its flexibility (eg ability to combine quantitative and qualitative data and include hard-to-monetise and incommensurable impacts), its multi-disciplinarity approach, and its strong involvement of stakeholders (Browne and Ryan 2011). Criticisms of MCDA include that it is not sufficiently rigorous, the assumptions are often not available and so it lacks transparency, and stakeholders may exert strong influence in the development of the criteria, associated weighting and subsequent analysis (Watkiss, et al. 2014).

MCDA is a well-established and widely used tool. It is increasingly used for decision-making in environmental policy evaluation due to the complexity of issues and MCDA's ability to capture the full range of impacts (Browne and Ryan 2011). For example, MCDA has been fairly widely used in in climate change adaptation policy (Lamichhane, et al. 2021). As well as environmental policy, MCDA has also been used in public health and infrastructure decisions (Gampera and Turcanu 2007). In New Zealand, MBIE and other agencies indicated that they use MCDA for regulatory changes and in other policy work, especially when CBA is deemed to be not feasible.

In the context of transformative change, MCDA is relevant to assessing alternative policy options to support transformative change, especially when the goals and impacts are hard-to-monetise or quantify such as environmental ones.

Cost-Effectiveness Analysis (CEA) is an economic evaluation tool to identify least-cost options for achieving a pre-defined goal or output (Browne and Ryan 2011). CEA involves estimating all the costs (but not the benefits) of alternative options.

The key strength of CEA is its applicability where monetary valuation of benefits is difficult or contentious (Watkiss, et al. 2014). Other benefits of CEA include that it helps decision-makers rank options, is fairly easy to use, and can be used as an efficiency criterion when combined with other non-efficiency approaches (Browne and Ryan 2011). Its main weakness is in situations where benefits are wide-ranging or where identifying a highly-specific common goal is challenging. Other weaknesses are similar to CBA eg narrow and static focus.

CEA is a fairly widely used tool and has become the main appraisal method for greenhouse gas mitigation (Watkiss, et al. 2014).

In the context of transformative change, CEA is relevant to assessing alternative policy options aimed at a single goal. CEA is an alternative economic evaluation tool to CBA when the focus of transformative change is on hard-to-monetise benefits.

System Dynamics is a simulation modelling approach, originally drawn from engineering concepts, for understanding the behaviour of complex dynamic systems. System Dynamics involves causal mapping, the development of computer simulation to understand system behaviour, and the testing of policy and scenario options to answer 'what-if' questions (Currie, Smith and Jagals 2018). Specifically, the approach models the feedback loop structure of a system by using nodes (stocks, constants, and variables), relationships between nodes (arrows), table functions (a type of constant), and time delays.[9]

The benefits of System Dynamics include that it allows policy-makers to experiment with their decisions before implementation in the real world, and to gain a better understanding of how the system will respond to their decisions including potential unintended consequence (Currie, Smith and Jagals 2018). In addition, System Dynamics focuses on the relationships between the parts of a system rather than focusing on separate parts in isolation. The collaborative process of creating the model can bring together diverse perspectives. Limitations of System Dynamics include its complexity and that those using the model but not closely involved in the model's development may struggle to understand and trust the model (Currie, Smith and Jagals 2018).

System Dynamics models have occasionally been used in policy areas such as public health, energy and the environment, and sustainable development and urban systems (Ghaffarzadegan, Lyneisb and Richardson 2011). However, the method has not been widely used in policy to date (Currie, Smith and Jagals 2018; Ghaffarzadegan, Lyneisb and Richardson 2011). Similarly, in New Zealand System Dynamics does not appear to have been widely used in policy, although its use has been promoted in urban policy for example (see Harvey, et al. 2018).

In the context of transformative change, System Dynamics is relevant to understanding the complex, systemic processes involved. It is particularly well suited to modelling difficult social problems like sustainability (Ghaffarzadegan, Lyneisb and Richardson 2011). System Dynamics could potentially be used early in the policy process to explore the system(s) that is (are) the focus of transformative change.

Scenario Analysis is a tool to describe alternative ways the future environment might evolve. It can be divided into techniques that explore how futures may unfold under various drivers (problem exploration) and those that test how various interventions may play out (solution exploration) (Jones, et al. 2014). Scenarios tend to be developed through engagement with experts and stakeholders, through workshops for example, and via desk research (Waverley Consultants 2017).

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[9] https://www.thwink.org/sustain/glossary/SystemDynamics.htm

The benefits of Scenario Analysis include that the use of creative processes can broaden the span of decision-makers' thinking about the future including in areas of deep uncertainty, in relation to disruptive change, and in relation to emerging trends for which few established quantitative data sources are available (Wilkinson 2017). Criticisms include that (qualitative processes) place a strong emphasis on the selection of suitable individuals, are hard to reproduce and so can be rather opaque (Miles 2002).

Scenario Analysis is a well-established technique which has been used in a range of contexts. Recent examples in New Zealand include modelling of various Covid-19 scenarios (see for example Sense Partners' (2020) modelling for Treasury, plus MBIE's unpublished scenario analysis). Another example is XRB's (2022) guidance for sectoral scenarios for climate-related disclosures.

In the context of transformative change, Scenario Analysis can be used early in the policy process to better understand the future context and range of plausible futures. It can also be integrated with other analytical tools, such as CBA, to rethink the counterfactual.

Real Options Analysis derives from methods developed in financial markets (Watkiss, et al. 2014). A financial option gives the investor the right, but not the obligation, to acquire a financial asset in the future, allowing him/her to see how market conditions play out before deciding whether to exercise the option. The same insights are useful for investment in physical assets, hence 'real' options, in cases where there is risk/uncertainty attached to future values and the option for delay. Real Options Analysis quantifies the investment risk with uncertain future outcomes. The analysis is similar to a classical CBA, except it includes additional considerations, namely the options created and destroyed by the investment project (Hallegatte, et al. 2012).

Real Options Analysis is particularly beneficial when the investment decision is irreversible, or the decision-maker has some flexibility when to carry out the investment, or the decision-maker faces uncertain conditions and by waiting they gain new information regarding the success of the investment (Watkiss, et al. 2014). Its weaknesses include its data intensity, as it requires much of the same data as for a CBA and the complexity is larger.

Real Options Analysis tends to be most relevant to large capital-intensive projects such as flood protection or water storage (Watkiss, et al. 2014). In New Zealand, Real Options Analysis has been used to inform decisions about climate change adaptation (Stroombergen and Lawrence 2022).

In the context of transformative change, Real Options Analysis is relevant to assessing policy options and in particular large infrastructure projects, especially in the face of risks and uncertainties. Real Options Analysis is an alternative economic policy appraisal tool to CBA in the face of risk/uncertainty and when there is some flexibility in the timing of investment.

Portfolio Analysis (PA) originated in financial markets as a way of utilising portfolios of assets to maximise the return on investments, subject to a given level of risk (Watkiss, et al. 2014). As well as risk and return, PA can be used to maximise other sets of objectives across a given portfolio (Isaranuwatchai, et al. 2018). The analysis starts by defining an 'objective function', weighting the outcomes, then using mathematical programming to determine the optimal allocation according to the objective function, subject to any recognised constraints.

A key benefit of PA is that it can provide a structured way of spreading risk through the identification of suitable combinations of options that, between them, achieve defined objectives. The limitations of PA include the challenge of defining a (simple) objective function and the information needs for complex constraints (Isaranuwatchai, et al. 2018).

PA does not appear to have been used much in a policy context, although its use has been advocated in areas such as science policy (Wallace and Rafols 2015).

In the context of transformative change, PA is a tool that is relevant to developing portfolios of policies or investments. In particular, it can be used for dealing with the risks associated with transformative change by helping to select a set of options which (together) are effective over a range of possible futures rather than a single option best suited to one possible future.

Robust Decision Making (RDM) provides a decision framework for decisions with long-term consequences and deep uncertainty (Watkiss, et al. 2014). RDM involves testing strategies across a large number of plausible futures. RDM has a series of steps beginning by structuring the problem, proposing alternative strategies and identifying performance measures. Levels of uncertainty characterising these strategies and performance measures are determined by assigning uncertainty parameters. Depending on the application, these parameters can be derived using modelling techniques and/or stakeholder consultation. Each strategy is then assessed over a wide range of future scenarios. Qualitative and quantitative information is incorporated in a computer modelling interface that adopts data sampling algorithms to analyse strategies over large runs.

RDM's benefits include that it forces the decision-maker to make explicit his/her preferences for the importance of relative uncertainties in the model inputs (Hallegatte, et al. 2012). A further benefit is that the stakeholder process to define measures of success and potential futures builds consensus on action even under diverse assumptions and priorities (Watkiss, et al. 2014). However, if the analysis involves a lack of quantitative probabilities, then it may be subjective and influenced by stakeholders' perceptions (Hallegatte, et al. 2012). Otherwise, the formal application also has a high demand for quantitative information, computing power, and expert resources and so the approach is time consuming and costly.

RDM does not appear to have been widely used across countries in a policy context, although it has been used in the context of large infrastructure projects (Bhave, et al. 2016). Similarly, RDM does not appear to have been used much in New Zealand policy.

In the context of transformative change, RDM is relevant to assessing alternative strategies and policy options, especially in the face of risks and uncertainties.

Risk-Opportunity Analysis is a new tool developed by EEIST in the UK (see: Mercure, et al. 2021; Grubb, et al. 2021). Grubb, et al. (2021) described what they see as the steps involved: 1) establish objectives, options, key system characteristics and system feedback; 2) identify the impacts of policy options on processes of system change; 3) assess risks and resilience; 4) assess innovation and opportunity creation; and 5) engage decision-makers on impacts and uncertainties in multiple dimensions. However, Risk-Opportunity Analysis has been described by different commentators in slightly different ways. For example, Mercure, Sharpe, et al. (2020) described Risk-Opportunity Analysis as a generalisation of welfare economics to complex dynamical systems, where risks broadly equate to costs and opportunities broadly equate to benefits, whereas Mercure, et al. (2021) characterised Risk-Opportunity Analysis as an alternative to CBA.

The benefits of Risk-Opportunity Analysis include its broad criteria and flexible approach. While a number of other tools consider risks, Risk-Opportunity Analysis is one of the few that explicitly considers opportunities. Proponents (see for example Grubb, et al. 2021; Sharpe, et al. 2020) argue that analysing risks and opportunities encourages a broad and forward-looking focus, and that considering processes of change in the economy can help identify feedback loops, 'tipping points' and other dynamic effects. However, the approach is new and untested and details are limited. In addition, it appears to suffer from many of the same limitations of MCDA.

Risk-Opportunity Analysis does not appear to have been used much internationally, and has not yet been used by any of the New Zealand agencies involved in this present paper. However, it is attracting attention internationally (see for example Voldsgaard, Mazzucato and Conway (2022)) and in some New Zealand agencies.

In the context of transformative change, Risk-Opportunity Analysis appears to be most relevant to assessing alternative strategies and policy options, especially in the face of risks and uncertainties.

Behavioural Insights (BI) involves the study of human behaviour, often drawing on empirical research in fields including economics, psychology and sociology.[10] BI encompasses a number of qualitative and quantitative techniques. The most widely used technique is 'nudging' which involves designing interventions to influence individuals' choices and decision-making (Kuehnhanss 2019).

The strengths of BI include that it makes more realistic assumptions about people's behaviour than the 'rationality' assumed in traditional economic theory, and that it draws on a diversity of disciplines (Kuehnhanss 2019). The main concerns (about nudging) are that it is paternalistic and manipulative.

To date, BI has tended to be used relatively late in the design of policy, for example to fine-tune and improve implementation and compliance (OECD 2017). Similarly, in New

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[10] https://dpmc.govt.nz/our-programmes/policy-project/policy-methods-toolbox/behavioural-insights

Zealand BI has focused on 'nudges' about implementation such as the 'opt-in' default setting for KiwiSaver. A number of New Zealand agencies have established behavioural insights units such as Ministry of Justice's Behavioural Science Aotearoa (BSA). As the OECD (2019) pointed out, there is an opportunity to use BI much more widely than its present narrow use. This wider application could include in the early stages of the policy process including problem definition.

In the context of transformative change, BI is relevant to behaviours with long-term consequences and which involve uncertainty such as climate action. BI could be used in its traditional way ie to fine-tune and improve implementation and compliance, or in the early stages of the policy process including problem definition.