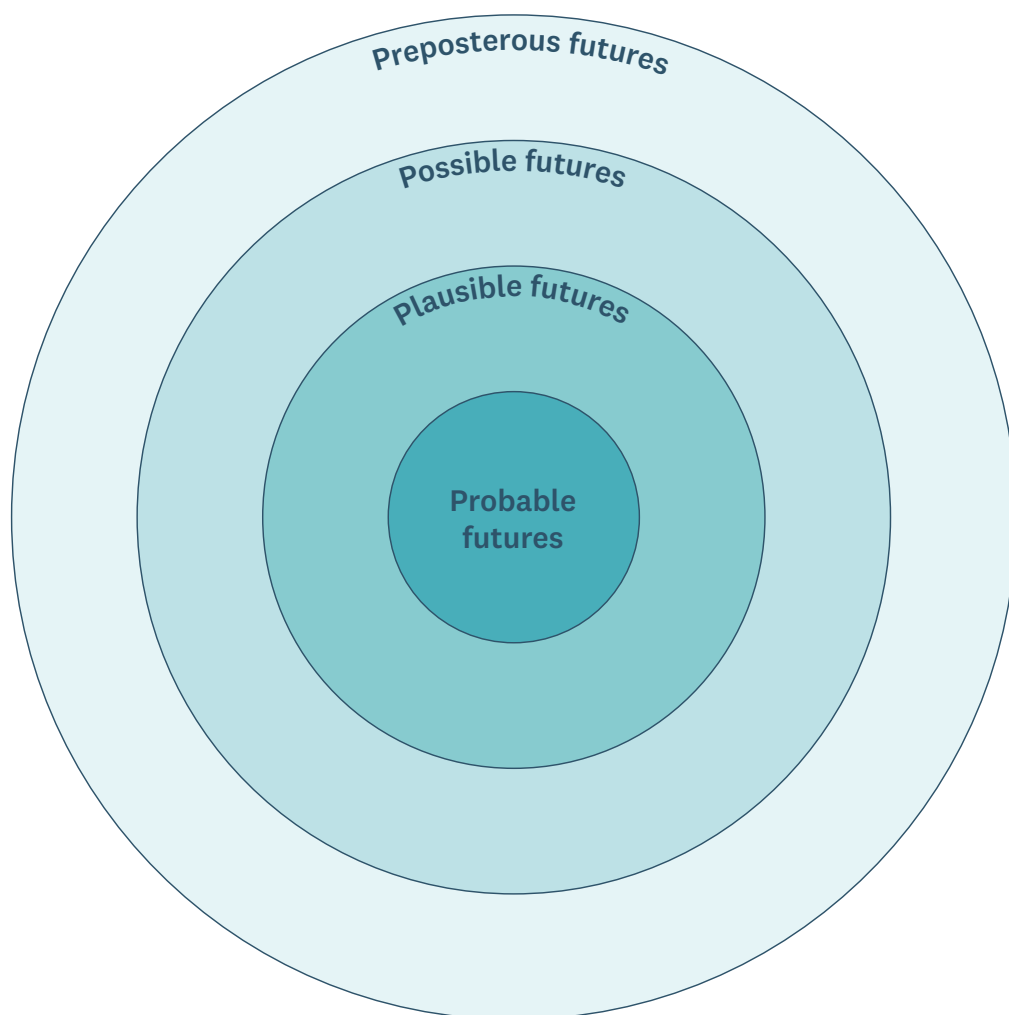


Establishing national climate-related reference scenarios



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1.0 Introduction

This paper explores why and how Aotearoa New Zealand should establish national climate-related reference scenarios.

1.1 Purpose

The purpose of this paper is to:

- i. explore the benefits, risks and costs of developing a national climate-related reference scenario framework (Section 2.0),
- ii. explore how to create national climate-related reference scenarios (Section 3.0), and
- iii. consider who is best positioned to create national climate-related reference scenarios (Section 4.0).

1.2 Background

This discussion paper has been influenced by and adapted from a discussion event, *Establishing Aotearoa New Zealand's Reference Climate Scenarios*, held by the McGuinness Institute on 18 August 2021. The event focused on exploring what national climate-related reference scenarios might look like for Aotearoa New Zealand. The majority of participants came from environmental science, economics, strategic planning or public policy backgrounds.

Across all data, observations indicate that the scenario landscape (both at a national and local level) is fragmented, complex and inconsistent. See *Working Paper 2023/01 – List of publicly available national and local scenarios* to learn more about the current state of domestic scenario development and to view a list of scenario documents identified by the Institute.

This discussion paper sits alongside other discussion papers, including *Discussion Paper 2021/02 – Need for speed: strategy mapping and adaptive management*, and *Discussion Paper 2021/04 – An Accounting Dilemma: Does a commitment to purchase offshore carbon credits create a requirement to disclose that obligation in the financial statements of the New Zealand Government?*

The information and discussions presented in this paper aim to contribute to an evidence base that the Institute will use to develop core assumptions that will influence and develop the narrative underpinning future *ClimateChangeNZ* research – namely the latest *Project2058* report, *Report 18: Climate Change Strategy for Aotearoa New Zealand*, currently being developed by the Institute. The overall aim of *Report 18* is to explore what an actionable and inclusive climate strategy would look like for Aotearoa New Zealand. There are countless parallels between insights raised in this discussion paper and *Report 18*.

1.3 About Project ForesightNZ

ForesightNZ is a McGuinness Institute policy project that aims to explore Aotearoa New Zealand's probable, possible and preferred futures. Our intention is to build public policy capability in Aotearoa New Zealand by encouraging long-term, agile thinking around our uncertain future. Initiated in 2008, *ForesightNZ* is about conceptualising the broad range of possible futures for Aotearoa New Zealand through up-to-date tools and approaches used in the field of futures studies. Foresight tools often applied by the Institute include the Cone of Plausibility, scenario development and backcasting. Relevant outputs from *ForesightNZ* are:

- *Report 6 – Four Possible Futures for New Zealand in 2058* (2008): This report created a matrix to explore the issues of climate change and genetic modification. This produced four scenarios to help us understand whether or not the world might manage itself well, and whether or not Aotearoa New Zealand might manage itself well in response to these issues. The results illustrate why small countries have such a vested interest in contributing to international affairs.¹

- ForesightNZ playing cards: A major output from the Institute’s three-day workshop, *ForesightNZ: Untangling New Zealand’s long-term future* (hosted in 2016 in collaboration with the New Zealand Treasury), was the ForesightNZ playing cards. The cards enable players to frame and explore how trends and events can co-exist and intersect with each other, ultimately challenging the certainty of the future. They aim to provide a useful resource for individuals, businesses, schools, communities, councils and government departments that are interested in exploring Aotearoa New Zealand’s long-term future.
- *Discussion Paper 2021/02 – Need for speed: strategy mapping and adaptive management*: This discussion paper is a result of a half-day Emissions Reduction Plan Strategy Mapping Workshop, which was run to test the utility of strategy and assumption mapping in improving the overall design and communication of an emissions-reduction strategy.
- *Working Paper 2021/07 – Scoping the use of the term ‘climate scenarios’ and other climate-related terms in Aotearoa New Zealand and international literature*: Observations across domestic and international climate literature indicate that climate-related terms are defined and used in many different ways. In light of this, the Institute prepared and published this working paper as a way to develop and create a language for our ongoing work.
- *Working Paper 2021/10 – List of Existing Scenarios in Aotearoa New Zealand*: This paper was the Institute’s first attempt to identify scenarios developed from a national perspective. It aimed to scope what was already being undertaken and published.
- *Working Paper 2023/01 – List of publicly available national and local scenarios*: This paper provided an update on *Working Paper 2021/10*. It reviewed publications that used the word ‘scenario’, collating five datasets:
 1. scenarios published by a central government department,
 2. scenarios published by a Crown research institute,
 3. other national scenarios,
 4. scenarios published by local government organisations (regional authorities [11], territorial authorities [11 city councils and 50 district councils] and unitary councils [6]), and
 5. other local scenarios.

You can view these on the Institute’s website. Research to collect a list of scenarios in the public arena is still ongoing, but we hope that over time we can develop a useful dataset in order to design a method for analysing the inputs, processes, outputs and outcomes (learnings) of a range of scenarios. It will likely take a few more years of research, discussion and reflection to design a useful system.

- Worksheets, exercises and slideshows: The Institute continues to provide resources to improve scenario development and understanding of scenarios in Aotearoa New Zealand. In addition to worksheets and exercises found on the Institute’s website,² the Institute’s slideshow *How to think like a futurist* aims to provide key insights for those interested in preparing scenarios.³
- *Discussion Paper 2023/02 – Establishing national climate-related reference scenarios* (this paper): This forms part of a discussion paper series that considers solutions to policy knots relating to climate change.

1.4 What is a scenario?

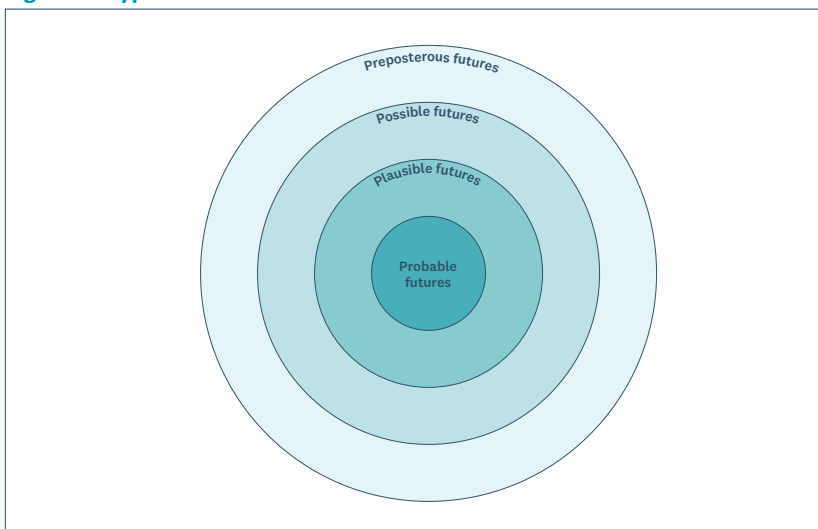
In the Institute's view, there are many ways to produce scenarios. Some key questions are:

- What is the problem/area you are trying to scope?
- What type of futures are you trying to explore – probable, plausible, possible, and/or preposterous futures? See Figure 1 (below). The type of scenarios that are developed depends upon the nature of the problem, and the subject area or domain that is being explored.

A number of entities limit the scope of their scenarios – for instance, NIWA and the Department of the Prime Minister and Cabinet (DPMC) focus solely on plausible futures. In the Institute's view, this is quite narrow (although this depends on how these entities define the term 'plausible').

- NIWA defines scenarios as: '**Plausible** and often simplified descriptions of how the future may develop based on a coherent and internally consistent set of assumptions about driving forces and key relationships. Scenarios may be derived from projections but are often based on additional information from other sources and sometimes combined with a narrative storyline [bold added]'.⁴
- DPMC states: 'Good scenarios cover multiple futures not just one future, are **plausible** and non-linear, are provocative and explore assumptions, are concise and clear, and create an immersive experience [bold added]'.⁵

Figure 1: Types of futures



It can be difficult to tell the difference between a scenario and a projection. For example, the Institute considers what NIWA calls a 'climate change scenario' to be a regional projection, because NIWA is only preparing one 'plausible future climate for a region'. Regional projections of climate change are essential for councils and regional entities to understand the probable impacts of climate change on their communities.

NIWA states on its website:

What is a climate change scenario?

Predicting human-induced ('anthropogenic') changes in climate, over the next 100 years, for a particular part of New Zealand requires:

- A prediction of global greenhouse gas and aerosol emissions for the next century
- A global carbon cycle model to convert these emissions into changes in carbon dioxide concentrations (and similar models for calculating concentrations of other greenhouse gases and aerosols)
- A coupled atmosphere-ocean global circulation model (AOGCM) which uses the greenhouse gas and aerosol concentration information to predict climate variations forward in time.

- Downscaling of the AOGCM results through a procedure which takes account of the influence of New Zealand's topography on local climate. This can be done either statistically or with a high resolution regional climate model.

Given our current knowledge and modelling technology, there are uncertainties in each of these steps. For example, emission predictions depend on the difficult task of predicting human behaviour, such as changes in population, economic growth, technology, energy availability and national and international policies, including predicting the results of international negotiations on constraining greenhouse gas emissions. Our understanding of the carbon cycle and of sources and sinks of non-carbon dioxide greenhouse gases is still incomplete. As discussed in NIWA's climate modelling web page, there are significant uncertainties in current global climate model predictions—particularly at the regional level.

The climate change scenario approach recognises these uncertainties. A scenario is a scientifically-based projection of **one plausible** future climate **for a region**. For guidance on regional impacts of climate change, a range of scenarios is desirable. These can span credible estimates of future greenhouse gas emissions, and the uncertainty range in climate model predictions. [bold added]⁶

1.5 Terminology

Currently there are many issues with the language being used by different sectors and industries (e.g. use of the terms 'models', 'forecasts' and 'scenarios').

Please note that these terms are still evolving in international literature, but these are the definitions that the Institute has developed for the purposes of this discussion paper.

Local and national scenarios

Scenarios can relate to a local community (i.e. within a specific region or regions) or a national community (i.e. considering Aotearoa New Zealand as a whole). Although both are useful, the Institute's interest is in impacts to the country from a national perspective.

Specific scenarios

Specific scenarios are scenarios that may be local or national in nature but explore a specific subject area or industry, such as climate change or the geothermal industry. This distinction is important as the Institute is more interested in some subject areas than others. For example, this paper focuses on the specific subject area of climate change.

Reference scenarios

Reference scenarios are scenarios developed without too much detail, usually by government, as a base for users to build upon, in order to test policy or business decisions. There is normally more than one, e.g. a best-case scenario and a worst-case scenario. Reference scenarios are often confused with baseline scenarios (see the Institute's definition of baseline scenarios below).

The EU defines a reference scenario as 'an informed, internally consistent, and policy relevant projection on the future developments ... that acts as a benchmark for new policy initiatives'. The 2020 EU Reference Scenario states:

The EU Reference Scenario is one of the European Commission's key analysis tools in the areas of energy, transport and climate action. It allows policy-makers to analyse the long-term economic, energy, climate and transport outlook based on the policy framework in place in 2020. This scenario can provide policy-makers with a comprehensive analytical basis against which they can assess new policy proposals.

National experts from all EU countries contributed to the Reference Scenario 2020 through a consultation process, and stakeholders have also contributed on technology assumptions.⁷

Baseline scenarios

Baseline scenarios are singular scenarios created to act as a control within a group of scenarios. For example, in regard to the climate, baseline scenarios are:

... scenarios that are based on the assumption that no emission mitigation policies or measures will be implemented beyond those that are already in force and/or are legislated or planned to be adopted. Baseline scenarios are not intended to be predictions of the future, but rather counterfactual constructions that can serve to highlight the level of emissions that would occur without further policy effort. Typically, baseline scenarios are then compared to emission mitigation scenarios that are constructed to meet different goals for greenhouse gas emissions, atmospheric concentration, or temperature change. The term 'baseline scenario' is often used interchangeably with [the term] 'no policy scenario'.⁸

Climate models

Carbon Brief, a UK-based website specialising in the science and policy of climate change, describes a climate model as 'an extension of weather forecasting, but focusing on changes over decades rather than hours'. A global climate model takes 'hundreds of scientists many years to build and improve; and it can require a supercomputer the size of a tennis court to run. The models themselves come in different forms – from those that just cover one particular region of the world or part of the climate system, to those that simulate the atmosphere, oceans, ice and land for the whole planet.'⁹

Climate-related scenarios

Climate-related scenarios are scenarios that aim to provide an opportunity for organisations to develop their ability to better understand and prepare for the uncertain future impacts of climate change.

The External Reporting Board (XRB) defines climate-related scenarios in *Aotearoa New Zealand Climate Standard 3: General Requirements for Climate-related Disclosures (NZ CS 3)* as:

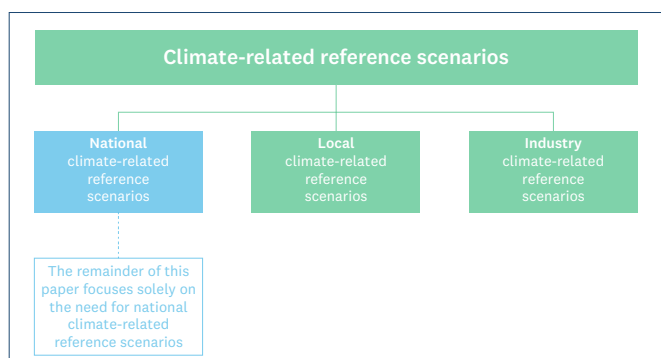
A **plausible**, challenging description of how the future may develop based on a coherent and internally consistent set of assumptions about driving forces and relationships covering both physical and transition risks in an integrated manner. Climate-related scenarios are not intended to be probabilistic or predictive, or to identify the 'most likely' outcome(s) of climate change. They are intended to provide an opportunity for entities to develop their internal capacity to better understand and prepare for the uncertain future impacts of climate change [bold added].¹⁰

Climate-related reference scenarios are reference scenarios that explore the impacts of climate change. For example, climate-related reference scenarios could explore Aotearoa New Zealand under various Representative Concentration Pathways (RCPs), such as RCP 2.6 (below 2.0°C warming), RCP 6.0 (1.4°C–3.1°C), and RCP 8.5 (2.6°C–4.8°C).

In contrast to projections and sensitivity analysis, climate-related reference scenarios should include more variables, such as social, economic, and technological responses. Rather than attempting to predict the future (as with projections), they should generate many possible (but not necessarily likely) future worlds. It is this key policy tool that is missing. We need to understand the range of possible climate futures we may face, in order to build an antifragile Aotearoa New Zealand – a country that is more resilient to the future, whichever possible future becomes reality.

The term 'climate-related scenario' can be applied nationally, locally, or industrially. This terminology is summarised in Figure 2 below.

Figure 2: Types of climate-related reference scenarios



2.0 The benefits, risks and costs of national climate-related reference scenarios

Section 2.0 focuses on the potential benefits, risks and costs of having national climate-related reference scenarios.

Faster adaptation responses to climate change

Decision-makers will be better informed. Scenarios by their very nature are coherent narratives about possible futures. Because of this, they are easily modified as new information becomes available. These scenarios are often revisited and adapted, creating new versions that can be quickly assimilated into the public arena. These new versions may take into account new policy ideas or new information on unintended consequences.

Meeting user needs

Accurate, comparable and publicly available climate-related information is needed to consolidate and coordinate action toward achieving domestic emission targets and international commitments. Scenarios that ‘have legitimacy with stakeholders ... have to include non-climate and climate policy elements that reflect the perceived, or real, degree of national independence and ability to forge one’s own path, while employing credible scientific techniques to ensure robust links between global and national scale developments are made where relevant’.¹¹

Ideally, reference climate scenarios will enable users to explore how multiple drivers of change can work in unison in order to identify different futures, and how these futures help expose climate-related vulnerabilities. Scenario analysis can then identify possible pathways to become more resilient to these vulnerabilities.

Users should also be aware of how their operations are vulnerable to known climate risks (physical, transitional and legal). National climate-related reference scenarios will help users to identify and understand leverage points.

Information equality

There is inequality in the dissemination of information throughout New Zealand. Māori and other minority groups are consistently under-represented in Crown research institutes, as well as the wider research, science and information (RSI) industry (for more information see the Institute’s response to the *Te Ara Paerangi – Future Pathways Green Paper consultation*). Minority groups are at risk of being unaware information exists, being unable to afford access to it, or it not being relevant to them. Diverse thought, life experience and values are crucially necessary for developing solutions to complex issues. Aotearoa New Zealand needs to ensure there is a level playing field for all users and/or potential users of information.

Better communication between the public and private sectors

A set of national climate-related reference scenarios would introduce common language, narratives and insights, helping sectors communicate more effectively internally, as well as aiding communication between sectors (see, for example, the discussion on NIWA’s definition of climate change scenarios in Section 1.4).

In addition to NIWA’s use of the term ‘climate change scenario’, another example of issues regarding language is the use of the term ‘climate models’¹² (particularly amongst climate scientists) to represent technical inputs, processes, output systems or scenarios when they start moving towards high levels of uncertainty. In such cases, the terms ‘projections’ and ‘sensitivity analysis’¹³ might be more appropriate.

Better alignment between the public and private sectors

Having a set of national climate-related reference scenarios will provide a common basis for discussion and decision-making, enabling better alignment both within and between sectors. This in turn will help sectors and industry to reach a common understanding and/or a set of goals (such as mitigation and adaptation goals), and improve cooperation and innovation in order to develop cost-effective and timely solutions.

Supporting preparers of climate-related disclosures

The passing of the Financial Sector (Climate-related Disclosures and Other Matters) Amendment Act 2021 gives the External Reporting Board (XRB) a mandate to issue a climate-related disclosure framework for climate reporting entities (CREs) in Aotearoa New Zealand. The standard, NZ CS1, is largely based on the TCFD (Taskforce on Climate-Related Financial Disclosures) framework (see Figure 3 below) and includes scenario analysis.

The users of national climate-related reference scenarios will initially be CREs – large listed companies with a market capitalisation of more than \$60 million; large licensed insurers; registered banks; credit unions; building societies and managers of investment schemes with more than \$1 billion in assets; and some Crown financial institutions (via letters of expectation).^{14,15} Initial users will also include entities that already voluntarily participate in TCFD reporting.

Figure 3: Recommendations and supporting recommended disclosures of the TCFD framework¹⁶

Source: *Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures*, p. 14.

| Governance | Strategy | Risk Management | Metrics and Targets |
|---|---|---|---|
| Disclose the organization's governance around climate-related risks and opportunities. | Disclose the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning where such information is material. | Disclose how the organization identifies, assesses, and manages climate-related risks. | Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material. |
| Recommended Disclosures | Recommended Disclosures | Recommended Disclosures | Recommended Disclosures |
| <ul style="list-style-type: none"> a) Describe the board's oversight of climate-related risks and opportunities. b) Describe management's role in assessing and managing climate-related risks and opportunities. | <ul style="list-style-type: none"> a) Describe the climate-related risks and opportunities the organization has identified over the short, medium, and long term. b) Describe the impact of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning. c) Describe the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario. | <ul style="list-style-type: none"> a) Describe the organization's processes for identifying and assessing climate-related risks. b) Describe the organization's processes for managing climate-related risks. c) Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organization's overall risk management. | <ul style="list-style-type: none"> a) Disclose the metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process. b) Disclose Scope 1, Scope 2, and, if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks. c) Describe the targets used by the organization to manage climate-related risks and opportunities and performance against targets. |

A new public policy tool to test policy options

Currently, there is no public policy tool that enables climate policy to be tested, other than in a very direct cause-and-effect manner. National climate-related reference scenarios help to solve this problem, by providing a practical and accessible policy tool that seeks out second- and third-level effects.

Good scenarios will endeavour to clarify what is known and what is known to be unknown, and acknowledge that there are unknown unknowns. Although there remains a high level of uncertainty regarding climate change impacts, climate science is increasingly moving towards the known. What remains less certain is our response. That is why scenarios are so useful; they create possible landscapes for discussion and exploration of costs, risks and benefits (often over a long-term period), without producing expectations relating to specific outcomes (in contrast to projections, sensitivity analysis and models). There is no right or wrong scenario; the aim is to become better informed, not to predict the future.

Scenarios are about the rapid generation of ideas and responses – they are playful and exploratory. Projections, sensitivity analysis and models are technical and analytical and take time to prepare. Although they are about making decisions, the purposes are very different. A good projection, model, or sensitivity analysis is about specific, technical decision-making, which tends to result in a specific operational response. Alternatively, a good set of scenarios leads to high-level thinking and the crafting of strategic options of a general, broad nature.

Trade-offs not being apparent

A key concern raised throughout the discussion event was what trade-offs are likely to occur as a result of making decisions. Evidently, difficult decisions will need to be made. Three of the most significant trade-offs that came up are:

a. Comparability vs relevance

To a large degree, the intent behind the development and implementation of climate-related reference scenarios is to ensure that comparable scenarios are consistently made by reporting entities. The trouble is that different users' have different needs. There is a risk that if all users have access to the same reference climate scenarios, there will be total comparability of information derived from the application of those scenarios (though potentially, not enough relevance). On the other hand, if all users have access to more specific reference scenarios, there will be more relevance of information within sectors, but less overall comparability. Getting this balance right is important.

b. Global vs domestic alignment

Similarly, scenarios that enable global comparability are likely to have less domestic relevance. Thus, the line between domestically and globally aligned scenarios must be considered. For example, investors, banks and multinational corporations are likely to be more concerned with 'global audiences' than local government and iwi. Thus, they would require (and be more interested in) globally aligned reference scenarios, rather than domestically focused scenarios.

c. Feasibility for preparers vs needs of users

Another challenge lies in securing the balance between how scenarios can be made feasible for climate reporting entities to apply, while also providing information that is useful to the primary users of the disclosures.

Reference scenarios will require additional funding

A team will need to be brought together to collect data, information and knowledge from a range of experts. This will need to be co-ordinated with experts in scenario development. Exact costs will need to be scoped, but costs are likely to be within the vicinity of \$500,000 to \$1,000,000. The actual cost will depend on who undertakes this work, and how frequently the scenarios are updated. An initial exercise could be undertaken at a lower cost to test their use as a policy tool.

3.0 How to create national climate-related reference scenarios

Bob Frame and Andy Reisinger's paper *Climate Changes, Impacts and Implications for New Zealand to 2100* discusses how to create meaningful scenarios:

- enable understanding about the extent to which global, national and local-scale societal developments can influence the nature and severity of climate change risks;
- involve researchers across many disciplines, stakeholders with an interest in long-term impacts and implications, and policy-makers who take the long view; and
- be credible, salient and legitimate but not necessarily downscaled from global models.¹⁷

While Frame and Reisinger acknowledge that global scenarios clearly matter, they note that national-scale scenarios are likely to 'have credibility, salience and legitimacy with stakeholders'. They set out three elements for developing national climate-related scenarios: two 'scaled-down' elements, plus one 'bottom-up' element. See their description of each element below:

Element 1: Representative concentration pathways (RCPs) 'describe the global atmospheric radiative forcing associated with varying levels of greenhouse gas (GHG) concentrations. GHG concentration pathways depicted in the RCPs serve as inputs to global climate modelling which, in turn, provides boundary conditions for regional climate modelling, with finer spatial and temporal resolutions of more relevance to policy, planning and resource management. The emissions that give rise to the RCPs are consistent with some potential socio-economic development pathway, but they are not primarily development pathways.'¹⁸

Element 2: Shared socio-economic pathways (SSPs) 'describe future global socioeconomic conditions including emissions of GHG. They outline plausible alternative states of human and natural societies at a macro scale including both narrative and quantitative elements of socio-ecological systems such as demographic, political, social, cultural, institutional, lifestyle, economic and technological variables and trends. They also include the human impacts on ecosystems and ecosystem services such as air and water quality and biodiversity. The global SSPs are designed to be extended to regional and sectoral scenarios but make no assumptions about global or national-level climate change policy.'¹⁹

Other components of this element could include megatrends and wildcards (see examples in Table 1), and other existing national and international climate-related scenarios. See the table of national and local scenarios on the Institute's website.²⁰

Table 1: Examples of characteristics that contribute to socio-economic pathways

| Topic | Examples |
|----------------------|---|
| Demographics | Population total and age structure |
| | Urban and rural population |
| Economic development | Global and regional GDP and trends in productivity |
| | Regional, national and sub-national distribution of GDP |
| | Share of population in extreme poverty |
| | Nature of international trade |
| | Sectoral structure of national economies, including share of agriculture and agricultural land productivity |
| Welfare | Human development including access to public health and health care infrastructure |
| | Attainment of education |
| Environment | Air, water, soil quality |
| | Ecosystem functioning |
| Resources | Fossil fuel resources and renewable energy potentials |
| | Other resources such as phosphates, fresh water, etc. |
| Institutions | Existence, type and effectiveness of national/regional/global institutions |
| | Degree of participation/rule of law |
| Technology | Type (slow, rapid, transformational...) and direction (environmental, efficiency, productivity...) |
| | Innovation in specific sectors |
| World views | Lifestyles (including diets) |
| | Societal tension |
| Policies | Non-climate development strategies, urban planning, transportation policies, energy security policies, environmental policies, etc. |

Element 3: Shared climate policy assumptions (SPAs) ‘describe potential climate change mitigation and/or adaptation policies specific to New Zealand, which enable our futures to diverge from (accelerate, slow down or even counteract) the trends that are assumed in global-scale SSPs. These are described through a set of societal categories which are elaborated as indicators in more detail. A mix of qualitative and quantitative factors was used to describe indicator elements and scenario narratives. The SPAs capture key climate policy dimensions not specified in the SSPs and provide a means to employ common assumptions across studies. But crucially, they allow national-level development choices that may reinforce global trends or actively go against them. As such they provide a third axis to the scenario matrix.’²¹

Climate change mitigation and/or adaptation policies specific to New Zealand include domestic targets, assessments and plans, such as:

- the domestic-aligned 2050 emissions target;
- the latest National Climate Change Risk Assessment (NCCRA);
- the latest emissions reduction plan (ERP);
- the latest national adaptation plan (NAP);
- NIWA projections.

4.0 Who should be responsible for creating national climate-related reference scenarios

At present, there is no institution required (or publicly funded) to produce national climate-related reference scenarios. While various entities undertake climate-related scenario work, there is no designated government provider of such work. If national climate-related reference scenarios are not publicly owned and managed, they are likely to be outsourced, privately owned and costly.

It is the Institute's opinion that national climate-related reference scenarios should be developed independent of NIWA and the Climate Commission, in order to prevent projections becoming too dominant – this work calls for a more exploratory approach.

Endnotes

- 1 See McGuinness Institute. *Report 6 – Four Possible Futures for New Zealand in 2058*. Retrieved 9 November 2021 from www.mcguinnessinstitute.org/publications/project-2058
- 2 See McGuinness Institute. Worksheets/Exercises. Retrieved 9 November 2021 from www.mcguinnessinstitute.org/publications/worksheets
- 3 See McGuinness Institute. (September 2022). *How to think like a futurist*. Retrieved 23 May 2023 from www.mcguinnessinstitute.org/publications/slideshows-and-presentations
- 4 See National Institute of Water and Atmospheric Research (NIWA). (n.d.). Glossary. Retrieved 23 May 2023 from niwa.co.nz/adaptationtoolbox/glossary
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- 11 See Frame, B. & Reisinger, A. (2016). *Climate Changes, Impacts and Implications for New Zealand to 2100: Synthesis Report: RA5 – Exploring Options for New Zealand under Different Global Climates*. National Institute of Water and Atmospheric Research (NIWA), p. 7. Retrieved 26 May 2023 from niwa.co.nz/climate/research-projects/climate-changes-impacts-and-implications-for-new-zealand
- 12 See images of climate models at Intergovernmental Panel on Climate Change (IPCC). (n.d.). 8: Climate Models and Their Evaluation. Retrieved 23 May 2023 from www.ipcc.ch/report/ar4/wg1/climate-models-and-their-evaluation
- 13 Climate scenarios may sometimes simply be a sensitivity analysis of one variable changing – commonly a change in the RCP (the options being RCP2.6, RCP4.5, RCP6.0, and RCP8.5). See Carbon Brief. (2 December 2019). CMIP6: the next generation of climate models explained. Retrieved 23 May 2023 from www.carbonbrief.org/cmip6-the-next-generation-of-climate-models-explained
- 14 See External Reporting Board (XRB). (13 December 2022). Climate-related Disclosures. Retrieved 5 May 2023 from www.xrb.govt.nz/standards/climate-related-disclosures

- 15 A letter of expectation is a formal but not legislative tool that allows an opportunity for the Minister to set out expectations for the coming year. In this case this tool was discussed in terms of climate-related disclosures.
- ‘The Government’s expectation is that the risks posed by the climate emergency – and the action this Government is taking to address them – become a routine consideration in the investment decisions made by Crown financial institutions. This will lead to a better allocation of public money and support the work this Government is doing to transition Aotearoa New Zealand to a low carbon future.’ See Shaw, J. (12 March 2021). Climate reporting for Crown financial institutions [press release]. Retrieved 26 May 2023 from www.beehive.govt.nz/release/climate-reporting-crown-financial-institutions
- 16 Task Force On Climate-Related Financial Disclosures (TCFD). (June 2017). *Recommendations of the Task Force on Climate-related Financial Disclosures*, p. 14. Retrieved 10 November 2021 from www.fsb-tcfd.org/recommendations
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