Working Paper 2021/07 Appendix 1 – Climate-related terms in Aotearoa New Zealand and international literature

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Appendix 1: Climate-related terms in Aotearoa New Zealand and international literature (scoping)

As at 25 August 2021.

This becomes Appendix 1 of *Working Paper 2021/07: Scoping the use of the term 'climate scenarios' and other climate-related terms in Aotearoa New Zealand and international literature* (in progress).

Working Paper 2021/07 forms part of the Institute's ongoing background research for our *Project ClimateChangeNZ* and in particular *Report 18: Climate Change Strategy for Aotearoa New Zealand.*

The Institute has compiled an initial list of definitions for several key terms, from both domestic and international sources. These terms are:

1. 'Scenario/s' (including 'pathways')
2. 'Reference scenario/s' (including 'baseline scenario/s')
3. 'Climate change scenario/s' (including 'projections and 'predictions')
4. 'Climate model' (including 'regional climate model')
5. 'Story' and 'Narrative'

The Institute was also interested to identify and distinguish the different types of:

6. climate-related scenarios and,
7. climate-related pathways.

*Note: Bordered text indicates that definition has been derived from an Aotearoa New Zealand based organisation.

The following definitions are a starting point, and we invite your comment on, or addition to, this list.

1. 'Scenario/s' (including pathways')

- A **scenario** is 'a plausible representation of an uncertain future, sometimes including the pathway leading to this future, based on assumptions and key parameters that are mutually consistent' (Institute for Climate Change and Economics, 2019; p. 56)

- A **scenario** is 'a plausible and often simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions about key driving forces'. (MfE, 2008; p. 110)

- A **scenario** 'is often given other qualifications, such as 'emission scenario' or 'socio-economic scenario'. For the purpose of forcing a global climate model, the primary information needed is the time variation of greenhouse gas and aerosol concentrations in the atmosphere. In New Zealand, the climate impacts community prefers to limit the term 'scenario' to describing a storyline consistent with a particular combination of greenhouse gas and socio-economic 'pathways'. Therefore, with results from climate model simulations, we endeavour to use the term RCP or pathway, rather than scenario' (MfE, 2018; p. 125)

- **Scenarios** are 'an alternative set of possible futures. Scenarios say what might happen given a set of observed mega-trends. Scenarios do not predict the future; rather they help to guide our decisions using a qualitative view of what may lie ahead' (https://www.treasury.govt.nz/sites/default/files/2017-12/nip-trends-scenario.pdf)

- **Scenarios** are 'stories that describe alternative ways the external environment might develop in the future' (https://dpmc.govt.nz/our-programmes/policy-project/policy-methods-toolbox/futures-thinking/scenarios)

- A **scenario** is 'a plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, prices) and relationships. Note that scenarios are neither predictions nor forecasts but are used to provide a view of the implications of developments and actions' (TCFD, 2020; p. 112).

- A **scenario** is 'a plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change (TC), prices) and relationships. Note that scenarios are neither predictions nor forecasts, but are used to provide a view of the implications of developments and actions.' (IPCC, 2021; p. 60)

- A **scenario pathway** 'refer[s] to the political, technological, and economic developments and associated risk drivers (e.g., which sectors and regions bear the most emissions reductions, or which energy technologies win out in different economies) that lead to a particular scenario outcome; there can be distinctively different pathways leading to the same outcome (TCFD, 2020; p. 112).

- **Pathways** are the 'temporal evolution of natural and/or human systems toward a future state. Pathway concepts range from sets of quantitative and qualitative scenarios or narratives of potential futures, to solution-oriented decision-making processes to achieve desirable societal goals' (TCFD, 2020; p. 111).

- **Pathways** are the 'temporal evolution of natural and/or human systems towards a future state. Pathway concepts range from sets of quantitative and qualitative scenarios or narratives of potential futures to solution oriented decision-making processes to achieve desirable societal goals. Pathway approaches typically focus on biophysical, techno-economic, and/or socio-behavioural trajectories and involve various dynamics, goals and actors across different scales.' (IPCC, 2021; p. 53)

2. 'Reference scenario/s' (including 'baseline scenario/s')

- A **reference scenario** is a 'scenario used as starting or reference point for a comparison between two or more scenarios' (IPCC, 2021; p. 60)

- A **baseline scenario** 'refers to 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 "reference scenario" and "no policy scenario."' (TCFD, 2020; p. 112).

- A **reference scenario** 'is an informed, internally consistent, and policy relevant projection on the future developments of the EU energy system, transport system and greenhouse gas GHG emissions that acts as a benchmark for new policy initiatives' (European Commission, 2020; p. 8).

3. 'Climate change scenario' (including 'projections' and 'predictions')

- A **climate change 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' (NIWA, n.d).

- A **climate change scenario** 'is the difference between a climate scenario and the current climate' (CIFOR, 2008; p. 25)

- A **climate change scenario** is 'the simulated response of the climate system to a scenario of future emission or concentration of greenhouse gases and aerosols, generally derived using climate models' (Institute for Climate Change and Economics, 2019 p. 57).

- **A climate scenario** is 'a plausible and often simplified representation of the future climate, based on an internally consistent set of climatological relationships that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change, often serving as input to impact models' (IPCC, 2021; p. 21)

- A **regional climate scenario** is 'a narrative used to describe how the future might unfold for a region. These are often used to guide impact understanding and adaptation efforts.' (IPCC, 2021; p. 58)

- A **climate prediction** is 'the result of an attempt to produce (starting from a particular state of the climate system) an estimate of the actual evolution of the climate in the future, for example, at seasonal, interannual or decadal time scales' (IPCC, 2021; p. 21)

- A **climate prediction** is 'an attempt to provide a most likely description or estimate of the actual future evolution of the climate' (MfE, 2008; p. 106)

- A **climate projection** is 'a potential future evolution of the climate in response to an emission or concentration scenario of greenhouse gases and aerosols. Often based on a simulation by a climate model' (MfE, 2008; p. 106)

- A **climate projection** is a 'simulated response of the climate system to a scenario of future emissions or concentrations of greenhouse gases (GHGs) and aerosols and changes in land use, generally derived using climate models. Climate projections are distinguished from climate predictions by their dependence on the emission/concentration/radiative forcing scenario used, which is in turn based on assumptions concerning, for example, future socio-economic and technological developments that may or may not be realised.' (IPCC, 2021; p. 21

4. 'Climate model'

- A **climate model** 'is a numerical representation of the climate system based on the physical, chemical, and biological properties of its components, their interactions and feedback processes, and accounting for some of its known properties' (TCFD, 2020; p. 110).

- A **climate model** 'is a numerical representation of the climate system based on the physical, chemical and biological properties of its components, their interactions and feedback processes, and accounting for some of its known properties' (Institute for Climate Change and Economics, 2019; p. 57)

- A **climate model** is 'a numerical representation (typically a set of equations programmed into a computer) of the climate system. The most complex and complete climate models are known as 'General Circulation Models' (MfE, 2008; p. 106)

- A **climate model** is 'a qualitative or quantitative representation of the climate system based on the physical, chemical and biological properties of its components, their interactions and feedback processes and accounting for some of its known properties. The climate system can be represented by models of varying complexity; that is, for any one component or combination of components a spectrum or hierarchy of models can be identified, differing in such aspects as the number of spatial dimensions, the extent to which physical, chemical or biological processes are explicitly represented, or the level at which empirical parametrisations are involved.' (IPCC, 2021; p. 21)

- A **regional climate model** is a 'climate model at higher resolution over a limited area. Such models are used in downscaling global climate results over specific regional domains' (IPCC, 2021; p. 58)

- A **regional climate model** is a model that 'run[s] at higher spatial and time resolution than GCMs but over a limited area of the globe. RCMs take boundary conditions from GCMs, and provide a physically consistent downscaling of the large-scale climate changes simulated by the GCM. They can cater for relatively small-scale features such as New Zealand's Southern Alps' (MfE, 2018; p. 125).

5. 'Story' and 'narrative'

- A **storyline** is 'a way of making sense of a situation or a series of events through the construction of a set of explanatory elements. Usually it is built on logical or causal reasoning. In climate research, the term storyline is used both in connection to scenarios as related to a future trajectory of the climate and human systems or to a weather or climate event. In this context, storylines can be used to describe plural, conditional possible futures or explanations of a current situation, in contrast to single, definitive futures or explanations.' (IPCC, 2021; p. 65)

- A **scenario storyline** is 'a narrative description of a scenario (or family of scenarios), highlighting the main scenario characteristics, relationships between key driving forces, and the dynamics of their evolution' (TCFD, 2020; p. 112).

- A **narrative** is 'a qualitative descriptions of plausible future world evolution, describing the characteristics, general logic, and developments underlying a particular quantitative set of scenarios' (TCFD, 2020; p. 111).

6. Types of climate-related scenarios

- A **concentrations scenario** is a 'plausible representation of the future development of atmospheric concentrations of substances that are radiatively active (e.g., greenhouse gases (GHGs), aerosols, tropospheric ozone), plus human-induced land cover changes that can be radiatively active via albedo changes, and often used as input to a climate model to compute climate projections' (IPCC, 2021; p. 62)

- An **emission scenario** is 'a plausible representation of the future development of emissions of substances that are radiatively active (e.g., greenhouse gases, aerosols). It is based on a coherent and internally consistent set of assumptions about driving forces (such as demographic and socioeconomic development, technological change, energy, and land use) and their key relationships. Concentration scenarios, derived from emission scenarios, are often used as input to a climate model to compute climate projections' (TCFD, 2020; p. 112).

- A **mitigation scenario** is 'a plausible description of the future that describes how the (studied) system responds to the implementation of mitigation policies and measures' (TCFD, 2020; p. 112)

- A **socioeconomic scenario** is 'a scenario that describes a possible future in terms of population, gross domestic product, and other socioeconomic factors relevant to understanding the implications of climate change' (TCFD, 2020; p. 112).

- A **socioeconomic scenario** is 'a scenario that describes a plausible future in terms of population, gross domestic product (GDP), and other socio-economic factors relevant to understanding the implications of climate change' (IPCC, 2021; p. 60)

7. Types of climate-related pathways

- A **representative concentration pathway (RCP)** is a 'scenario that includes time series of emissions and concentrations of the full suite of greenhouse gases (GHGs) and aerosols and chemically active gases, as well as land use/land cover' (IPCC, 2021; p. 53)

- A **representative concentration pathway (RCP)** is a 'concentration scenario identified by its approximate total radiative forcing at 2100 relative to 1750.' (MfE, 2018; p. 125).

- **Representative concentration pathways (RCP)** are 'a suite of future scenarios of additional radiative heat forcing at the Earth's surface by 2100 (in Watts per square metre), which is the net change in the balance between incoming solar radiation and outgoing energy, radiated back up in the atmosphere' (MfE, 2020; p. 129)

- **Shared socio-economic pathways (SSP) are** scenarios that 'have been developed to complement the Representative concentration pathways (RCPs). By design, the RCP emission and concentration pathways were stripped of their association with a certain socio-economic development. Different levels of emissions and climate change along the dimension of the RCPs can hence be explored against the backdrop if different socio-economic development pathways (SSPs) on the other dimension in a matrix.' (IPCC, 2021; p. 53)

- **1.5°C pathway** are 'pathway of emissions of greenhouse gases and other climate forcers that provides an approximately one-in-two to two-in-three chance, given current knowledge of the climate response, of global warming either remaining below 1.5°C or returning to 1.5°C by around 2100 following an overshoot' (IPCC, 2021; p. 53)

- **Adaptation pathways** are 'a series of adaptation choices involving trade-offs between short-term and long-term goals and values' (IPCC, 2019; p. 555)

- **Development pathways** are 'trajectories based on an array of social, economic, cultural, technological, institutional and biophysical features that characterise the interactions between human and natural systems and outline visions for the future, at a particular scale.' (IPCC, 2019; p. 555)

- **Emission pathways** are 'modelled trajectories of global anthropogenic emissions over the 21st century are termed emission pathways' (IPCC, 2019; p. 555)

- **Mitigation pathways** are 'temporal evolution of a set of mitigation scenario features, such as greenhouse gas emissions and socio-economic development' (IPCC, 2019; p. 555)

- **Transformation pathways** Trajectories describing consistent sets of possible futures of greenhouse gas (GHG) emissions, atmospheric concentrations, or global mean surface temperatures implied from mitigation and adaptation actions associated with a set of broad and irreversible economic, technological, societal and behavioural changes. This can encompass changes in the way energy and infrastructure are used and produced, natural resources are managed and institutions are set up and in the pace and direction of technological change. (IPCC, 2019; p. 556)

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