Climate Change Scenarios for the Health Sector

March 2024

DISCLAIMER:

This report presents future climate change scenarios for the health system, to support consideration of what impacts may need to be planned for and managed. The work was facilitated by Tonkin + Taylor (T+T), drawing on the input of individuals from various organisations across the health sector, including research institutes and academia.

It is emphasised that the scenarios in this report are purely hypothetical; they provide alternative views of the future to provoke consideration of what such scenarios could mean for the health system.

While many organisations have supported the development of scenarios, it is emphasised that the report does not represent the views of any particular individual involved in the work, nor any organisation.

The purpose of the report is to better enable organisations – given the importance of future planning – to identify what potential future scenarios could mean for them. As the scenarios are hypothetical, no data or comment should be relied on by any party in drawing their own insights or making their own decisions. Individual parties should undertake their own analysis to develop specific views on how hypothetical future events, such as those in this report, impact their own affairs.

Climate change is widely recognised as the single greatest threat to human health and wellbeing. Increasingly frequent and intense climate events have broad impacts on our environments, placing greater stress on our health directly, as well as the health system's ability to provide services. Responding to climate change also presents opportunities and a wide range of health co-benefits.

Our vision is for a sustainable and resilient health system that delivers equitable health outcomes. Understanding and planning for the impacts of climate change risk and greenhouse gas emissions reduction are a core dimension of high-quality healthcare. In setting out sector climate scenarios, this document encourages those in the healthcare sector to consider the risks and opportunities they face from a changing climate, and how their sector or organisation could respond.

Whiria to tangata. There has been a weaving together of the wide range views of the risks and opportunities for the sector and what the most relevant drivers are for us consider within these scenarios. We are grateful for all those that have contributed.

Support was also provided by the Accident Compensation Corporation, Ministry of Health | Manatū Hauora, Māori Health Authority | Te Aka Whai Ora and Health New Zealand | Te Whatu Ora

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Tonkin+Taylor

T+T was engaged to facilitate and support the development of the Sector Scenarios.

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1. Glossary and acronyms

1.1 GLOSSARY

Adaptation: The process of adjustment to actual or expected climate and its effects.[1]

Climate reporting entity (CRE): Climate reporting entities include those entities which are required to issue climate-related disclosures under NZ legislation.

Climate variable: A physical variable or a group of linked variables that critically contributes to the characterisation of earth's climate, including mean temperature, maximum and minimum temperatures, frosts or hot days, mean precipitation, dry days or very wet days, droughts, storms, extreme wind speeds, circulation, solar radiation, relative humidity, and mean sea-level pressure.

Climate-related disclosures: By providing a consistent framework for entities, climate-related disclosures (CRDs) enable primary users (e.g., shareholders) to assess how well entities are assessing and managing their climate-related risks and opportunities and the related financial impacts. If successful, CRDs would shift capital towards activities consistent with an international transition to a low-emissions, climate resilient future.

Climate-related scenario: A plausible, challenging description of how the future may develop based on a coherent and internally consistent set of assumptions about key 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' outcomes(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.

Communities of need: Communities of need have a larger proportion of children, young people and adults that experience the impact of inequitable distribution of the determinants of health – e.g., income, employment, education, housing, health care and social support. Determinants of health are influenced by several factors, including ethnicity, social class, age, gender, sexual orientation, geographical location, exposure to abuse and neglect, and residency status. In relation to climate change, communities of need also include population groups that are more vulnerable to the direct and indirect consequences of climate change, including people with pre-existing health conditions and people more exposed to climate hazards.

Driving forces ('drivers'): Driving forces (also known as 'drivers') are typically broad scale factors which influence the direction of future change. Understanding which driving forces will have the greatest influence in shaping outcomes for the sector is an essential step in creating climate-related scenarios.

External Reporting Board (XRB): New Zealand's External Reporting Board, which issues national reporting standards for entities across the private, public and not-for profit sectors.

Hapū: A socio-political unit comprised of a number of whānau (extended families). Hapū are usually genealogically bound units, that have references to a defined geographical territory. These units ensured the socio-cultural and socio-political rights and interests of the members.

Hauora: A Māori view of health that covers physical, mental, social and spiritual needs.

Intergovernmental Panel on Climate Change (IPCC): The United Nations body for assessing the science related to climate change, and to provide governments at all levels with scientific information that they can use to develop climate policies.

Iwi: The largest socio-political unit (kinship group) referred to under a Māori social structure. An iwi is comprised of a number of hapū. Iwi are usually referred to in relation to a founding ancestor, key geographical features and territorial boundaries.

Kaitiakitanga: Kaitiakitanga is a component of a broader social, economic, cultural and spiritual system that was established by hapū to protect, guard, preserve and nurture the environment. The concept is based on Māori knowledge systems and worldviews where

a relationship with the spiritual and physical worlds are reconciled.

Kaumātua: A term that refers to a tribal elder, that has gained mutual respect from whānau members. A kaumātua usually has a good knowledge of tikanga, language and history. The term is often used to refer to all elders.

Mahinga kai: Food gathering locations, such as areas of cultivation and gardens, and the practice of food gathering, preparation, and maintenance of the environment for generations to come. Mahinga Kai practices are inherently linked to sustainability and the protection of the environment.

Mara kai: A concept that refers to food gardens. In traditional times lores were applied using tikanga and kawa to prepare, plant, grow and harvest food.

Mātauranga Māori: The value and role of distinctive Māori ways of knowing, being and doing that honour tino rangatiratanga and mana motuhake. The term is also used in relation to a traditional/ancient Māori knowledge system, that is selectively handed down through generations to elected hapū members.

Mauri: Life principle, life force, vital essence, special nature, a material symbol of a life principle, source of emotions – the essential quality and vitality of a being or entity.

Papakāinga: A term commonly used to describe housing on ancestral land and can include other activities such as marae, shared gardens (mara kai) or commercial activities that provide jobs and income to support those living in the settlement.

Paris Agreement: The Paris Agreement is an international treaty on climate change that was adopted in 2015. The agreement covers climate change mitigation, adaptation, and finance, and 195 members of the United Nations Framework Convention on Climate Change (UNFCCC) are currently parties to the agreement.

Physical risks: Risks related to the physical impacts of climate change. Physical risks can be event-driven (acute) such as increased severity of extreme weather events. They can also relate to longer-term shifts (chronic) in precipitation and temperature and increased variability in weather patterns, such as sea level rise.[2]

Rāhui: Refers to forms of restriction that are placed by Māori leaders and kaitiaki for example on land, waters, oceans to achieve forms of balance. An example that is often referred to, is the restrictions that are often placed on mahinga kai spaces disallowing the collection of kai, to allow for restoration to take place.

Rangatahi: The younger generation. A teenager or young adult.

Rangatiratanga: Chieftainship, right to exercise authority, chiefly autonomy, and chiefly authority. Within health, there is reference to the rights of tangata whenua to self-determine and manage one's own health and wellbeing aspirations according to kawa and tikanga.

Rohe: tribal territory, tribal homelands.

Rongoā (Rongoā rākau): Rongoā is related to the wider practice of healing and wellbeing, connecting to one's tinana, mauri and wairua. Rongoā rākau relates specifically to the practice of plants that provide healing and wellbeing.

Representative Concentration Pathways (RCP): A greenhouse gas concentration trajectory adopted by the IPCC. Four pathways were used for climate modelling and research for the IPCC Fifth Assessment Report (AR5) in 2014. The pathways describe different climate change scenarios, all of which are considered possible depending on the amount of greenhouse gases (GHG) emitted in the years to come.

Scenario Analysis: A process for systematically exploring the effects of a range of plausible future events under conditions of uncertainty. Engaging in this process helps an entity to identify its climate-related risks and opportunities and develop a better understanding of the resilience of its business model and strategy.

Shared Socio-economic Pathways (SSP): These are climate change scenarios of

projected socioeconomic global changes up to 2100 as defined in the IPCC Sixth Assessment Report (AR6) in 2021. They are used to derive greenhouse gas emissions scenarios with different climate policies. The SSPs provide narratives describing alternative socio-economic developments. These storylines are a qualitative description of logic relating elements of the narratives to each other.

Tamariki: Children.

Te Taiao/Taiao: Refers to the natural world, the environment that contains and surrounds us - the land, waters, star systems, climate, and living beings. The concept refers to the spiritual and physical interconnection between people and nature, as attained through genealogy and expressed through the environment.

Tikanga: Tikanga is the set of beliefs associated with practices and procedures to be followed in conducting the affairs of a group or an individual.[3]

Tohunga: An expert with experience in a selected field of practice that is founded on forms of mātauranga Māori and bound usually by tikanga and kawa. Tohunga could include experts who are highly knowledgeable in medicinal plants, including the preparation and application methods required to assist in the facilitation of healing and general wellbeing.

Tohungatanga: Expertise and proficiency. In the context of this document reference is made to the practices, skills and expertise of a tohunga in relation to health and wellbeing as understood from a te ao Māori perspective.

TCFD framework: The Task Force for Climate-Related Disclosures (TCFD) framework, is an internationally adopted structure for disclosing an organisation's climate-related risks and opportunities to investors, lenders and insurance underwriters.

Te Tiriti o Waitangi: New Zealand's treaty document that was signed in 1840 between the crown and various hapū of Aotearoa It is an agreement entered into by representatives of the Crown and of Māori iwi and hapū. The status of the Treaty has evolved over time. Unlike many other countries, New Zealand does not have a constitution in the form of a single document. It has a collection of common laws, customs and legislation that establish the framework of government.

Transition risks: Risks related to the transition to a low-emissions, climate-resilient global and domestic economy, such as policy, legal, technology, market and reputation changes associated with the mitigation and adaptation requirements relating to climate change.[4]

Whānau: The basic social unit in Māori society that refers to the extended family (up to four generations), as based on genealogy.[5] Within contemporary society the word also refers to a set of relationships that reflect that of a genealogical whānau, based on a common cause.[6]

1.2 ACRONYMS

BEV	Battery electric vehicle
CRD	Climate-related disclosures
CRE	Climate reporting entity
ICE	Internal combustion engine
IPCC	Intergovernmental Panel on Climate Change
SSP	Shared Socio-economic Pathway
TCFD	Taskforce on Climate-Related Financial Disclosures
XRB	External Reporting Board
UNFCCC	United Nations Framework Convention on Climate Change

Executive Summary

Section 2

2. Executive Summary

This report presents the climate change scenarios developed by a collective group of health sector stakeholders within Aotearoa New Zealand (NZ). The project involved drawing on insights from individuals within public agencies, private sector entities, research institutes and academia. Tonkin & Taylor Ltd (T+T) was engaged as the facilitator for this process. This sector-wide initiative was funded by the contributing parties listed on the inside front cover of this report. This report does not necessarily reflect the views of any individual, party, or contributor.

The sector scenarios contained within this report provide alternative views of the future grounded in key drivers of change and uncertainties. They are considered hypothetical plausible stories about conditions and events which ***may*** occur, however, they are not presented as predictions about what ***will*** occur. ***Whilst these scenarios have been developed to aid decision making, the data contained in these scenarios has been derived from various sources and should not be relied upon as predictive or probabilistic when making decisions.***

These scenarios provide a way for organisations in the health sector to consider and challenge their strategies and future plans. These organisations include climate reporting entities (CREs), who are required to undertake scenario analysis in line with the External Reporting Board (XRB's) reporting standard NZ CS 1.

Under NZ CS 1, the XRB defines a climate scenario as:

'A plausible, challenging description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces and relationships covering both physical and transition risks in an integrated manner' (NZ CS 1).

Under these standards, the XRB requires the development of, at minimum, three climate change scenarios:

- A high-warming scenario - 3°C or greater at the end of the century.
- At least one Paris Agreement-aligned transition scenario – 1.5°C at the end of the century.
- An additional scenario.

A Leadership Group, Technical Working Group and Te Ao Māori Roopu, each consisting of health sector experts, were established to support and oversee this work (see Section 4.3 and Appendix A for further details). The three sector-specific scenarios presented in this report align with NZ CS 1.[7]

The scenarios were agreed as follows:

- Scenario 1: A 'Hothouse world' (high-warming scenario).
- Scenario 2: A 'delayed and disorderly' transition (additional scenario).
- Scenario 3: An 'ambitious and orderly' transition (Paris Agreement-aligned transition scenario).

Section 7 provides a short overview of each health sector scenario, with detailed narratives found in Section 8.

Project Background and Purpose

Section 3

3. Project background and purpose

3.1 BACKGROUND

The impacts of climate change are already being experienced across a broad spectrum of society, resulting in damage and loss to individuals, communities, and organisations. As a result, there is a growing recognition of the risks and opportunities posed by climate change, and an increased demand for climate-related information across all sectors of society.

For example, from an investment perspective, investors are increasingly interested in evidence that organisations are considering the impacts of climate change within their business decisions. In line with this broader trend, NZ became the first country in October 2021 to pass legislation making climate-related disclosures mandatory for banks, insurers, asset managers, and larger listed companies.

The goals of mandatory climate-related disclosures are to:[2]

- Ensure that the effects of climate change are routinely considered in business, investment, lending and insurance underwriting decisions.
- Help climate reporting entities better demonstrate responsibility and foresight in their consideration of climate issues.
- Lead to more efficient allocation of capital, and help smooth the transition to a more sustainable, low emissions economy.

The legislation effectively enabled the NZ's Climate Standards (developed and governed by the XRB). The standards require the development and use of climate scenarios, and the XRB have recommended that sectoral scenarios are developed, which can then be used by entities within sectors (as shown in Figure 3.1).

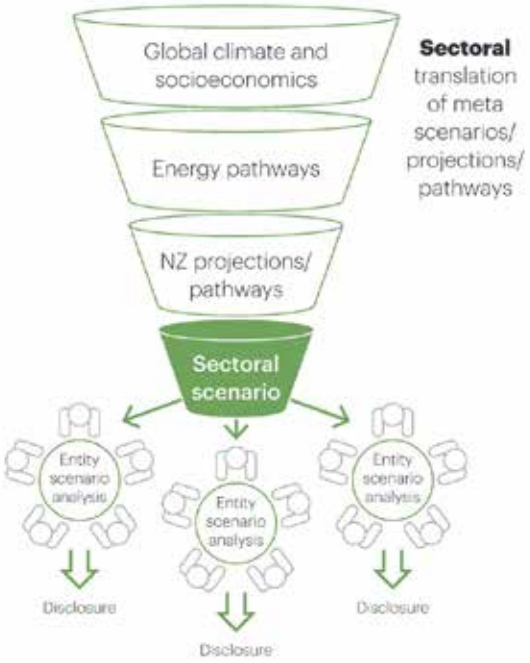

Figure 3.1: The development of sectoral scenarios for use by entities.[8]

3.2 OVERVIEW OF CLIMATE IMPACTS TO THE HEALTH SECTOR

The Lancet Countdown has stated that: 'climate change is the greatest global health threat facing the world in the 21st century, but it is also the greatest opportunity to redefine the social and environmental determinants of health'.[9] It is also widely recognised that a coordinated effort is needed across the NZ health sector to strengthen the climate resilience of health facilities, responsiveness of health services, and strategic planning of health entities.[10]

Climate hazards can result in a number of impacts on population health outcomes, health services, and the operation of health entities, including:[11]

- More frequent extreme weather events, such as heatwaves, storms and floods leading to excess mortality and illness.
- Temperature and precipitation changes that can disrupt food systems, increase the spread of vector borne diseases, and lead to mental health issues in exposed populations.
- Climate hazards that can cause broader impacts to the health workforce, health facilities and infrastructure.
- Undermining of determinants of health, such as livelihoods, education, housing and access to social support structures (see Section 5 for further information on determinants of health).

Additionally, climate-sensitive health risks are disproportionately experienced by people within communities of need. These communities have a larger proportion of children, young people and adults that experience the impact of inequitable distribution of the determinants of health, e.g. income, employment, education, housing, health care and social support. As outlined in Section 5, determinants of health are influenced by several factors, including ethnicity, social class, age, gender, sexual orientation, geographical location, exposure to abuse and neglect, and residency status. In relation to climate change, communities of need also include population groups that are more vulnerable to direct and indirect climate impacts, including people with pre-existing health conditions and people more exposed to climate hazards.

3.3 PURPOSE OF SCENARIOS

Faced with increasing operational uncertainties in a changing climate, it can be challenging to make long-term decisions. The development of these scenarios can help organisations to identify and prepare for uncertain impacts, and can inform the development of responses to safeguard population health and strengthen the resilience of health entities. As outlined in these scenarios, climate action can also deliver co-benefits to the health sector – representing a significant opportunity to improve the delivery of health services and improve population health outcomes.

3.31 FOCAL QUESTION

The focal question sets the purpose and direction for the scenario planning exercise and guides the development of the health sector scenarios.

The chosen focal question was agreed at the outset of the project and is as follows:

'How could climate change plausibly affect population health and the health and disability sector, over the short, medium and long term.'

Scenario Planning Approach

Section 4

4. Scenario planning approach

4.1 INTRODUCTION TO CLIMATE SCENARIO PLANNING

Climate scenario planning is a tool that can help organisations navigate complex and uncertain futures. The process involves developing ***scenarios*** (which are plausible, hypothetical narratives about what the future might look like) that can then help with strategic planning. Within the climate change context, scenarios are often used to test strategies, identify climate-related risks and opportunities, and then assist with transition planning. The purpose of scenario analysis under NZ CS 1 is to help entities explore the climate-related risks and opportunities they may face and therefore better understand the resilience of their business model and strategy. Figure 4.1 provides a visual example of the scenario development process.

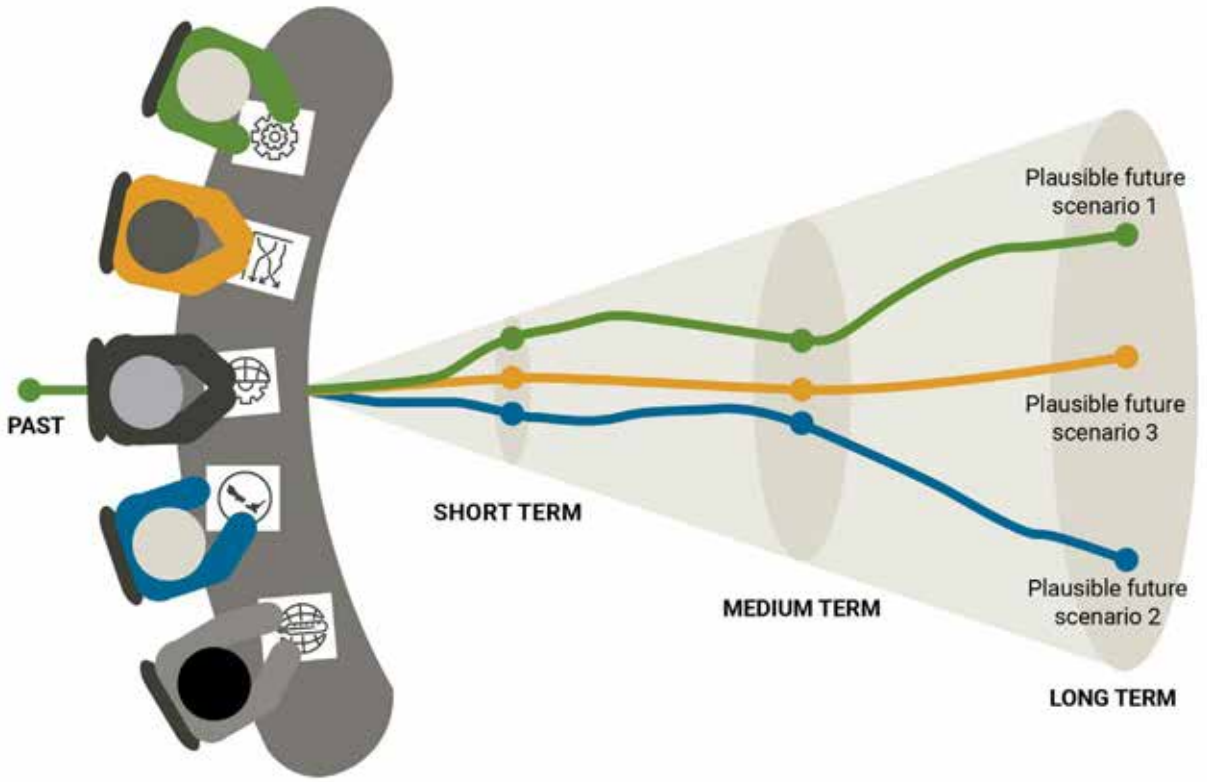

Figure 4.1: Visual example of climate scenario development.[12]

For further details regarding scenario planning methodology, please refer to Appendix B.

4.2 HEALTH SECTOR SCENARIO OBJECTIVES

Scenarios should be challenging, provide significantly different yet plausible views of futures, and also be specific and decision relevant to an organisation. While scenarios are not plans or policies, they support strategy, planning and policy development. Sectoral scenarios are inherently broad and encompass elements and storylines relevant to the range of organisations within different NZ sectors. Entities themselves may wish to further extend scenario development within their own organisation, building on these sector scenarios.

Under the XRB guidance, the broad objectives of scenario development are to:

- Translate the global and national reference-scenarios and potential pathways into tangible consequences for the sector.
- Build a cross-sector common understanding of climate-related risks and opportunities and of the scenario analysis process.
- Give visibility to the challenges faced by the sector in developing and implementing their approach to climate change adaptation.
- Highlight opportunities for addressing the challenges that will have the greatest impact in supporting the health sector's adaptation to climate change.

The primary objective of the health sector scenarios project was to *develop credible and plausible scenario narratives that are supported by relevant data and evidence* (where possible). Additional objectives were to:

- Build awareness and strengthen capacity for climate change solutions across the health sector through the use of an accessible and robust engagement process.
- Produce clear and understandable information that is tailored to the needs and context of stakeholders.

Finally, it is noted that this project only involved *developing* scenarios for the NZ health sector. The *analysis* and *use* of the scenarios by entities is a separate process that each will approach in their own way.

4.3 PROJECT GOVERNANCE AND TECHNICAL INPUTS

Three groups were set up for this project to provide specific oversight and governance, technical inputs and specific inputs from a Te Ao Māori perspective. Please refer to Appendix A for further details on the groups listed below.

4.3.1 LEADERSHIP GROUP

The Leadership Group (LG) consisted of a chair and four members who provided oversight through the development of the health sector climate change scenarios.

Key roles of the LG were as follows:

- *Project delivery:* Monitor and guide the development and outputs of the scenarios.
- *Governance:* Provide sign off and approval for interim and final deliverables.

4.3.2 TECHNICAL WORKING GROUP

The purpose of the Technical Working Group (TWG) was to provide technical input and review to enable development of the scenarios and provide a technical review of project deliverables. The TWG consisted of a chair and approximately 30 members from the sector.

To qualify as a TWG member, individuals had to have professional expertise and experience in either public health, climate change, aged care, Māori health or other relevant thematic areas.

At various times during the project, specific members of the TWG were consulted on individual topics, related to their expertise.

4.3.3 TE AO MĀORI ROOPU

A Te Ao Māori Roopu was established to provide specific advice in reference to Te Tiriti o Waitangi and Hauora Māori, particularly across public and population health, and this included input from Iwi-Māori Partnership Boards.

Defining the Scope of the Health Sector

Section 5

5. Defining the scope of the health sector

5.1 HEALTH SYSTEM AND POPULATION HEALTH

As population health is a key component of the health sector scenarios, as outlined in the focal question (refer to Section 3.3), the scenarios have a strong focus on 'determinants of health'.[13,i]

Research from the World Health Organisation (WHO) indicates that key determinants of health include factors such as where we live, the state of our environment, our income and education level, and our relationships with friends and family.[13] Some of these factors are within the control of individuals, but many are outside their control. For example, the Pae Ora (Healthy Future) Act 2022 refers to climate change as a 'wider determinant' of health, a determinant that cannot be controlled by an individual.[14]

The distribution of determinants of health in NZ influences the health of the NZ population, which in turn influences the strategic priorities and status of the health system and its entities. The health entities that were assessed in the scenarios include:

- Primary and community health services (including specialist general practitioner doctors, physiotherapists, and dentists), community health centres, and hauora providers.
- Secondary and tertiary hospital services (including outpatient services, and hospital inpatient care).
- Other services, such as health protection and promotion (including services delivered by public health units).

Therefore, changes in population health will influence the demand for health services, health sector funding needs, workforce requirements, and other factors impacting the wider sector.

In the XRB sector level guidance, the selection of 'drivers of change' or 'driving forces' is a critical step in the development of scenarios[7]. There is a strong overlap between the ***determinants of health and driving forces***. The key determinants of health/driving forces (hereon referred to as driving forces) have been categorised by the STEEP categorisation (social, technical, economic, ecological and political) and are outlined in Figure 5.1. An additional 'Te Tiriti' category has also been added, given the importance of a Te Ao Māori view in a NZ context.

In addition, the scenarios acknowledge the importance of Te Tiriti o Waitangi and the status of Māori as treaty partners. This includes the role of government in actively supporting hauora Māori to pursue health equity, including ensuring Māori can exercise authority over their own health and wellbeing in ways that enable Māori to flourish.

This is of particular importance in the context of the inequities that Māori currently face and the potential compounding impacts this will have in the developed climate disorderly/orderly and hothouse worlds. We acknowledge the global drive under the Sustainable Development Goals to ensure that no one is left behind.

The sector scenarios seek to advance this goal, by building on previous public health initiatives that highlight the particular health inequities faced by Māori. These scenarios have also been developed to ensure that hauora Māori is forefront in decision making, to help advance policy and strategic pathways that take cognisance of the potential disproportionate impact that Māori may face.

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[i] *Determinants of health (which are also known as 'social determinants of health') are the circumstances in which people are born, grow up, live, work and age. These circumstances are in turn shaped by a wider set of forces: economics, social policies, and politics.*[13]

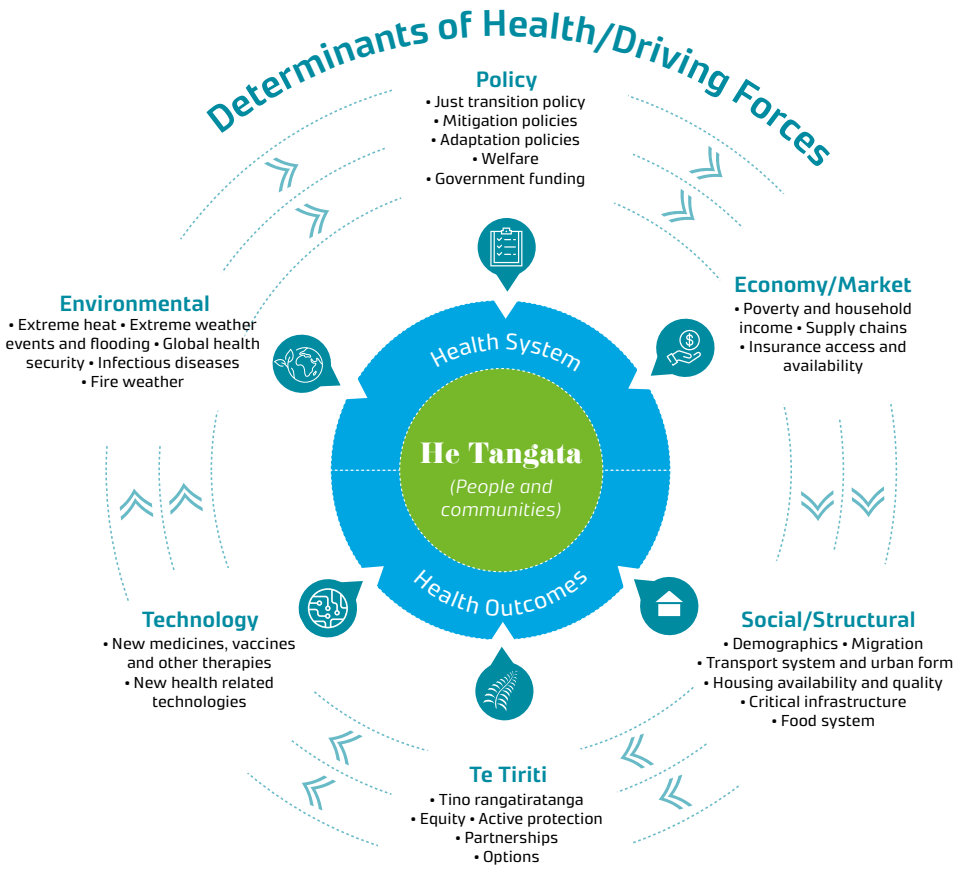


Figure 5.1: An overview of the scope the scenarios - this indicates key determinants of health and driving forces which relate to the health sector and health outcomes. Adapted from source.[11]

5.2 CLIMATE-RELATED HEALTH IMPACTS

Given the broad scope of the health sector scenarios, the narratives developed focus on the impact of climate change on health from the short-listed driving forces. A process was used to shortlist drivers, which is described in Section 6.

To illustrate the complexity and multiplicity of potential risks, Figure 5.2 provides an example of risks that arise (and cascade) due to flood, heavy rainfall and storms. The diagram illustrates primary (direct) risks and secondary (indirect) risks, as well as amplifying factors and health impacts. The range of risks presented in this diagram illustrates the importance of a broad definition of the health sector rather than a more narrow focus on just health sector entities and their services.

The health impacts arising from climate risks can cascade across sectors and through time. For example, evacuating communities during an extreme weather event can amplify crowding in shelters – this can, in turn, increase the number of infections for patients with pre-existing conditions as well as introduce new infections and vector-borne diseases. Additional health impacts may include violence and post-traumatic stress disorder.

A second example is the secondary risk of disruption to critical infrastructure (e.g., water main damage), which can amplify existing risks relating to contaminated soil and water. This could lead to illness, infections or chronic poisoning.

These complex interrelationships will vary for different climate hazards, driving forces, and also different health outcomes. For example, the vast number of complex systemic pathways by which climate hazards can impact mental health.[15]

Furthermore, Figure 5.2 identifies the importance of applying systems thinking to assessing climate risk. In this regard, entities should consider systems assessments as a part of their entity level scenario analysis. For example, an aged care provider may develop a system map that illustrates the risks and causal relationships resulting from an extreme weather event. This could be based on a future example in a scenario – such as the fictitious cyclone outlined in Scenario 2 (Box 4 in Section 8) – or the impacts of a past acute climate event (such as Cyclone Gabrielle).

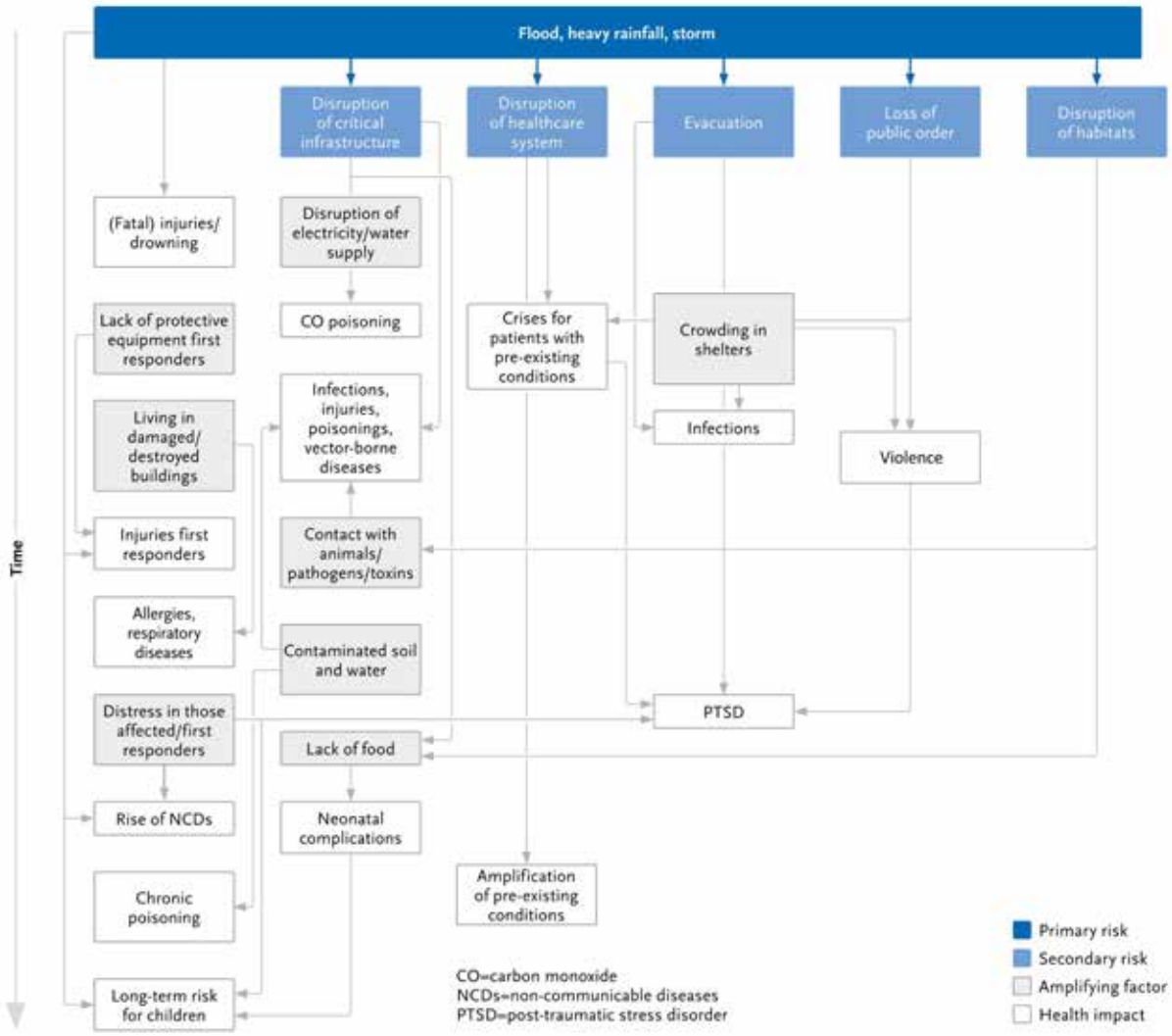


Figure 5.2: Cascading risks triggered by floods, heavy rainfall and storms. Arrows indicate possible casual relationships between risks, amplifying factors and health consequences. Adapted from source.[16]

Scenario Methodology And Inputs

Section 6

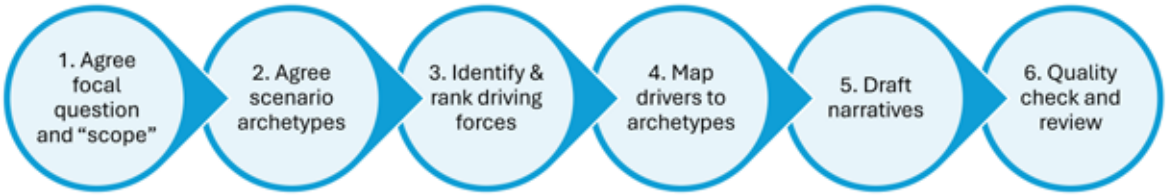
6. Scenario methodology and inputs

The climate scenarios presented have been developed for use by the health sector to undertake climate scenario analysis. These are intended to be used to test the resilience of entity strategies and plans under plausible yet challenging futures. ***The data contained in these scenarios has been derived from various sources and should not be relied upon as predictive or probabilistic when making decisions.*** The data is reflective of the available information at the time these scenarios were developed (September 2023 to February 2024). Updates should be made to these scenarios as new data becomes available. In addition, Appendix D outlines evidence-based metrics from peer reviewed sources.

6.1 METHODOLOGY OVERVIEW

The approach taken to develop the scenarios was based on guidance from TCFD and the XRB. Six steps were undertaken, as shown in the Figure 6.1, with a series of workshops being held with the TWG and Roopu as the project progressed. For further details on the methodology, refer to Appendix B.

Figure 6.1: Project steps.



6.2 TIME HORIZONS

The scenarios focused on short-, medium- and long-term time horizons. For the purposes of the sector scenarios, these are defined as:

- Short-term 2023 (present-day) – 2030.
- Medium-term 2030 – 2050.
- Long-term 2050 – 2100.

6.3 ARCHETYPES AND REFERENCE SCENARIOS

Three scenario 'archetypes' were agreed with the TWG. These follow a relatively consistent and common convention – namely:

- **Scenario 1:** Hothouse world.
- **Scenario 2:** Delayed and disorderly transition.
- **Scenario 3:** Ambitious and orderly transition.

In order to further describe these three archetypes, they were aligned with global reference scenarios – the UN Intergovernmental Panel on Climate Change (IPCC) Shared Socioeconomic Pathways (SSPs).

The SSPs describe major global developments that together lead to different challenges for mitigation and adaptation to climate change.[17]

The SSPs are based on five narratives describing alternative socioeconomic developments including sustainable development (SSP1), regional rivalry (SSP3), inequality (SSP4), fossil-fuelled development (SSP5), and middle of the road development (SSP2).[18]

To provide a robust foundation for creating the scenario narratives, each health sector scenario archetype has been referenced to one of the SSPs, as well as being aligned to the policy direction from the New Zealand Climate Change Commission (namely, the current policies, headwinds or tailwinds scenarios).[19] The three archetypes are summarised in Table 6.1.

Table 6.1: Summary of three archetypes

6.4 IDENTIFYING DRIVING FORCES

	Scenario 1 (>3°C aligned)	**Scenario 2**	**Scenario 3** (1.5°C aligned)
	'Hot House World'	**'Delayed & Disorderly'**	**'Ambitious & Orderly'**
SSP Scenario: **Temp. (2050):** **Temp. (2100):** **CCC Scenario:**	• SSP3 – 7.0 • 2.1°C • 3.6°C • Current policies	• SSP2 – 4.5 • 2.0°C • 2.7°C • Headwinds	• SSP1 – 1.9 • 1.6°C • 1.4°C • Tailwinds
Summary:	With resurgent nationalism around the world, policies shift over time to become increasingly oriented towards domestic and regional priorities. There is declining public investment in health and education, with countries focusing on achieving their own energy, water and food security at the expense of international cooperation.	The world follows a path in which social, economic, and technological trends do not shift markedly from current patterns. While global ambition and rhetoric are high, the implementation of climate action is variable across countries.	The world shifts towards a more sustainable and socially inclusive path, which respects environmental boundaries and emphasises human health and wellbeing. With growing recognition that climate change is causing a global health emergency, emissions decline globally from 2025 - 2050 through the implementation of ambitious and coordinated climate action across countries.

The most significant driving forces are critical factors that can have a material impact on the health sector and population health outcomes (as per the focal question). They are usually large-scale, exogenous factors that impact how climate risks and opportunities cascade through the health sector. The XRB outlines the importance of 'understanding which driving forces will have the greatest influence in shaping outcomes for the sector is an essential step in creating climate-related scenarios'[7].

Through the workshop process, the TWG identified a long list of driving forces that will affect the health sector in the future (Appendix C). This long list of drivers was then ranked to identify a short list of drivers that were then used to create the scenarios.

These short-listed drivers are identified in Table 6.2 with the corresponding identification letter (e.g. C1) for reference to the long list of drivers in Appendix C.

At a high level, the process for identifying driving forces was as follows:

- Brainstorming and identifying drivers within categories shown in Figure 5.1.
- Review and refinement of the long list.
- Shortlisting through ranking of impact/importance.
- Differentiation of scenario archetypes based on high-impact drivers with high uncertainty.
- Development of driver mapping across the three agreed archetypes.
- Developing detailed narratives.

For further detail on the specifics of this method, please refer to Appendix B.

Table 6.2: Shortlisted driving forces

Category	Driver
Cultural	**C1**: Te Tiriti o Waitangi.
Environment	**E1**: Changes in the severity, frequency and duration of fire weather. **E2**: Extreme heat and heatwaves. **E3**: Extreme weather (storms, high winds, high rainfall) and associated flooding. **E5**: Infectious diseases, insects and pests. **E6**: Changes in global health security.
Financial / Economic	**F3**: Household income (inequities). **F4**: Poverty. **F5**: Health sector staffing. **F7**: Welfare (including superannuation).
Policy	**P1**: Government policy on transition to low emissions economy. **P3**: Government policy on a just transition. **P4**: Government policy on adaptation. **P5**: Political change.
Social/ Structural	**S2**: Changes in food demand/consumption (due to commercial actors, marketing). **S3**: Changes in local water security (driven by physical hazards e.g. drought). **S4**: Changes in global and local food supply (yield/availability). **S5**: Demographics. **S6**: International migration. **S7**: Domestic migration. **S8**: Stability of electricity system, and cost. **S9**: Housing availability and quality. **S11**: Changes to urban form. **S12**: Changes to transport systems and travel modes.
Technology	**T1**: Development of new medicines, vaccines, and other therapies. **T2**: Development of health-related technologies. **T3**: Quality of the climate-related public health surveillance system. **T4**: Development of low-carbon technologies

Scenario Overviews

Section 7

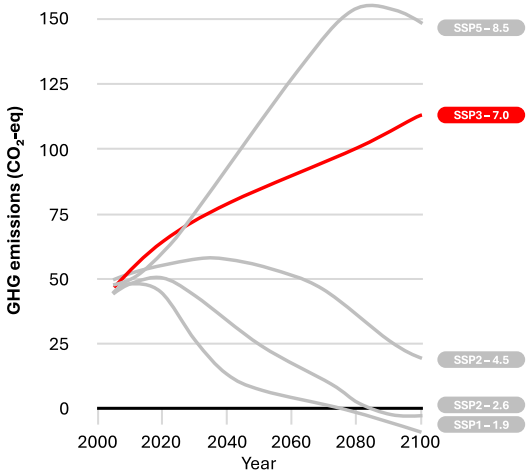
7. Scenario overviews

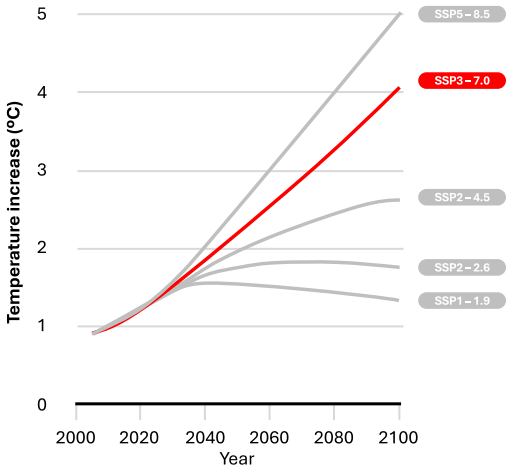
The scenarios summarised in this section are presented to provide a brief snapshot and set the global and key national context for the full narratives – which are provided below in Section 8. The tiles indicate key statistics or metrics that provide insight into the scenario.[ii]

The global level descriptions are derived from the IPCC SSP narratives. The national level descriptions are drawn from the highest-ranked driving forces that emerged from the driver ranking process undertaken via workshops, and feedback received from the TWG.

7.1 SCENARIO 1 OVERVIEW: HOTHOUSE WORLD

[ii] *The variables and indicators in the scenarios are not intended to demonstrate precise future values and should not be used to conduct probabilistic calculations. The variables and indicators provided are from both peer-reviewed sources (when a relevant source is available) and formulated by the T+T specialists and TWG members.*





Reference scenario:

SSP3-7

Global average temperature projection (2081–2100):

3.6°C

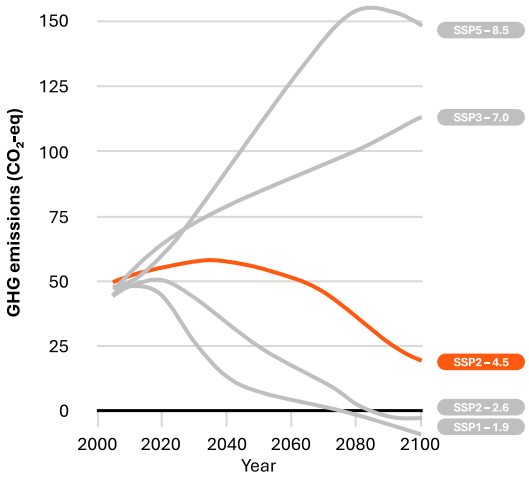
GLOBAL CONTEXT

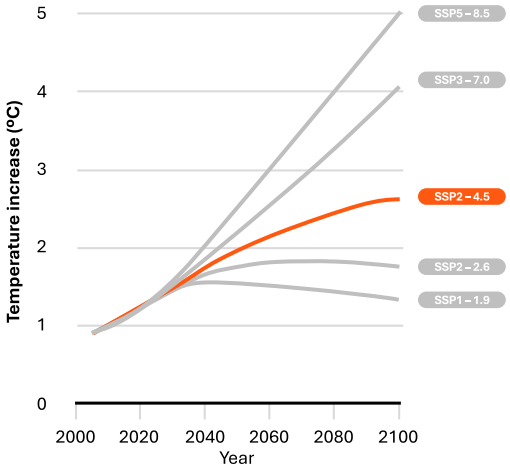
- Global efforts to address climate change are insufficient, leading to severe physical risks and irreversible impacts.
- There is a growth in nationalism and geopolitical tension, as countries become increasingly oriented towards domestic priorities.
- Economic development is severely hindered, and poverty increases in climate vulnerable countries.
- Health impacts are widespread and increase in severity across all aspects of society, with large health inequities both within and between countries.

NEW ZEALAND CONTEXT

- Policy failures, both in NZ and internationally, contribute to an acceleration of climate impacts across the century.
- Communities across the country are increasingly affected by climate impacts throughout the century, including severe and frequent heatwaves, extreme weather, and increasing food and water insecurity.
- The transparency and accountability of governance systems decline, leading to reduced public trust, erosion of democracy, and polarisation of society. There are substantial reductions and disruptions in government services, negatively impacting healthcare access.
- By 2040, successive governments havent worked effectively with Māori on a sustainable basis, including insufficient progress to achieve Māori health equity. This results in stronger collective action to push for focus on Māori health needs.
- Health inequities increase throughout the century, as climate risks negatively impact determinants of health. Severity and prevalence of mental health issues increase, especially for younger and older people living in climate-exposed areas. Health access and quality of care are substantially impacted, as health facilities close, waitlists grow, privately funded health service delivery increases, and travel is frequently disrupted by extreme events.

7.2 SCENARIO 2 OVERVIEW: DELAYED AND DISORDERLY TRANSITION





Reference scenario:

SSP2-4.5, CCC Headwinds

Global average temperature projection (2081–2100):

2.7°C

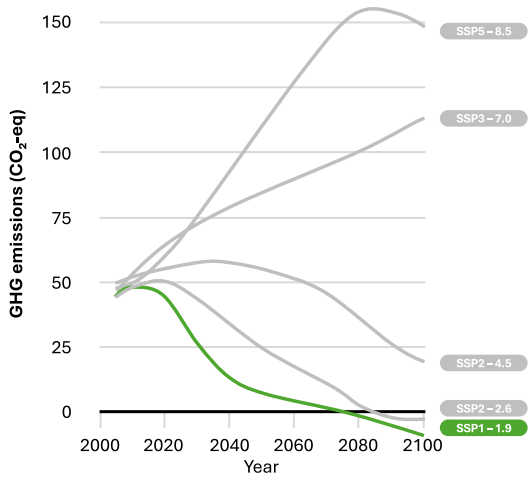
GLOBAL CONTEXT

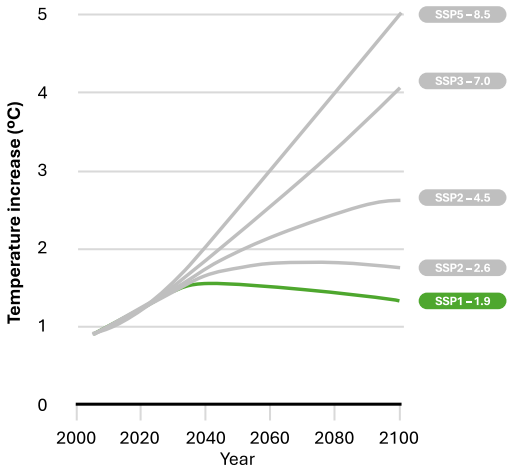
- The world follows a path in which social, economic, and technological trends do not shift markedly from current patterns.
- International agreements in the early 2030s result in incentives for countries to undertake climate action and catalyses strengthened emissions reduction planning, including in NZ.
- With a delayed and disorderly transition, physical risks increase markedly throughout the century.
- While there are health challenges in many countries, global health risks are reduced by strengthened international cooperation and the availability of improved therapeutics and vaccines.

NEW ZEALAND CONTEXT

- The delayed implementation of emissions reduction action results in high social costs, and there is inadequate public funding available to support a just transition.
- There is a steep cut in emissions between 2035 to 2050, followed by a gradual decline in the second half of the century.
- The century sees a growth in economic and social disparities, exacerbated by transition and physical climate risks.
- By 2040, successive governments reduce or abandon NZ's commitments under the United Nations Indigenous People's Rights Declaration, which leads to a redefined application of Te Tiriti o Waitangi.
- Despite the high costs and disruption associated with the transition, some policies to reduce emissions deliver health co-benefits. There is, however, a decline in the overall health status of the NZ population due to reduced investment in health services, direct health risks from increased exposure to physical climate hazards, and the undermining of health determinants.

7.3 SCENARIO 3 OVERVIEW: AMBITIOUS AND ORDERLY TRANSITION





Reference scenario:

SSP1-1.9, CCC Tailwinds

Global average temperature projection (2081–2100):

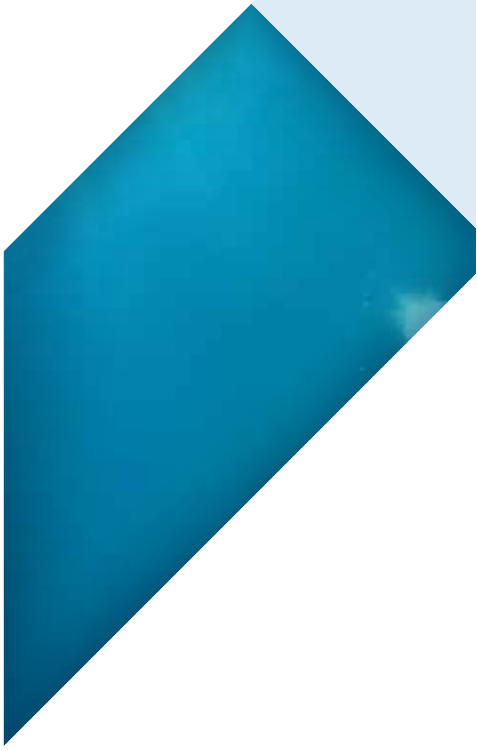
1.4°C

GLOBAL CONTEXT

- The world shifts towards a more sustainable and socially inclusive path, which respects environmental boundaries and emphasises human health and wellbeing.
- Throughout the 2020s, major corporate polluters commence rapid emissions cuts following a series of legal judgements across jurisdictions.
- Emissions decline globally from 2025 - 2050 through the implementation of ambitious and coordinated climate action across countries.
- There is a decline in global poverty and reduced gaps in per capita income across countries. Treatments for disease improve, global health risks decline, and life expectancy increases throughout the century.

NEW ZEALAND CONTEXT

- The transition in NZ is coordinated and immediate, with decarbonisation taking place across all sectors of society. There are clearly signalled policy changes aligned with the SSP1-1.9 pathway, reaching net zero emissions by 2050.
- Through consultative and transparent public sector engagement, shifting social norms, and increasing recognition of the benefits of climate action, support for the transition grows across society.
- There is a longer-term shift towards environmental protection and social justice. Political pressure is applied to central government to advance the Sustainable Development Goal of 'leaving no one behind'.
- Successive governments adopt a significant focus on eliminating inequities for Māori, supporting their rights and interests under Te Tiriti o Waitangi.
- The health system shifts rapidly to deliver low-emissions care and the sector is seen as a sustainability leader within NZ. There is a move to community-oriented healthcare, with a strong focus on addressing the risk factors that lead to disease, which leads to a decline in preventable hospital admissions.



Detailed Scenario Narratives

Section 8

8. Detailed scenario narratives

SCENARIO 1: HOTHOUSE WORLD

Overall context

1.1 Global context

The world moves into an era defined by extreme nationalism and geopolitical tension. Domestic issues are prioritised over regional and global concerns, with efforts to address greenhouse gas emissions being supplanted by a focus on economic growth.

In November 2024, the newly elected administration in the United States announces their withdrawal from the Paris Agreement and the United Nations Framework Convention on Climate Change (UNFCCC). As a result, throughout the 2020s, there is increased instability and distrust in the global climate negotiations, and additional countries begin to withdraw from the UNFCCC. The international climate framework holds on by a thread for a decade, but officially collapses in 2036. This triggers a dramatic decline in the price of European emissions credits and the global collapse of emissions markets.

As there is minimal action to reduce emissions, global average temperatures surpass 2°C by 2050 and increase to 3.6°C above pre-industrial levels by 2100. Severe, frequent, and in some cases irreversible, physical impacts result which cause widespread loss and damage.

Economic development is severely hindered, and poverty increases in climate vulnerable countries across the century. This heightens international health security concerns, particularly from infectious diseases and food insecurity. Government institutions at all levels are challenged due to the multiple and cascading implications from climate risks and poor economic performance.

The level of public investment in health and education declines globally. Health impacts are widespread and increase in severity across all aspects of society, with large health inequities both within and between countries.[20]

1.2 National context

Policy failures, both in NZ and internationally, contribute to an acceleration of climate impacts across the century. There are substantial reductions and disruptions in government services, negatively impacting healthcare access.

Throughout the 2020s, successive governments prioritise recovery following extreme weather events over reducing greenhouse gas emissions. As a result, central government does not meet its international emissions reductions target.[iii]

Achieving the international commitment under NDC1 requires offsetting emissions through purchasing international permits. As the cost of buying permits is estimated at NZ$ 23 billion, central government decides to walk away from its international commitment in 2030.[21] With several key trading partners also not meeting their targets, successive governments do not face any material consequences from this action.

This approach is supported by the majority of New Zealanders, particularly communities that have been most impacted by extreme events – which leads both major political parties to prioritise disaster recovery and adaptation action over emissions reduction. The Climate Change Response (Zero Carbon Act) Amendment Act (2019) is repealed in 2036 following the collapse of the UNFCCC, leading to the abolition of the NZ Emissions Trading Scheme.

The transparency and accountability of governance declines in NZ, which reduces public trust, erodes democratic norms, and causes further polarisation of society. In 2040, central government are in discussions with iwi/Māori. There is on-going collective action against policy changes and the

[iii] *The target is articulated in NZ's first Nationally Determined Contribution (NDC1), which covers the period of 2021 to 2030.*

limited resources available for communities of need. While there is a strengthening of social cohesion in some spaces, many other communities experience an increase in factionalism and division.

Health inequities increase throughout the century, as climate risks negatively impact determinants of health. Long-term successive government strategies to address these issues have limited success. The increased severity and frequency of extreme weather events leads to worsened health, particularly to communities of need (whānau, families and individuals with multiple health co-morbidities).

The severity and prevalence of mental health issues increase, especially for rangatahi (youth) living in flood-prone areas, and also in communities exposed to fire and drought hazards. Health access and quality of care are substantially impacted, as health facilities close, waitlists grow, and travel is frequently disrupted by extreme events.

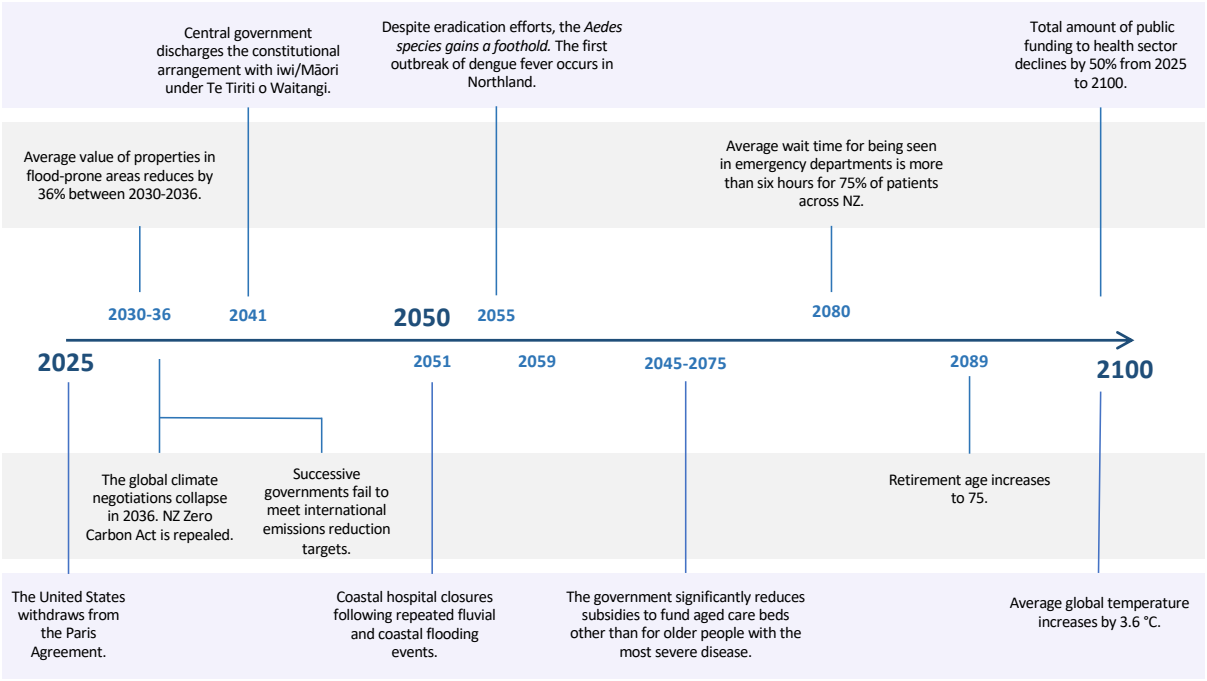


Figure 8.1: A summary of key events occurring over 2025 - 2100 in Scenario 1.

Government policy and funding drivers

2.1 Policy

NZ is caught in a cycle of response and recovery, which limits the availability of resources for climate readiness and adaptation.

Policies to reduce emissions are weakened and abandoned by successive governments, as the use of fossil fuels remains widespread, particularly for vehicles, air travel, and baseload electricity generation. Some industries still invest in reducing emissions, but this is driven by global technological advances and cost savings rather than policy settings.

Public funding is focused on maintaining critical infrastructure and protecting large urban areas, resulting in resources being unequally distributed across NZ. This disproportionately increases the climate risk to housing in lower-income and rural areas, further exacerbating health inequities in

communities of need, including rural Māori communities and the Pacific population in South Auckland.

2.2 Government funding

Public funding and financing are severely impacted throughout the century, with an increasing proportion of central government budget allocated to disaster response and recovery, policing and prisons, and the cost of public debt repayments.[22] The condition of the NZ economy deteriorates throughout the century due to climate shocks and increased trade protectionism, leading to public debt increasing faster than central government revenue.

Increasingly constrained successive government budgets result in massive cuts in healthcare spending, impacting the whole health sector. The total amount of public funding to the health sector (in terms of dollars spent on health in the budget) declines by 50% between 2025 and 2100, while the proportion of private funded services (both user funded services and health insurance contributions) increases throughout the century. User funded services (which are also known as out-of-pocket expenses) increase from 15% in 2025 to 40% in 2100, and private insurance contributions increase from 5% of health financing in 2025 to 20% in 2100.[iv]

The limited amount of public funding available goes primarily to acute hospital services and patients with the most severe disease. Most primary care and community services are funded by out-of-pocket expenses, and major elective surgeries are solely funded by private health insurance. Central government significantly reduces subsidies to fund aged care beds between 2045-2075, other than for older people with the most severe disease.

Funding to science and research is equally strained, which reduces the capacity to develop innovative solutions to the major social, environmental and economic crises afflicting the country. The health sector is particularly impacted by funding cuts to the Health Research Council of NZ, limiting the understanding of how climate-related impacts are affecting health outcomes.

Successive government funding to communities of need, such as Māori communities, declines over time, limiting the capacity of these communities to adapt to extreme events. This places further stress on personal, whānau and hapū health and wellbeing. With central government funding to health services declining, Māori health providers no longer receive funding.

2.3 Mātauranga Māori

As there is no longer funding for Māori health providers providing community and primary care, there is a decline in the cultural safety of healthcare services. A higher form of dependency amongst low-income whānau develops within the context of a failing health system. Many low-income whānau and families struggle to access services, particularly in rural areas. In many places, taonga species have not survived the extreme weather conditions. Biodiversity has collapsed, waterways are highly contaminated and the overall mauri of the taiao is in disrepair. In anticipation of this loss, mātauranga Māori and rongoā experts co-invest in innovative controlled environments to ensure the survival of some taonga species.

Socioeconomic and demographic drivers

3.1 Socio-economic status

Poverty and socio-economic inequities continue to increase, with successive government welfare spending eroded by increasingly scarce and contested funding. By the end of the century, welfare for unemployment and chronic illness (e.g., the sickness benefit) is no longer available.

Health inequities increase because of worsening economic conditions, decline in publicly funded health services, and increasing

[iv] *The metrics provided in the three scenarios on the allocation of funding in 2100 are fictitious. The metrics provided on funding in 2025 are sourced from the International Health Care System Profiles.*[23]

living costs. This leads to a reduction in social cohesion, which exacerbates the vulnerability of communities to acute and chronic climate events, and further increases poverty levels.

With limited central government funding, superannuation becomes means tested and the retirement age increases to 75 in 2089. While superannuation payments are the main source of income for many older New Zealanders, these are increasingly inadequate. Climate-related impacts have increased the costs of key household goods and services, such as transportation and insurance. This increases poverty among this age group, and contributes to negative health impacts associated with the undermining of health determinants. Health impacts include worsened mental health, poor nutrition, and a higher risk of dementia, disabilities and reduced life expectancy (particular for older individuals with limited savings).[24]

There is a movement of rural Māori and other population groups from climate exposed rural areas to towns and cities. A combination of unaffordable housing, resource shortages, high unemployment and insufficient central government support increases poverty in urban communities of need. In Māori communities, this has significant health and wellbeing implications, particularly for tamariki (children) and kaumātua (older people), exacerbating long-term inter-generational poverty and economic inequities.

Where regional Māori economies have diversified, resilience is somewhat higher. For most people, however, day-to-day survival is difficult. Key Māori business interests, especially in the primary sector, become severely challenged as climate damages affect financial performance and the capacity of iwi to directly assist their own.

3.2 Demographic changes and migration patterns

Conflict and resource shortages cause a mass displacement of people globally, including within the Pacific. Given NZ's *relative* temperate geography and resilient economy – in comparison to other countries – climate-displaced people aspire to migrate to NZ.

With an ageing workforce and ongoing economic challenges, central government's immigration policy focuses on high-net worth individuals and working-age migrants. Given NZ's strong people-to-people ties to the Pacific, and high demand for primary sector and construction workers, over a million migrant workers from the Pacific move to NZ across the century.

The population in 2050 increases to 6.93 million people from 5.25 million in 2025. Over this period, the population older than 65 increases from 17% to 22% and the population older than 85 increases from 2% to 4%.[25] The ageing population leads to significant demographic changes, but the immigration of younger migrants helps to offset the increasing age dependency ratio.[v]

The rising sea levels shapes the geographic distribution of settlements across NZ, with movement of people away from coastal areas that are inundated and highly exposed to flooding.[vi] Relocation of the most at-risk coastal communities is largely unplanned, as households need to self-fund movement to less exposed locations. Due to funding constrain successive governments no longer provide financial support to coastal communities to undertake managed retreat.

For households in inland areas that are exposed to periodic flooding, there are limited options for lower income households (and households in other communities of need) to relocate. Immobile households are more likely to have poor health outcomes due to higher rates of housing insecurity, homelessness, and poor health access (as health facilities close in communities at high risk from climate hazards).

The price of property in areas with less exposure to climate hazards increases dramatically, which further increases economic inequities. High income communities living in low-risk areas experience better health outcomes, while the health condition of communities in coastal areas and flood hazard zones declines across the century.

The increase in climate migrants and refugees from around the world and the Pacific causes competition for jobs, and places pressure on food and water supplies. For labourers and blue-collar workers who work outside, on-job hours have been significantly reduced due to extreme weather conditions.

Environmental drivers

4.1 Extreme heat and heatwaves

There is a rise in extreme heat events throughout the century, with cities and towns experiencing significantly higher temperatures due to the urban heat island effect. This is offset, in part, by an effort to increase green spaces, but many of these attempts fail as frequent water shortages result in vegetation loss.

The behaviour of New Zealanders changes to accommodate a shift to hotter summers, with outdoor working (e.g. agriculture and construction) and exercise no longer taking place between the hours of 10:00 - 4:00pm during heatwaves.[vii] These modifications help to reduce the mortality rate associated with extreme heat, but excess deaths continue to increase due to limited adaptation options during the most extreme heat events. **Box 1** describes a series of heatwaves that occur in 2041, which result in increased excess mortality and health system impacts.[27]

4.2 Extreme weather events and associated flooding

The century also sees an increase in the severity and frequency of extreme weather events, with particularly costly impacts to flood-prone and coastal areas. While households with financial resources relocate from the most at-risk areas, many lower income individuals and communities of need, do not have the resources. The cumulative impact of extreme events causes damage to the housing stock and loss of personal possessions and associated psycho-social stresses.[28]

There are short term health impacts, such as an inacrease in acute injuries from floodwaters, and longer term impacts including post-traumatic stress disorder, depression, and anxiety in the months following exposure to flooding.[28,29] **Box 2** outlines how these health impacts are inequitably distributed, with communities of need facing greater health risks from flood hazards.

4.3 Infectious diseases, insects and pests

The distribution of infectious diseases (such as vector-borne diseases) is also affected by changes in climatic conditions. In the early 2040s, there are several instances of the *Aedes species* of mosquito being introduced from container ships. Despite eradication efforts, these species gain a foothold across the North Island, and the first outbreak of dengue fever occurs in Northland in 2055. While there are improved treatments for vector-borne diseases available, the number of infections and severity of illness is higher in communities of need in Northland, particularly isolated rural households. In the second half of century, dengue fever and associated diseases are highly treatable, but access to medication is regularly impacted – particularly as a result of extreme weather events affecting supply chains later in the century.[30]

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[v] *Key factors in demographic change are fertility, mortality, and migration patterns. In NZ, population growth is expected to slow, due an ageing population and a narrowing of the gap between the number of births and deaths. Future policy settings on migration would influence population growth and the age dependency ratio – which is the number of people in the 'dependent' age groups (e.g. 0 – 14 and 65+ years) to the working-age population (e.g. 15 – 64 years).*[25]

[vi] *There are location specific sea-level rise projections out to the year 2300 for every 2 km of the coast of NZ – these projections can be accessed through an online tool on the NZ SeaRise website.*

[vii] *At present, there are heat warning issued in the United States and the United Kingdom that recommend people avoid being outside between 10:00 am - 4:00 pm*[26].

4.4 Fire weather

Fire weather worsens throughout the century, driven by increased temperatures and drought conditions – wildfire risk is the highest in Canterbury, which experiences dramatic reductions in rainfall and higher windspeeds.

Wildfires impact air and water quality, particularly in communities near forested areas, such as Rotorua, Northland, Tairawhiti and Christchurch. This causes an increased number of hospitalisations due to asthma and respiratory diseases, and disrupted health services as ventilation and air conditioning systems in hospitals are overwhelmed by smoke and ash.[31] Transboundary haze from Australia also periodically reduces air quality in NZ, which further increases the health burden and leads to increased climate anxiety.

4.5 Water security

Droughts and floods lead to water insecurity across NZ, especially in areas with ageing and underfunded water supply infrastructure. Periods of extreme drought lead to strict water conservation measures being implemented by Councils. While water supply to health facilities is prioritised, there are concerns that the volume of water stored on site for emergency use is insufficient.

Water quality issues also occur, such as increased exposure to cryptosporidium and other water-borne pathogens.[viii] Access to safe drinking water and sanitation becomes a growing public health issue, particularly in communities of need, such as among the urban poor and isolated rural Māori communities in eastern regions of NZ.[ix]

Built environment and food system drivers

5.1 Transport systems and urban form

Transport policy is focused on the recovery and maintenance of road infrastructure. There is a gradual increase in battery electric vehicle (BEV) use throughout the century, but this is primarily driven by consumer preferences (e.g., frustration due to ongoing fuel shortages from supply chain disruptions) rather than policy incentives. There are no central government subsidies in place to support the uptake of BEVs, and individuals from lower-income households mostly continue to drive second-hand Internal Combustion Engine (ICE) vehicles.

With fuel prices increasing and road access frequently impacted, people from communities of need (especially lower-income and isolated rural communities) face worsened health outcomes. This, in turn, undermines key health determinants, including reduced health service access, rising unemployment, and worsened education outcomes. The reduction in health access disproportionately impacts disabled people, who are more likely to suffer health problems, particularly during acute climate events.[34]

There are some bus services available across NZ, but these are frequently disrupted – trains are no longer publicly subsidised, leading to closure of most train services nationally. This impacts people in many communities of need, such as Māori and Pacific peoples and the working poor who have moved to outer suburbs for cheaper rent and housing.

As local government services decline, there is decreased emphasis on urban planning and enforcement of land use regulations. Urban development is uncoordinated, and increasingly driven by private interests and the degree of exposure to climate hazards.

[viii] *A pathogen is defined as an organism causing disease to its host. Climate change hazards are expected to increase the spread of certain pathogens, such as mosquitos[32].*

[ix] *Wind and rainfall patterns are projected to shift, bringing more rain to western regions, and drier conditions in the east of NZ[33].*

Box 1

Severe heatwave strikes deep south in 2041

Extreme heat and high humidity have become a feature of NZ summers. In February 2041, there is a heat warning issued for NZ. Temperatures are forecast to reach 35°C with 50% humidity for 7 days in Northland. This creates dangerous heat stress conditions and is an extreme threat to health. In the South Island, Canterbury and Central Otago are forecast to reach over 38°C for 5 days.

Government agencies implement their Regional Heat Health Plans, establishing evacuation centres with cooling, providing surge capacity in emergency health units, and communicating warnings to households.

The number of air conditioning units installed has dramatically increased over the last decade, and previous heatwaves have revealed the fragility of the electricity network. Limited central government financing, and the impact of successive extreme events, has delayed urgent upgrades to the national electricity grid.

The grid is overwhelmed by the surge in demand, leading to blackouts and damage to critical transformers. Global supply chains are in crisis, and the repair of the grid is constrained and delayed by a shortage of necessary parts in NZ and difficulties importing required components.

Impacts from the first 48 hours

The record for the hottest night is passed, and unrelenting heat and humidity continue throughout the next day. There is a spike in hospital admissions for children and older adults, and ambulance dispatches increase by 40% due to heat-related heart attacks, respiratory distress and other health impacts.[x]

People experiencing homelessness are also disproportionately exposed to extreme temperatures, leading to increased health risks – the proportion of homeless people accessing hospital emergency departments for psychiatric needs increases during the heatwave.[27]

There is a dramatic increase in excess deaths, particularly among older people (people aged over 90 experience the highest mortality rate) in urban lower-income neighbourhoods with limited green space.[27]

Health system overloaded as heatwave continues

A second night of high heat is experienced, and many urban centres remain without power. There is an increase in family violence and public disorder, and public hospitals become overwhelmed.[36,37]

To make matters worse, wildfires break out in North Canterbury, leading to increased indoor air pollution in surrounding areas. There is an uptick in respiratory hospitalisations, particularly for people with pre-existing conditions.

The workforce in public hospitals has been under high pressure prior to this event, with long waitlists and chronic staff shortages – and there are further resignations following this heatwave. Unions have previously attempted to improve working conditions and patient care through negotiations, including seeking wage increases and better staffing in publicly funded facilities. These attempts at negotiations have failed, however, leading to a prolonged period of strike actions. Union-led initiatives do not improve working conditions, as central government has insufficient funding available to meet demands, increasing the number of health professionals seeking work in privately funded health services.

Impact on aged care, and legal action

The mortality rate in aged care centres is high during the heatwave, particularly in areas most impacted by power cuts.[38] As most aged care centres were constructed between 1990 - 2020, these facilities are not designed to maximise air flow and utilise passive cooling. Instead, there is a high reliance on air conditioning to maintain a safe indoor temperature, and the power outages result in indoor temperatures exceeding 30°C in the most impacted facilities.

Following the heatwave, legal action is initiated by the residents' families against several private aged care providers for insufficiently protecting residents, particularly relating to inadequate emergency planning (such as back-up power provision).

There is a national inquiry into the aged care sector following the heatwave. This results in significant reputational damage to aged care companies, and financial penalties to the aged care providers that were found to be negligent in their duty of care during the heatwave.

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[x] Based on data from Würzburg, Germany, which found that dispatches for cardiovascular disease on a day with a mean temperature of 30°C are 37% higher relative to days with a mean of 18°C.[35]

5.2 Supply chains, infrastructure, and housing

Shipping and international freight are frequently impacted by extreme events, disrupting supply chains and increasing the cost of imported goods. This has wide-ranging impacts on the health sector including the supply of specialist equipment and pharmaceuticals. Across the century, there are impacts across the sector, including delays in surgical care from global equipment shortages and difficulties importing essential medicines when trade routes are disrupted by regional and global security issues.

As 1-in-100 year events begin to occur on an annual basis, the constant damage to road networks disrupts domestic supply chains and access to communities (including papakāinga and ancestral lands). Rural communities often face shortages of pharmaceuticals, impacting the provision of healthcare, particularly for people with chronic health conditions and co-morbidities.

Lack of investment means the electricity grid is vulnerable to high winds and flooding, which results in frequent power outages to health facilities in rural areas and smaller towns. Electricity prices fluctuate based on climatic conditions, and power companies no longer offer fixed term contracts. This means that health entities and households must pay the floating market rate for electricity, which increases exposure to electricity price changes. Demand for air conditioning during heatwaves causes price spikes, which disproportionately impacts lower income households.

Lack of access to climate-resilient housing is a major risk factor leading to poor health outcomes. Over time, the cumulative impact from climate hazards reduces the quality of housing, leading to increased dampness and mould during winter months. Housing precarity is exacerbated by insurance withdrawal in higher risk areas, and increased insurance premium prices throughout NZ.

5.3 Food security and dietary changes

With a decline in biodiversity, disrupted supply chains and frequent crop losses, food costs skyrocket and food insecurity increases throughout NZ. Diet patterns are linked to socioeconomic status, and NZ sees an increase in food-related non-communicable diseases, particularly diabetes and cardiovascular disease. This is particularly prevalent among low-income Māori and Pacific communities, and other communities of need.[39]

Some global food producers establish local factories to minimise supply chain impacts, which floods the NZ market with unhealthy low-cost processed foods. The health of low-income consumers is disproportionately impacted, as vegetables and fruit are sold at a premium price to wealthy consumers in both NZ and overseas markets.

Terrestrial and marine ecologies are severely compromised causing extreme impacts to mahinga kai practices. The prevalence of food insecurity grows, particularly among children. This contributes to worsened educational outcomes, higher rates of paediatric disease (including poor dental health), and an increased risk of disease during adulthood.[40] These ecological impacts also negatively impact Iwi-owned businesses in the primary sector, which causes additional financial strain on hapū and whānau.

Impacts to the health system

6.1 Primary and community care

Access to primary and community health services, including general practitioners (GPs), district and community nurses, hauora Māori providers, physiotherapists and pharmacists, is reduced across the century as a result of reduced public funding. The decline in health access increases health inequities, as primary health becomes primarily funded by out-of-pocket expenses and health insurance payments.

Box 2

A South Pacific divide: haves and have-nots

With the deterioration of the NZ economy and growing inequities, the country further splits into those that can afford a comfortable life and a growing number that cannot. Society is increasingly polarised across political and ideological views.

With a breakdown in social cohesion and growing economic inequities, private developers start building gated communities for the wealthy (in locations that are less exposed to flooding). These communities have resident-only private health facilities, supermarkets, and other amenities.

As an example, in the aged care sector, the share of wealthy migrant residents doubles every decade between 2050 - 2100, as they see NZ as a country at lower risk of insecurity and severe climate events. Aged care facilities are seen as a refuge, located in gated communities with security. Older people living in these facilities maintain good health into their 90s, with access to new medications and therapies.

Meanwhile, in areas more exposed to climate risk, chronic poverty develops. With limited central government support available, renters and homeowners in these locations are unable to move to lower risk locations or access affordable insurance for their current residence. There is a gradual decline of infrastructure in these communities, with increasing outages to roads, water, power and other critical infrastructure.

Following two successive extreme events in West Auckland in the late 2020s, the average value of properties in flood-prone areas reduces by 40% between 2030 - 2033. With the rebuild having just been completed in 2035, a third event occurs. Insurance had been withdrawn, and the cost of recovery is beyond the abilities of the council and central government to support. Property values are now less than 20% of former value. With insurance withdrawn from these communities, and key determinants of health undermined, these areas rapidly deteriorate. An urgent task force is established to try and develop a solution for the 5,000 homes, but this becomes drawn out over many years and is eventually abandoned.

Climate hazards increasingly impact health facilities and services, with public funding allocated to 'climate resilience' mostly going to large urban hospitals. There are repeated flooding events throughout the century, leading to the closure of several regional hospitals, and rural communities become increasingly reliant on primary care services.

In the regions most exposed to acute climate hazards, particularly rural areas in Northland, Thames-Coromandel, Tairawhiti and the West Coast, access to primary health services is regularly impacted by road closures and power outages. The health of disabled people living in these communities is disproportionately impacted, as people with disabilities experience heightened levels of mental and emotional distress and worsened physical health outcomes following exposure to extreme weather events.[41]

In 2051, coastal hospital closures occur following repeated fluvial and coastal flooding events. Between 2050 - 2100, several hospitals and health facilities close around the country as repeated climate events cause damage and there is insufficient funding for maintaining and repairing buildings and associated infrastructure. Significant workforce shortages are also present in these locations, which results in a dramatic decline in rural health outcomes, particularly in areas of NZ with a high proportion of Māori people and people aged over 85 years old.

The increase in inequities in primary and community health access puts pressure on hospital emergency departments, and increases the prevalence of chronic preventable issues. Over time, more and more patients are having to travel to central hospitals for routine procedures such as wound dressing, accessing antibiotics for bacterial infections, and skin examinations. There is a heightened demand for skin checks and associated procedures as skin cancer incidence increases with higher average temperatures.[42]

There is an uptake in traditional healing practices among Māori in response to health access issues. While this becomes foundational for many low-income whānau households, resulting in measurable health benefits, the health of Māori people declines across the century. Life expectancy for Māori in 2100 is lower than 2025.

6.2 Hospital care

Due to primary care being inaccessible for many parts of the community, by 2080 the average wait time in hospital emergency departments is more than six hours for 75% of patients. This contributes to overcrowding, particularly in waiting rooms, and increased instances of violence in the department. The triage methodology is adjusted during periods of high demand, with some patients turned away without being seen.

Hospital services prioritise acute patients, with waitlists for publicly funded elective surgeries continually growing due to limited funding and specialists primarily providing their services to privately funded hospitals.

Given the crisis in the public hospital system, people from communities of need face long delays to access specialist services. The proportion of Māori with private healthcare is substantially lower than non-Māori, creating an increased reliance on a declining public health system leading to the exacerbation of health inequities.

While the continued reputation of NZ as a *relatively* resilient and peaceful country encourages immigration of specialist doctors and nurses, the majority of high-skilled migrants work in private hospitals in wealthier urban communities. The health system is unable to provide sufficient training spots for domestically trained doctors to become consultants. This leads to many specialist doctors becoming more generalised, and a shortage of doctors able to provide care for rare conditions and advanced procedures, including neurosurgery, plastic surgery, and transplant surgery.

Box 3 provides an insight to the daily life of a patient in Auckland City hospital in 2063.

Box 3

A day in the life of a patient in Auckland City Hospital in 2063

Major hospitals around the country are at peak capacity, following the closure of multiple regional health facilities. We asked Simone (a type 1 diabetes patient) to write about the experience of living in Thames, and accessing specialist care in Auckland.

Simone's experience:
I developed diabetes symptoms at 13 years old, I'm now 22. I grew up in Thames in a house close to the coast. My parents also grew up locally, and have lived in the same house for the past 30 years. They didn't believe in climate change when they bought the place, and are now trapped there as central government no longer helps people to move. My dad is now sick and unemployed, and my mum works as a cleaner part time and cares for him. We didn't have much money when I was growing up, and everything my mum earnt would go to repairing the house after it flooded or fixing our car. The flooding I experienced when I was younger really affected my mental health, I still find rain triggering to this day.

My local hospital closed when I was 10, three years before getting diabetes. I was sick for about two years before I collapsed at school, but my parents couldn't afford to see a local GP. My mum had to drive me to the emergency hospital in Auckland because there were no ambulances available – I can still remember that awful drive. Because I waited so long to be seen by a doctor, I now find it difficult to walk and have lost feeling in both of my feet. The doctors in the hospital said that there are new medicines available that can help, but these are not funded by central government.

I work with my mum when I'm well. We clean the house for one family that lives on a big farm inland, they grow fruit and vegetables indoors. They've helped me get health insurance, which pays for basic treatments and seeing my local GP. The community is really helping each other in these tough times.

6.3 Public health services

Funding for health protection and prevention is reduced between 2025 - 2100. In the latter half of the century, the main priority is infectious disease control – particularly managing outbreaks of mosquito-borne illnesses and monitoring borders to stop new viruses and other pathogens entering the country.

While there are improved forecasts and surveillance of hazards (e.g., heatwaves and floods) and infectious diseases (e.g. water-borne/vector-borne diseases), public health agencies face barriers to actioning information due to limited central resources.

6.4 Aged care

The proportion of the population in aged care declines between 2025 - 2050 due to reduced funding, and closure of facilities (reducing supply of aged care beds). In addition, as the savings of many households are eroded by house price declines (related to climate hazard exposure and insurance withdrawal), the ability of residents to pay for aged care services is eroded.

This triggers an industry wide decline in share prices of listed aged care entities, which impacts the ability of these entities to access debt financing. Some international corporate providers pull out of NZ, while other companies cannot access finance to make capital improvements (such as flood proofing facilities).

While private aged care facilities are available in major urban centres, access is limited to higher-income New Zealanders and there is a five-year waitlist for the small number of publicly subsidised beds available for older people with severe disease. The shortage of publicly funded beds means that families are separated when residents need to be located in a different city.

The closure of aged care facilities in high-risk areas results in older people moving in with their families (when possible) and also increased homelessness and poverty in this age group. The century sees a decline in the proportion of people dying in aged care, with 20% of the population dying in aged care facilities in 2100, down from an estimated 38% in 2025.[xi]

As an increased number of older individuals with co-morbidities do not live in aged care, the health status of this population declines. This puts additional strain on the health system, particularly during extreme weather events and heatwaves. For example, in periods of extreme heat in the second half of the century, there is particularly high demand for emergency medicine services from patients older than 85 due to their higher vulnerability to heat-related morbidity and mortality.[44]

The share of Māori In aged care remains low - this is attributed to the increased costs of care, declining cultural safety practices and preferences for supporting the aged in place. For care in place, central government support is significantly reduced, causing whānau to struggle to secure the resources needed to support a multi-generational support system.

6.5 Medicines and medical supplies

Driven by continued investment by multinational pharmaceutical and technology corporations, there is a gradual improvement in the development of new medicines, vaccines, and other technologies.

Access is highly inequitable, however, with successive governments unable to publicly fund most new medicines and medical supplies. New medicines and therapeutics (such as new cancer medications and genetic techniques) are largely provided by private health services, which have expanded, as publicly funded care has declined.

[xi] *The proportion of the population dying in residential aged care is an indicator of residential care access, other indicators include the proportion of people having accessed services during a period of time (e.g. past 10 years) and utilisation of aged care at a single time point.*[43]

Successive governments continues to publicly fund pharmaceuticals and medical supplies, but this is largely restricted to medicines that are labelled both essential and generic. The cost of medications fluctuates frequently because of supply chain disruptions. While there is an increased storage capacity domestically, essential medication shortages are common, particularly in the public system.

6.6 Health insurance

There is a growth in privately provided healthcare and an increase in private insurance coverage – the share of the health system funded by private insurance increases from 5% in 2025 to 20% in 2100. The cost of health insurance is prohibitive for most people, with premiums for health insurance increasing due to the ageing population and increased health risks associated with climate impacts.[45,46] For Māori, low income families, and many households from communities of need, the costs of private insurance restricts access to quality health care, contributing to the widening of the inequity gap.

In 2055, publicly funded accident insurance is cancelled due to a lack of available central government funding, higher healthcare costs, and the increased cost of providing compensation for car accidents and other injuries associated with extreme weather events.[47] For low-income whānau and families, this has a major impact on those who have had accidents, resulting in reduced household income levels and reduced health and wellbeing.

The increased proportion of privately funded health services results in a range of negative consequences to population health. For example, more attractive working conditions in the private system lead to increased workforce shortages in the public system.[48]

SCENARIO 2: DELAYED/DISORDERLY TRANSITION

Overall context

1.1 Global context

The world follows a path in which social, economic, and technological trends do not shift markedly from current patterns. While global ambition and rhetoric are high, the implementation of climate policies and legislation is varied across countries.

In 2024 - 2025, global climate action is upended by the geo-political fall-out from the Ukraine and the Middle East conflicts, and worsening global economic conditions. Inaction continues until the late 2020s, when there are a series of technological breakthroughs, particularly in hydrogen, solar and battery technologies.

The combination of cost reductions in low-emissions technologies and changing global norms results in a ramping up of decarbonisation efforts from 2028 – 2035, with the European Union, South Korea, Japan and Australia acting as early movers. A patchwork of international agreements emerges in the early 2030s, including a bilateral partnership between the European Union and China in 2033. This results in trade barriers for emission-intensive goods exported to these markets, which catalyses strengthened emissions reductions globally. While the United States experiences high levels of climate policy uncertainty throughout the 2020s and early 2030s, key corporates continue to invest in climate action over this period. The US commits to international climate action in 2034.

As a result of the delayed and disorderly transition, physical risks increase markedly throughout the century. Global average temperatures reach 2°C by 2050 and increase to 2.7°C above pre-industrial levels by 2100, causing widespread impacts from climate hazards.

While there are global health security challenges, such as the emergence of new infectious diseases, health risks are reduced by strengthened international cooperation and the availability of improved therapeutics and vaccines. Global life expectancy moderately increases throughout the century due to a decline in communicable disease deaths from improved sanitation and drinking water access.[xii]

1.2 National context

Given ongoing policy uncertainty and bipartisanship, NZ is slow in commencing climate action. The delayed and disorderly transition is costly to households and businesses, and there is inadequate public funding available to support those most affected.[xiii]

With increased oil prices contributing to a worsening cost of living crisis throughout 2024, central government is reluctant to increase the cost of carbon-intensive goods and services – which further delays climate action. As successive government do not achieve the 2030 emissions reduction target, the purchase of international offsets is needed for NZ to meet its international commitment under the Paris Agreement (as outlined in NDC1). There is unwillingness among political parties and the public to pay this bill (NZ$ 24 billion), however, central government decides to meet international commitment following threats of sanctions from major trading partners.

In the summer of 2030, a deadly heatwave and catastrophic ex-tropical cyclone occur within one month. Public support for stronger

[xii] *Communicable disease deaths are expected to fall in absolute terms under all SSPs by 2100, but the burden of disease will likely remain relatively higher in lower income climate vulnerable countries.*[20]

[xiii] *A just transition encompasses a broad range of concepts such as inclusiveness, justice, equity, fairness, wellbeing and sustainability, as well as processes such as representation, collaboration, partnership, co-design and participatory democracy.*[49]

climate action grows over the subsequent years, and the newly elected government commits to a new international target in 2033.

In 2035, the second 15-year Emissions Reduction Plan is developed, which outlines a set of onerous policy actions requiring urgent implementation. Emissions are rapidly reduced over the next two decades, with significant consequences on the agricultural sector as there are limited technological options available to cost-effectively cut emissions from farming. This is followed by a gradual decline in emissions in the second half of the century.

As a result of worsening climate impacts, and significant recovery costs, government services aimed specifically at improving hauora Māori are progressively reduced. This leads successive governments to progressively reduce or abandon NZ's responsibilities under the United Nations Indigenous Peoples Rights Declaration, and redefined application of Te Tiriti o Waitangi.

The climate-related impacts to the health sector in NZ are caused by a combination of physical and transition risks, which result in a high population health burden. There is a growth in economic and social inequities, exacerbated by transition and physical climate impacts, which contribute to an increase in chronic health conditions in Māori. In response to successive governments failing to develop a coordinated and effective approach for managing Māori health issues, iwi assume greater responsibility in the delivery and commissioning of health services for Māori.

Loss of whenua for some coastal and river-based communities contribute to declining forms of identity and belonging as culturally meaningful places are claimed by the elements. Homelessness and overcrowding in housing increases in these communities. Food and water insecurity also declines, and mahinga kai is severely impacted by the degradation of te taiao. All of these impacts contribute to the worsening of health inequities for Māori, Pacific peoples and people within other communities of need.

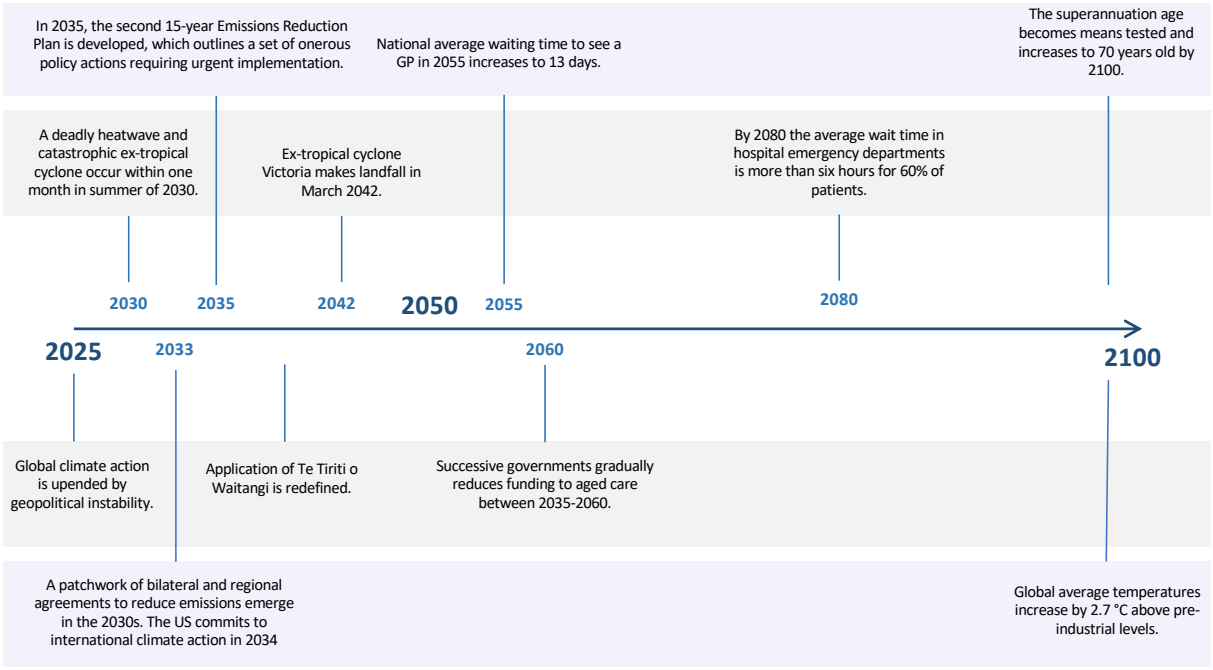


Figure 8.2: A summary of key events occurring over 2025 – 2100 in Scenario 2.

Government policy and funding

2.1 Policy

New policies and regulations to reduce emissions are enacted abruptly from 2035, which focus primarily on the agricultural and transport sectors as these represent NZ's largest sources of emissions. There are a range of negative economic and social impacts as these sectors adjust. There is also a rapid increase in emissions pricing throughout this period, driving up fuel prices, and limiting the ability of successive governments to reduce emissions through purchasing offsets. The increased cost of fuel and impacts from extreme events result in major supply chain issues in NZ and globally, including for pharmaceutical and medical supplies.

At the same time, there is an increase in physical climate risks across the century, and successive governments fail to manage trade-offs between adaptation and mitigation action. The need for infrastructure repair and recovery after extreme events reduces the amount of funding available to support communities to transition, and vice versa. Poorly designed and executed policies increases socio-economic disparities between communities, with regions more exposed to transition and physical climate risks experiencing less economic development.

The combined cost of emissions reduction and climate disasters limits the capacity of central government to maintain core services, including the publicly funded healthcare system. Long-term strategic planning is impacted by policy uncertainty, as ministers and senior officials have to respond to frequent emergencies and economic shocks. There is a reduction in levels of public trust, as the effectiveness of government systems decline.

Self-determination by Māori of their own affairs is driven entirely through the Māori economy, with reduced central government incentives for global trade and the de-prioritisation of governance and partnership arrangements. The historically marginalised bear the brunt of a costly transition as successive governments opt to deprioritise Māori in policy development under a 'one New Zealand society' approach to transition. Decreased levels of agency and options become compounded for communities of need as limited networks and a loss of livelihood exacerbate systemic inequities.

2.2 Government funding

The level of public debt increases due to the cost of funding the transition and repair of infrastructure following severe extreme weather events. This, in turn, reduces the level of funding available for public services and welfare. The long-term health of children and older adults in communities of need are the most impacted by these funding decisions, as reduced public spending leads to worsened education and employment outcomes.

Coastal and river-based communities of need (including those with a high proportion of Māori) are particularly impacted by road disruption and damage to housing during extreme weather events. The limited public funding available is allocated to reactive and poorly designed projects, which erodes the economic capacity of communities and regions generally.

The total amount of public funding to the health sector (in terms of dollars spent on health in the budget) declines by 25% between 2025 and 2100, while the proportion of user funded services and health insurance contributions increase throughout the century. User funded services (out-of-pocket expenses) increase from 15% in 2025 to 30% in 2100, and private insurance contributions increase from 5% of health financing in 2025 to 10% in 2100.

The funding cuts to the health system largely affect non-urgent specialist care and elective surgeries. Reductions in health funding also negatively impact primary and community care, but to a lesser extent. Successive governments also gradually reduces funding to aged care between 2035 - 2060, resulting in much of population being unable to access subsidised beds. For Māori opting for at-home care for their elders, there is limited funding,

leaving the financial burden to be carried by whānau.

2.3 Mātauranga Māori

There is an increased focus on mātauranga Māori approaches by iwi/Māori and environmental groups. Climate displaced people from the Pacific also bring their learnings and traditional knowledge, and join forces with Māori to progress community-led adaptation and transition actions.

Iwi strengthen their kaitiakitanga rights and interests in their own rohe (areas), enforcing more stringent lores (e.g., rāhui) to protect their lands, forests, rivers and taonga. The uptake of traditional healing practices significantly increases, as publicly funded healthcare services reduce. For some whānau, traditional healing becomes the primary approach for their health and wellbeing.

Socioeconomic status and demographic drivers

3.1 Socio-economic status

The erosion of public services, combined with increases in household costs and unemployment, results in an increase in poverty and economic inequities. With a lack of central government support to compensate workers that lose their jobs during the transition, social cohesion and public trust in central government deteriorates across the century. The rural and agricultural sectors are particularly affected, given their significance within the NZ economy (in terms GDP and employment) and exposure to climate extremes (e.g., after cyclones, as described in **Box 4**). These transition impacts propagate through the broader economy.

For some iwi/Māori businesses invested in the primary sector this has devastating economic, social and cultural impacts on the Māori economy and their communities. Others attempt to pivot, through the development of innovative solutions for green businesses and the forging of partnerships with private sector investors, but many struggle to maintain profitability with the rapid increase of emissions pricing and shifting consumer demands.

Superannuation payments are increasingly seen as unaffordable due to constrained public financing and the increase in the ageing population. In spite of widespread opposition, the superannuation age becomes means tested and increases to 70 years old by 2050 to limit increases in public debt. This causes disproportionate impact to older Māori people, given their shorter life expectancy and higher likelihood of being employed in physical jobs (with physical jobs reducing the viability of continuing work after 65 years old).

These socio-economic impacts cascade through the Māori economy and communities. Collective action among iwi/Māori contributes to forms of social cohesion, but factionalism and conflict begin to emerge over time.

3.2 Demographic changes and migration patterns

NZ's worsening economic situation and reduced employment opportunities leads to declining migration between 2035 and 2060. The majority of migrants over this period are highly-skilled workers (including health professionals) and high-income individuals that access NZ through an investor visa program (given increased global climate risk, and NZ's reputation as a safe haven country). Migration slowly increases in the latter half of the century, including climate displaced people from countries in the Pacific.

The population in 2050 increases to 6.13 million people (from 5.22 million in 2025), with the population over the age of 65 increasing by 23% over this period.[25] This results in a higher age dependency ratio, and an increased need for aged care workers. The ageing population results in economic and financial impacts, including increased pension and healthcare costs.[50]

Domestic migration patterns are shaped by higher-income households relocating from areas of NZ at high risk of flooding and sea level rise. There is increased migration from rural to urban areas, due to both transition risks and heightened physical risks in isolated communities.

Relocation is both planned and unplanned, with some central government support provided to the most at-risk communities. Communities that are unable to relocate, or are unsupported, experience worsened health outcomes, and children from these families are more likely to experience longer-term adverse health impacts, including psychosocial stress and mental health challenges.[51] This is particularly noticeable amongst rural Māori communities, and in other rural communities of need.

By 2050, a large proportion of Māori are aged between 41 - 70 years. While some of this cohort are unemployed as a result of climate impacts, many maintain household income levels by securing jobs in more stable sectors. The capacity of Māori to care for kaumātua and children of working parents remains high, enabling households to work collectively and effectively respond to climate disruptions.

Relocation of coastal and river-based communities occurs, with some whānau facing economic hardship, as central government funding is reduced to support this process. In rural areas, households opt for off-grid options, māra kai, sustainable water supply systems, and alternative cultural economies.

Environmental drivers

4.1 Extreme heat and heatwaves

There is an increase in extreme heat events throughout the century, particularly in Northland, Tairawhiti, Canterbury and Central Otago. Housing conditions are a key factor in reducing health risks, as people spend over 60% of each summer day at home indoors in NZ.[52] While the number of air conditioning units increases between 2025 - 2100, housing in NZ remains poorly suited to the warming climate conditions. This leads to unsafe temperatures and negative health outcomes (including heat stress, cardiovascular diseases, higher morbidity), particularly during multi-day heatwaves with high night time temperatures.[27]

4.2 Extreme weather events and associated flooding

The exposure of households around the country to flood hazards increases between 2025 - 2100, as heavy rainfall becomes more frequent and flood protection schemes increasingly focus on protecting critical infrastructure and densely populated urban communities.

This results in substantial short-term and long-term health impacts, particularly among households that are yellow and red stickered following extreme events. Among yellow and red stickered households, there is an increase in cardiovascular morbidity and mortality in the first week after exposure to severe flooding.[53] These households also contend with a decline in mental health (e.g., from higher rates of post-traumatic stress disorder), and some people continue to experience worsened mental health years after the flooding occurs.[28] In some cases, rainfall also becomes triggering, which further increases the anxiety of flood-affected people in the changing climate.[54] Extreme weather events also result in an increase in acute injuries from floodwaters, and the incidence of people drowning in a given flood event increases across the century.[29]

4.3 Fire weather

The severity, frequency and duration of fire risk dramatically increases with drought conditions and increased afforestation. Given the delay in the transition, successive governments rely heavily on domestic and international offsets to reduce NZ greenhouse gas emissions. This increase in afforestation, particularly of fast-growing tree species, combined with worsening drought conditions, results in wildfires dramatically increasing between 2040 - 2100.

Regular fires lead to declining air quality, particularly in rural communities, which increases the incidence of respiratory disease. The health of communities that experience long-term exposure to wildfire smoke are most adversely impacted, as there is an increase in cardiovascular disease mortality, mental health conditions (mainly post-traumatic stress disorder), and other negative health outcomes.[31]

Built environment and food system drivers

5.1. Transport systems and urban form

From 2030, transport policy prioritises both low emissions mode shifts and actions to reduce physical climate risks. The poorly coordinated and delayed transition results in an uneven and inequitable distribution of social benefits and costs. In densely populated urban areas, the use of electrified public buses increases throughout the century. While this helps to reduce emissions, periods of grid instability, particularly during extreme weather events, means these services are viewed as unreliable. Public investment in trains is not considered a priority by local and central government, given the higher upfront construction costs and need for rapid emissions reduction solutions.

Central government enacts a ban on internal combustion engine (ICE) vehicle sales and imports by 2040. Direct subsidies to support the uptake of battery electric vehicles (BEV) are not provided, given limited central government financing. While a combination of tax incentives and declining BEV costs does improve long-term affordability, the rate of car ownership declines, especially among lower income households.

For low-income whānau, and families living in outer suburbs, access to health care, education and employment, and social services is severely impacted by limited investment in public transport and the transition to BEVs. Air quality improves in some urban areas of NZ, but the transport system remains a health burden overall due to negative impacts on a number of key determinants of health.

The urban form in towns and cities in NZ is largely unchanged, with housing largely remaining low density and the transport network reliant on private vehicles. Development is poorly planned, leading to several associated health impacts including limited access to green space and an amplification of heat exposure due to the urban heat island effect and increased air conditioning use.

Box 4

CASE STUDY: The 2042 ex-tropical cyclone Victoria

Ex-tropical cyclone Victoria makes landfall on March 15 2042, bringing high winds, severe coastal and inland flooding, and landslides. The cyclone makes landfall in the north of the South Island, and tracks down the east coast. Heavy rain and wind warnings are issued as Victoria approaches and on 16 March, states of emergency are declared for Blenheim, Picton and Kaikoura. The storm lasts for five days with total rainfall depths exceeding 500mm in some catchments.

Kaikōura faces the brunt of the event

The storm stalls over a forested area south of Kaikōura, and with rainfall intensities peaking at over 100 mm/hr for some periods, large volumes of slash and sediment flow down the swelling rivers.

Downstream communities are severely impacted, with buildings and houses destroyed and damaged. Power is cut off from March 17, and is out for 10 days. The roads are severely impacted in places, and food and pharmaceutical supplies are in short supply. For some community members, the marae becomes the emergency hub, housing many displaced households.

Another aged care provider leaves the region

There is a high proportion of older people living in the region, as the warmer summers and more temperate winters have made the region a hotspot for retired people. A large aged-care facility is severely impacted by strong winds and surface water flooding. The main building faces structural damage, and water supply and electricity are cut off, and the emergency generator and water pump fail.

Residents are stuck inside the facility for more than 24 hours, with many parts of the building experiencing waist deep water. Residents with complex health conditions, such as cardiovascular disease and advanced diabetes, are unable to access specialised care from outreach services at the Kaikōura Health Centre. Two individuals are airlifted to Christchurch Hospital to access emergency services. The aged care facility does not include critically unwell patients, such as individuals with advanced dementia, and there are no deaths.

The recovery is prolonged, and the facility is red stickered given the degree of damage. While there is an insurance payout, insurance is withdrawn from this area after this event. Due to a lack of beds, a relocation plan is hastily developed to shift residents around the country. There is limited consultation with the residents, which results in high levels of anxiety. The combined trauma of being exposed to the flooding and being notified of the need to move results in worsened mental health, with several residents diagnosed with anxiety disorders and post-traumatic stress disorder in the following year.

This becomes a significant issue given the impact on residents and their families, and the lack of preparedness by the aged care provider. The story is picked up by national media outlets a month after the event. This results in a rapid fall in the share price of the aged care company, which is listed on the NZ stock market, and the company needs to close further facilities around the country as a result of difficulties accessing financing from banks.

5.2 Supply chains, infrastructure, and housing

The cost of shipping goods goes up rapidly during the transition, as the increase in emissions pricing leads to higher petrol prices and excise taxes. There are also frequent disruptions in supply chains from road closures, impacting the supply of pharmaceuticals during and after cyclones.

The demand for electricity grows with an increase in the use of BEVs and other transition technologies. Investment in electricity generation and distribution is insufficient, leading to increased electricity prices and instability of supply during periods of peak demand. This increases the cost of operating healthcare facilities, and limits the ability of facilities and other public buildings to implement adaptation measures, such as the cooling of workplaces, early childhood education centres and schools during heatwaves.

The quality of housing is mixed, with older builds highly vulnerable to climate impacts and newer developments built to higher standards. New builds require low-carbon building techniques and inputs, and are more energy efficient, drier and more resilient to extreme heat and cold. The difference in housing quality is one of the largest drivers of health inequities, and people with sub-standard housing (particularly low-income Māori and Pacific families and the working poor) are at a higher risk of disease and hospitalisation following exposure to climate events.[39]

Iwi/hapū that have made significant investment in the development of papakāinga and alternative housing regimes early in the century benefit from strengthened community wellbeing. These housing options are designed by both urban and rural iwi/hapū, with many communities creating hubs and installing shared off grid energy systems and household water tanks. Conversely, smaller iwi / hapū that were less resourced to invest in sustainable housing early in the century are less resilient to higher costs of living and more severe climate hazards.

5.3 Food security and dietary changes

The consumption of red meat, dairy, and carbon-intensive foods declines from 2035. Larger farming operations switch to alternative products, such as sustainable meat alternatives, but limited central government support and lack of private investment in new technologies impacts their growth potential.

Frequent weather events means that NZ producers switch to climate-resilient crop varietals and controlled environment agriculture (e.g., the use of greenhouses). While this increases the cost of production, crop losses are reduced. Food products and fresh produce remain a major export earner for NZ, but increased international prices make locally grown food unaffordable for many New Zealanders. The amount of imported food increases, and there is a greater consumption of ultra-processed food by lower-income households. This contributes to a moderate increase in non-communicable diseases, which outweighs the health benefits resulting from a reduction in consumption of red meat and dairy products.

Impacts to the health system

6.1 Primary and community care

Despite the high costs and disruption associated with the transition, some policies to reduce emissions deliver health co-benefits, including from decreased air pollution and changing urban form (leading to more active lifestyles), particularly in urban locations in NZ. In general, however, the transition has a range of negative impacts on determinants of health, particularly in professions and communities that are highly exposed to transition risks – such as rural communities and the broader agricultural sector.

Overall, there is a decline in access to primary and community health services due to reduced funding. Successive governments does, however, prioritise primary care over hospital level care due to the associated longer-term benefits – e.g, lower health costs due to reduced hospitalisation and relatively less emissions intensive service delivery.

The number of primary and community care facilities in urban areas of NZ stays relatively constant, but the combined effects of an ageinag population, workforce shortages, and reduced population health status means that the national average waiting time to see a GP in 2055 increases to 13 days and the quality of primary healthcare measurably declines between 2050 - 2100.

Rural households find it increasingly difficult to access primary care, as facilities are closed due to rural population loss and difficulties attracting health professionals to rural centres. The lack of health and education services catalyses more migration from rural to urban centres, which further increases the difficulties associated with maintaining primary and community services.

In rural areas with a large Māori population, particularly in isolated parts of the Northland and Tairāwhiti, there are funding cuts to Māori health providers. Households often have long distances to travel to main centres to see a GP, and frequent road disruptions and increased cost of travel (with fuel prices increasing) impacts access.

6.2 Hospital care

Funding cuts increase the length of waiting lists for many services, including for joint replacements, eye surgeries, and specialist mental health care. There is an increase in the number of outpatient consultations and elective surgeries funded by private health insurance and out-of-pocket expenses. Successive Successive governments rely more on user payments, which disproportionately impacts communities of need.

Successive governments invest in training more specialist doctors, but shortages are present due to the ageing population and their health needs. The demand for emergency medicine services increases dramatically, particularly during heatwaves and extreme weather events. By 2080 the average wait time in hospital emergency departments is more than six hours for 60% of patients.

Given the difficulties accessing primary and community health services in rural areas, there is an increase in preventive mortality, particularly for chronic health conditions such as cancer and diabetes. People from more remote communities need to travel to major cities to access specialist hospital care, and the cost of travel and accommodation is no longer funded for these patients.

6.3 Public health services

The governments prioritise the development of an improved public health surveillance system. This allows for improved forecasts and surveillance of climate hazards (e.g. heatwaves and floods), and climate-related infectious disease outbreaks (e.g., water-borne and vector-borne diseases). A key pillar is the scaling up of early warning systems, which are used to notify the public of emergency events and disease threats. This focus on preparedness and prevention results in some long-term health benefits, but mostly for households with the resources available to respond to warnings (e.g., being able to avoid outside work and activity during periods of extreme heat).

6.4 Aged care

The public funding for aged care services decreases, which results in financial difficulties for many private providers. Operational costs increase due to increased electricity prices, higher building insurance premiums, and the need to climate proof facilities to cope with physical risks.

The ability of older individuals to pay for aged care also declines, as the savings of many households are linked to falling property prices in areas impacted by climate hazards. Successive governments provide funded beds for older people with serious health conditions, but there is a shortage of beds nationally. This means that many older people, including Māori, rely on home-based care.

The ageing population leads to a higher demand for health services, due to changing patterns of disease and health loss in the NZ population. There is an increase in individuals with multi-morbidities and chronic diseases, which, in turn, increases the vulnerability of the population to climate hazards (such as extreme heat and cold).

The aged care sector as a whole is negatively impacted by these changes, particularly the reduction in people being able to pay for services. The profitability of the sector declines throughout the century, which reduces the share price of aged care companies. Board members of aged care providers require more stringent climate change risk assessments and adaptation plans, as the risk from extreme weather events results in an increase in legal liabilities.

Please refer to **Box 5** for insight to the daily life of a manager of an aged care facility in 2042.

6.5 Medicines and medical supplies

The provision of new medicines, vaccines, and other therapies gradually improves, as new technologies are developed and biotechnology advancements progress. The impact of the transition on public finances reduces the ability of the government to purchase new high cost therapies and procure medical supplies and technologies. There are acute shortages during global supply chain disruptions, as NZ is viewed as a low-priority market by international pharmaceutical companies and other multinational corporations providing medical supplies.

Many New Zealanders cannot access new medicines, as these are not publicly subsidised. Inequitable access to medicines and medical supplies places extra stress on low-income households, and contributes to chronic health outcomes in this cohort.

6.6 Health insurance

The proportion of total health spending from private insurance doubles by the end of century, and contributions increase from 5% of health financing in 2025 to 10% in 2100.

Health insurers are profitable over the long term, as climate considerations are integrated into the design and pricing of health and life insurance products. The higher cost of premiums, as a result of increased health risks, means that the majority of people with health insurance are from high-income households. This exacerbates health inequities, as higher-income individuals can access new therapies and do not face long wait times. The expansion of private care also impacts the job market, as more health professionals choose to work in private facilities – this results in negative impacts to the quality of care and health access of individuals without insurance.

There is an increase in injuries across the century, particularly during and after extreme weather events, which places pressure on publicly funded accident insurance.[55] The coverage is incrementally reduced across the century due to cost pressures, and by 2100 it is only available for a short period following serious injuries.

Box 5

A day in the life of an aged care worker in 2042

There has been an ongoing increase in storm events over the past decade, which have resulted in flooding, high winds and landslips. These impact acutely on the most vulnerable, including older people living in aged care facilities.

We asked an aged care worker about their experiences of recent extreme events.

Working in 2042

For the past five years I've worked as a manager of an aged care facility that is 45 minutes drive south of Kaikōura. The areas surrounding the nearby rivers have flooded in the past following extreme storms, but we thought that our facility was located in a safe area – the flood modelling certainly suggested this. Before this job, I managed another facility near Nelson, but moved south due to the new development in this area and the opportunity to work in a brand new facility. The facility was being expanded to include a high-needs wing – and we are very fortunate that construction was delayed due to shortages in construction materials, particularly a new low-carbon alternative to concrete that was recently mandated.

We knew that Cyclone Victoria was likely to hit five days before it did, and we prepared by putting wooden boards over the windows and making sure we had one week of emergency supplies, including drinking water in the facilities tank – we thought that this was more than enough. The storm just sat over the top of us, and as the drains blocked, the water kept rising. Thankfully our facility has two levels, we moved all the residents upstairs at 2:00 am.

A health crisis in the first 24 hours

The biggest issue we faced was four residents with existing heart problems having chest pain and shortness of breath. Two of them developed their symptoms when the floodwater entered their rooms, and we called 111 right away – they were evacuated by helicopter, but it took almost four hours for them to get to hospital in Christchurch.

The other two developed their symptoms 18 hours later from a shortage of medications – we couldn't access their medication records, as this was stored on our servers. Without mobile phone coverage (the network went down), our generator failing, and the on-call nurse not being able to access the facility, we had no idea about the medical requirements of our aged care residents. Thankfully, the road to our facility was cleared after about 16 hours, and these residents were seen by the local GP.

Longer term impacts

The residents were housed in a local evacuation centre for about 3 days after the cyclone, while we waited for SH1 to re-open. We were notified on day five that the building was red stickered, and had to tell the residents and their families that the only option was for them to move to other facilities across the country. In hindsight, we could have managed this better, but our hands were tied. I think we've been unfairly targeted since then, as all aged care facilities are grappling with similar issues. A part of me wants central government to spend more on climate adaptation, protecting our roads and bridges, rather than trying to cut emissions. I'm now looking for a new job, but it's not easy after your name is all over the front page news.

SCENARIO 3:
AMBITIOUS AND ORDERLY TRANSITION

Overall context

1.1 Global context

There is an urgent and coordinated global response, with immediate climate action taken in high-polluting countries. Technological breakthroughs facilitate deep emissions reductions, and the provision of central government support helps to reduce transition risks in countries.

Changes in the global political climate in the mid-2020s see an increase in level of investment allocated to green technology research and development, and a focus on strengthened international cooperation. In 2025, the US commits to a massive ten-year electrification strategy, which catalyses technological innovations and cost reductions, including in battery storage capacity.[56]

Throughout the 2020s, major corporate polluters commence rapid emissions cuts following a series of legal judgements across jurisdictions. This facilitates action amongst the world's major emitters, including China.

Physical risks continue throughout the century due to 'locked in' levels of warming, with global average temperatures rising to around 2°C by 2050, and then declining to 1.4 °C above pre-industrial levels by 2100.

Driven by an increasing commitment to achieve sustainable development goals, there is a decline in global poverty and reduced gaps in per capita income across countries.[20] As a result, treatments for disease improve, global health security risks decline, and life expectancy increases throughout the century.

1.2. National context

NZ is an early mover, leading the way in climate action globally. Driven by ambitious policies and legislation, NZ rapidly decarbonises its economy by mid-century.

In 2025, the NZ Supreme Court issues a judgement requiring corporate entities in NZ to reduce emissions in line with the Paris Agreement. This triggers similar cases globally, including legal action against the world's highest emitting investor-owned companies.

Central government responds to the Supreme Court judgement by strengthening the Zero Carbon Act. Under the new legislation, company board members and executives face increased liability for not meeting sector-level emissions reduction targets. There is a rapid reduction in farming emissions, as a result of changes in trade rules and growing legal liabilities. Both the public and private sector reduce their reliance on offsets from 2025 - 2040, as domestic emissions decline across sectors.

While the transition results in significant long-term benefits, including for population health, there are onerous short-term costs for NZ households and businesses over the period 2025 - 2050, particularly in high emitting sectors such as agriculture and tourism. In contrast, the latter half of the century is characterised by political stability, strengthened community cohesion, and reduced economic disparities.

As the transition initially results in negative economic and social impacts, there is

opposition to some of the policies and regulations. Through consultative and transparent public engagement, shifting social norms, and increasing recognition of the benefits of climate action, support for the transition grows across the private sector, iwi/Māori and communities. The obligations to tangata whenua are nationally recognised – leading to a more united societal approach.

Over time, there is a societal shift in NZ towards environmental protection and social justice, which is driven by influential international and national action groups. Significant political pressure is applied to central government to advance the global Sustainable Development Goal of 'leaving no one behind'. Successive governments adopt a significant focus on addressing inequities in Māori, with policies and resourcing that addresses health need. Across the public sector, cultural training is emphasised, leading to a growing societal understanding of diversity as a strength.

The transition results in improvements in key determinants of health, particularly through the emergence of health-promoting transport and food systems in NZ. There is a move to community-oriented healthcare, with a strong focus on addressing the risk factors that lead to disease, which leads to a decline in preventable hospital admissions.

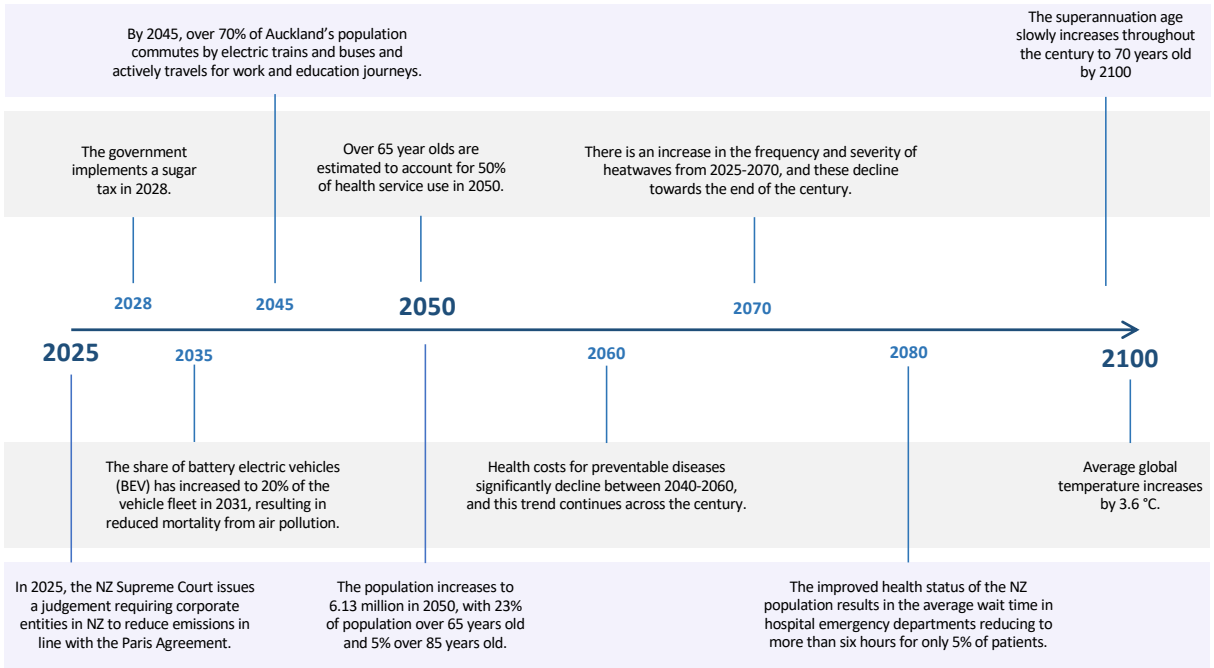


Figure 8.3: A summary of key events occurring over 2025 – 2100 in Scenario 3.

Government policy and funding

2.1 Policy

Emissions reductions plans, emissions pricing, *He Waka Eke Noa*, and regulatory instruments drive aggressive emissions reductions across the economy, including incentivising the adoption of low emission technologies in the health sector. These policies, however, result in negative economic impacts between 2025 - 2050, particularly for transition-exposed sectors such as agriculture, tourism and transport.[57]

There is a substantial increase in climate financing, both public and private, to develop infrastructure, reskill workers, and provide compensation and targeted support to business and households. While there is recognition by central government that the long-term economic benefits outweigh the costs associated with the transition, there are contentious debates throughout the 2020s on the best approaches to fund low emissions development.

As there are continued impacts from physical climate risks across the century, particularly coastal hazards and extreme weather events, successive government implement a range of adaptation planning measures. These are undertaken throughout the century, with prioritisation based on public health co-benefits, critical needs and infrastructure (e.g., health care facilities), and the socioeconomic vulnerability of communities. This strengthens the determinants of health within communities of need across NZ.

Kaitiakitanga over whenua, moana and taonga species is supported by successive governments and advanced through Iwi/Māori developed and led transition and adaptation plans. These plans have a strong focus on environmental regeneration and protection and climate mitigation and adaptation. At the national level, moreover, policies prioritise improved land management, food, water, housing and energy security as well emphasising people over profit.

2.2 Government funding

While public funding and financing are largely allocated to the transition, there is a minimal reduction in the national health budget as successive governments agree to protect and maintain funding for the health system.

Emissions reduction and climate adaptation actions are funded through a combination of public and private debt, targeted tax increases, and innovative financial instruments (e.g., green bonds). Following two decades of transformative infrastructure development, cost-cutting measures across other public services, and high levels of transition spending (e.g., direct support for households to decarbonise), there is a renewed increase in household savings and reduction in national debt from the 2050s onwards as the economy adjusts to a lower carbon trajectory.

As a result of lower health costs for preventable diseases between 2040 - 2060 (primarily resulting from a move to active transport, reduced urban air pollution, and a transition to a climate friendly diet), secondary and tertiary health spending is reduced in the latter half of the century. This allows for increased funding for primary health, aged care services, and health prevention, promotion, and protection activities.

Central government policy and funding mechanisms include significant funding for those iwi/Māori that are most impacted by the transition, particularly in rural communities. Funding models are co-developed alongside iwi/Māori leaders to reduce emissions, with a strong emphasis on the health and wellbeing co-benefits. Successive governments actively supports Māori to harness their own forms of rangatiratanga, through an approach that advances strategies that promote the achievement of equitable outcomes for the vulnerable.

2.3 Mātauranga Māori

The value of mātauranga Māori is also elevated by successive governments as an approach to rapidly advance a low carbon future and improve health outcomes. Key public sector programmes are developed that are centred on strengthening connections with whakapapa and mātauranga, which leads to more collaborative community-based approaches.

Socioeconomic status and demographics

3.1 Socio-economic status

The welfare state is expanded to include targeted financial support to individuals impacted by the transition, which helps to reduce income inequities between socioeconomic groups. Poverty declines from 2050 onwards as a result of economic innovation, investment in education, health and social services and improved public services.

With increased life expectancy and a trend of later retirement, the *superannuation age* slowly increases throughout the century to 70 years old by 2100. This reduces the financial cost to central government and allows for the reprioritisation of public spending. The superannuation policy is designed to be equitable, with an earlier superannuation age for particular individuals (e.g., people that have sustained working injuries, and are unable to work till 70 years old).

Initially, the Māori economy is negatively impacted by the transition, as iwi/Māori businesses, particularly in the primary sector, are required to move to low-emissions alternatives. As a result of partnerships and innovation, the Māori economy experiences economic growth from the 2040s onwards.

In the latter half of the century, Iwi businesses are at the forefront of delivering innovative, sustainable and socially inclusive commercial models, empowering communities and creating social momentum within whānau.

This catalyses regional development, and drives rural communities to increase the number of households that have self-contained water, energy, and food systems. These households become more prepared for natural hazard events. Earlier central government investment in Māori, Pacific peoples and other communities of need, through targeted health, social and education programmes, now pays dividends as health statistics, educational achievement levels and employment levels rapidly improve.

3.2 Demographic changes and migration patterns

Globally, the transition results in negative economic impacts from 2025-2050, including increased unemployment in adversely impacted sectors, particularly agriculture and tourism. This causes overall migration levels to NZ to decline over this period. In response, successive governments provide incentives for highly skilled workers (in healthcare and emerging economic sectors linked to the transition) to migrate to NZ.

The population increases to 6.13 million in 2050, with 23% of population over 65 years old and 5% over 85 years old.[58] The fertility rate slightly declines in the first half of the century and remains steady for the remainder of the century, and migration is the main contributor to population growth following the transition. The age dependency ratio is high throughout the century, however, which results in increased pension and healthcare expenditure (over 65 year olds are estimated to account for 50% of health service use in 2050).[50,xiv,xv]

[xiv] *In 2016, over 65 year olds accounted for 42% of health service use. In 2050, this has been estimated to increase to 50% based on the changing population structure and health gains[59].*

[xv] *The age dependency ratio is a demographic measure to compare the ratio of the non-working population (e.g. people younger than 16 or older than 65) to the working-age population (those aged 16-65)[60].*

There is an increase in domestic migration from areas at high climate risk (e.g., coastal areas) and communities most impacted by the agricultural transition (e.g., rural areas). The planned relocation process is participatory and community-led, culturally-sensitive, and is designed to ***improve*** the hauora (health and wellbeing) of communities – with a focus on providing high quality housing, enhancing access to public services, and building employment opportunities.

Successive governments allow climate-displaced individuals from the Pacific to immigrate (given ongoing impacts of sea level rise and other climate hazards), which is based on a series of bilateral relationships between NZ and Pacific countries. With the negative economic impacts from the transition, and limited central government resources, the support initially provided to Pacific migrants is inadequate. Due to language and cultural differences, institutional discrimination and restricted use of health services, Pacific migrants experience worsening health outcomes. By mid-century, successive governments improve resettlement support, which includes the provision of people-centred culturally sensitive health services and support to secure employment and housing.

Between 2015 and 2030, the Māori population is projected to grow by 16%, which compares with the non-Māori growth rate of 14%.[61] By 2050, a high proportion of Māori are of working age (between 41 - 70 years), strengthening the Māori workforce and contributing to increased household income levels. The age structure of the Māori population also means that there is continued capacity to adopt at-home care practices for kaumatua and children of working parents.

Environmental drivers

4.1 Extreme heat and heatwaves

There is an increase in the frequency and severity of heatwaves from 2025 – 2070; these decline towards the end of the century. Exposure to extreme heat is higher in urban areas between 2025 – 2035, but a concerted effort to plant trees in urban areas helps to ameliorate the urban heat island effect. This approach also has co-benefits related to emissions reductions, and health benefits from increased exposure to green spaces and biodiversity in urban areas. There is a positive relationship between contact with nature and children's health, and improvements in physical activity and mental health are realised.[62]

4.2 Extreme weather events and associated flooding

Extreme weather events continue to occur, resulting in negative impacts to health access and services in exposed areas. Rural areas face higher health risks, including increased prevalence of anxiety disorders and water-borne disease. To manage these risks, there is a strong focus on adaptation, including community preparedness and investment in climate-resilient low-emissions housing.

4.3 Infectious diseases, insects and pests

There is a minor increase in the distribution and ecology of infectious diseases, water-borne and vector-borne diseases, insects and pests. These impacts are managed by improved public health measures and the availability of improved health treatments and therapies.

4.4 Fire weather

The transition results in significant afforestation, which leads to heightened fire risk across the century. This leads to negative health impacts relating to declining air quality from wildfire smoke. The risk reduces in the latter half of the century as temperatures decline and the climate stabilises.

Built environment and food system drivers

5.1 Transport systems and urban form

Successive governments commit to an ambitious transport policy and urban form programme from 2030 - 2050. The key elements of this programme are increased investment in electrified public transport, supported by denser, mixed use urban centres, ambitious phase out of ICE vehicles, and development of infrastructure to support active transport modes.

See **Box 6** for an overview on the future of public transport in Tāmaki Makaurau / Auckland under this scenario.

Changes in urban form and increased density are driven by a combination of regulation and incentives, as well as such as investment in transport-oriented developments near public transport hubs. Significant efforts are made by successive governments to ensure that low-income areas have access to transport hubs and are supported with uptake of active transport modes. The changes in urban form result in health and wellbeing benefits, as residents walk/cycle instead of drive, build stronger community relationships, and take advantage of improved access to blue and green spaces. Through spending more time in urban parks and coastal areas, there are improvements to both the mental and physical health (including reductions in preventable mortality).[63]

While the benefits far outweigh the negative impacts associated with these urban changes (e.g., reduced accessibility and increased urban temperatures in the most densely populated urban areas), targeted central government support is also provided to address negative impacts (e.g., support for disabled residents facing accessibility difficulties, and actions to reduce urban heat exposure). Larger infrastructure projects (e.g., electrified rail in urban areas) are implemented with minimal consultation under emergency legislation.

These changes result in significant emissions reductions and public health co-benefits across the century, particularly from reduced air pollution (NO_2 and PM2.5) from ICE vehicles and increased walking and cycling associated with changing travel patterns.[64] The phase out of ICE vehicles results in an estimated 2,250 avoided premature adult deaths from reduced air pollution, 2,500 cardiovascular hospitalisations (all ages), and 7,000 respiratory hospitalisations (all ages).[65]

By reducing transport-related air pollution, avoiding road injuries, and increasing physical activity, approximately NZ$ 6 - 10 billion in health system costs are saved over the lifetime of the NZ resident population alive at the start of the transition. Māori gain greater health benefits than non-Māori, which translates into estimated reduction of 2 - 3% in the gap in life expectancy seen in 2025[64]

Box 6

Public transport and urban intensification in Tāmaki Makaurau / Auckland

With a rapid increase in the price of carbon from 2025 - 2030, and growing voter support for reducing emissions, there is a renewed effort to implement emissions reductions plans at all levels of central government.

While the share of BEVs has increased to 20% of the vehicle fleet in 2031 due to declining costs and the impact of carbon pricing on petrol prices, traffic congestion has worsened. The population of Auckland has grown faster than predicted, making the provision of improved public transport a priority.

Public support grows for climate action

Public support for an integrated public transport and cycling network grows due to chronic congestion, high petrol costs and increased public awareness (through the ongoing efforts of public health researchers and activists). There is also evidence of the health benefits from increased use of cycleways, with obesity rates declining in communities with cycling infrastructure and improved mental health outcomes. This health evidence, and related cost and congestion pressures, leads to a social mandate for large-scale urban regeneration programme, and congestion charging. New zoning and rating policies restrict ex-urban development (e.g, 'rural sprawl'), and incentivise apartment and multi-storey living, designed in an integrated manner around green-space and transport links.

Mitigation action results in health co-benefits

By 2045, over 70% of Auckland's population commutes by public and active transport modes for work and education journeys. The reduction in ICE vehicle air pollution and increase in physical activity results in major health benefits, including declining rates of ischemic heart disease, diabetes and asthma. This leads to a significant reduction in health system costs for the Auckland region.

The transformation of Auckland's transport system also catalyses investment in innovative, sustainable and equitable urban housing projects. These developments offer high-quality affordable housing under novel ownership and tenancy models, and are located close to employment, green spaces, and recreation and public services, which further contributes to a reduction in emissions and improvements in population health outcomes.

5.2 Infrastructure and housing

The cost of transporting goods (domestically and internationally) increases from 2025 to 2040 as a result of the transition and increased carbon price, which temporarily increases costs of building materials, pharmaceuticals, and medical equipment.[xvi]

There is an increased uptake of renewable energy, which is driven by several factors, including emission pricing, central government incentives, and global economic and technological trends. While there are increased costs to health and aged-care services during the transition, from high electricity costs and the need for capital investments (including in transmission and distribution infrastructure), the affordability of electricity improves later in the century due to reduced technology costs, energy efficiency gains, and the use of policies and regulatory instruments to support distributed energy resources (e.g., household solar and battery storage). Natural gas use is phased out, and the movement away from gas for cooking results in a reduction in the rate of asthma in children due to improved indoor air quality.[66]

There is a concerted effort to improve housing quality across NZ. A focus on Papakāinga development and urban iwi housing solutions strengthen Iwi/Māori social cohesion, a sense of identity and belonging.

Improving energy efficiency and maintaining healthier indoor temperatures are also priorities. This results in population health improvements, including a reduction in temperature-related health impacts.

New buildings increasingly use low-carbon building techniques and sustainable building

[xvi] *This is aligned with cost assumptions in the Climate Scenarios for the Construction and Property Sector.*[8]

materials, and public sector buildings are mandated to make these changes. This leads to higher short-term construction costs, but also lower operational costs for health facilities over the long-term due to improved energy efficiency and strengthened climate resilience of new buildings.

Due to flooding and coastal hazards, there are some high-risk areas where housing and building insurance premiums increase. While limited in scale and extent nationally, there are impacts to housing affordability. This results in negative health equity impacts over the short-term within communities of need at high levels of climate risk, as increased insurance premiums lead to higher rental prices.

5.3 Food security and dietary changes

New global and domestic regulations (e.g., treaties and emissions pricing) and consumer demand drive businesses to address the carbon footprint of their food and supply chains. Multi-national food companies reduce the production of ultra processed and calorie-rich foods to more sustainable and healthy alternatives, which contain vegetables, nuts, legumes, and seeds.[67]

There is also a reduction in red meat consumption, following agriculture being brought into the emissions trading scheme and resultant increases in meat prices. NZ becomes a leader in the production of nutritious plant-based alternative meat and dairy products, which provides employment opportunities for agricultural workers impacted by the transition. However, there is an overall reduction in the size of the agricultural sector in terms of sectoral contribution to GDP and the number of people employed.

There is also an expansion of the food sovereignty movement, as New Zealanders consume more domestically grown food, including from home and community food gardens. Mahinga kai continues to remain important for iwi/Māori, with new innovative ways developed to manage declines in biodiversity.

The shift to a healthier climate-friendly diet results in significant population health benefits, and health system cost savings estimated at NZ$ 14-20 billion over the lifetime of the NZ resident population alive at the start of the transition.[68] Additionally, central government implements a tax on sugar from 2028 onwards in response to the health cost of diabetes and other non-communicable diseases, which incentivises dietary improvements, and therefore results in health benefits and reduced health costs.

Status of the health system

6.1 Primary and community care

The health system shifts rapidly to deliver low-emissions care and is seen as a sustainability leader within NZ. There is a move to community-oriented healthcare, with a strong focus on addressing the risk factors that lead to disease, which leads to a decline in preventable hospital admissions.

The pivot to community-oriented care is partly driven by technology improvements, e.g., wearable health devices, handheld devices, and use of artificial intelligence (AI) to diagnose disease and enhance clinical decision making. This allows primary health providers to undertake more specialist services, such as diagnosis of skin cancer and Parkinson's disease. There is a recognition that increasing the provision of primary care represents better patient outcomes and improved value for money compared to hospital care.[69, xvii]

[xvii] The complex interlinkages between AI and health are not assessed in detail in these climate scenarios. This is assessed in a 2023 report titled 'Capturing the benefits of AI in healthcare for Aotearoa New Zealand' by the Prime Minister's Chief Science Advisor. The health equity opportunities associated with AI and the associated ethical and legal issues are assessed in this report, including through a future scenario on the use of AI by a primary health provider in 2035.[70] This assessment by Prime Minister's Chief Science Advisor, however, does not assess the links between AI, climate impacts and action, and health – this article provides a summary of these linkages.[71]

Successive governments are proactive in working alongside Māori leaders to develop solutions to health issues. There are more Māori-centred health services that are supported by Kaupapa Māori Primary Health Organisations and rongoā practitioners. This advances the reduction of racism, improved cultural safety practices and forms of cultural responsiveness within the health sector.

Box 7 provides an insight to the daily life of staff (including nurses and GPs) in a Kaupapa Māori Primary Health Organisation in Northland in 2045.

Box 7

A Kaupapa Māori Primary Health Organisation in Northland in 2045

Changes to health policies over the last decade has seen increased funding allocated to primary health care, with several health programmes established to target rural Māori health providers. In the north, we now have five health clinics thriving across our rural region.

Successes with central government and iwi in regional development programmes has meant that there has been more of a focus on employment and retraining for the transition. This has contributed to higher wages for some, strengthening health determinants. There have been significant inroads for rural Māori health, with many locals having retrained and now working in the health sector. Past experience has taught us that 'locals know locals', and when they work with their own, everyone benefits.

Whānau still struggling

The phase out of petrol vehicles has been hard for many whānau, as many households do not have the savings available to purchase new BEVs. This has meant that many either drive illegal vehicles or no longer have a vehicle to access health services, grocery stores and find it difficult to visit whānau. There is no public transport across our rohe yet, although there are plans for it in the future. There has been a growing reliance on locally funded BEV vans to take whānau to collect their prescriptions, do their shopping and attend their appointments.

Some have established off-grid Papakāinga, with shared mara kai arrangements and more secure water systems, which has helped them get through the floods which seem to occur too often these days.

Our Kaupapa Māori Health Provider

As a result of the programme, there have been some significant benefits. For example, we have seen an increase in Māori males accessing health services, a decrease in diabetes diagnoses and a significant uptake in healthy food programmes. However, on the downside, the costs of pharmaceutical supplies remain high. Many of our whānau cannot afford these extra costs and, in some cases, do not attend the health clinics because of this.

Our regional rongoā practitioners meet regularly and see patients across the region, with an increased local uptake in these traditional ways of healing.

6.2 Hospital care

The transition results in strong health co-benefits, including from active and public transport, reduced air pollution, healthier diets and an indigenised health system. This contributes to a reduction in morbidity and mortality from preventable non-communicable diseases and improved mental health outcomes.[xviii] A lower proportion of people aged under 65 years are hospitalised, however, there is an increase in admissions of older people. By 2080, the improved health status of the NZ population results in the average wait time in hospital emergency departments reducing to more than six hours for only 5% of patients.

While inequities still exist for Māori, Pacific peoples and the working poor, there has been a significant reduction in the hospitalisation of children and adults. This is largely due to improving key determinants of health, including socio-economic status of communities, housing access, and the food environment, which reduces the prevalence infectious diseases, respiratory disease, cardiovascular disease, diabetes and some cancers.[68]

From 2030 - 2050, there is a migration of highly skilled workers to respond to workforce shortages, including hospital doctors and nurses. Successive governments increase investment in the domestic education of Māori and Pacific people to become health professionals, which helps to alleviate *shortages of specialists* and results in a more diverse and representative health sector *workforce*. This contributes to a health workforce that is more culturally responsive.

6.3 Public health services

The quality of the climate-related public health surveillance system improves, with new technologies better predicting climate hazards (e.g., heatwaves and floods) and infectious disease outbreaks (e.g., water-borne and vector-borne diseases). This allows for improved early warning systems, better community preparedness, and reduction in the exposure of people to climate-related hazards and pathogens.

6.4 Aged care

After two decades of limited resourcing, the capacity of aged care services and facilities improves in the 2040s. As the population ages, there is an increased recognition of the importance of maintaining the health and wellbeing of older New Zealanders. The sector embraces sustainability and technological innovations, leading to cost savings and better quality of life for residents. Aged care options for Māori, and Māori systems of aged care, have increased central government support, which contributes to life expectancy rates slowly trending upwards.

While there are financial impacts to the aged care sector from the transition, including the increased costs associated with low-carbon building requirements, the sector performs strongly throughout the century. There is a significant increase in the demand for aged care beds as a result of the ageing population, particularly for residents aged over 90 years. At the same time, there is a reduction in the demand for high needs beds, as the health status of older people has improved due to climate co-benefits and new therapeutics.

The share price of aged care providers is volatile during the transition, which is driven by broader economic impacts and adapting to the onerous regulations and requirements associated with new climate legislation. Board members and executive teams view climate action as their highest priority, given the associated opportunities and risks. Companies that are more sustainable see higher share price increases, whereas companies that delay emissions reductions and do not adequately adapt to climate hazards face negative reputational impacts.

[xviii] *While the co-benefits from climate action while likely reduce the burden of key preventable NCDs in NZ, global modelling suggests that NCDs will remain the leading cause of mortality in high-income countries under all SSPs.*[20]

From 2050 - 2100, the aged care sector performs strongly on the NZ share market. The services offered by the sector diversifies, as the health status of older people improves. There is also an increase in the provision of more affordable options, which results in a higher proportion of lower-income residents in aged care.

6.5 Medicines and medical supplies

With new medicines, vaccines, and other therapies available, there is a gradual improvement in the management of major diseases impacting New Zealanders. There is an emphasis on providing equitable access to new treatments, which helps to reduce the health-related risks resulting from climate change. The century also sees the development of improved health-related technologies, which allow for the provision of lower cost health services and strengthened health access, including for isolated communities.

While there is an increase in the number of medicines available, successive governments still face issues with funding new medicines and other therapies given the relatively small population. There are some cost savings, however, as the funding to medicines for chronic conditions (such as heart disease) declines as the incidence of non-communicable diseases reduces. The additional funding available helps people with rare diseases, particularly through increased funding of new precision therapies.

6.6 Health insurance

Between 2030 - 2060, there is an increase in publicly funded accident insurance payouts for climate-related injuries, including car accidents and injuries during extreme weather events and heatwaves.[47] The proportion of health spending from insurance payments remains stable at 5% of total spending across the century, as most people consider the services provided by the public health system to be effective.

Climate-Related Health Sector Risks and Opportunities

Section 9

9. Climate-related health sector risks and opportunities

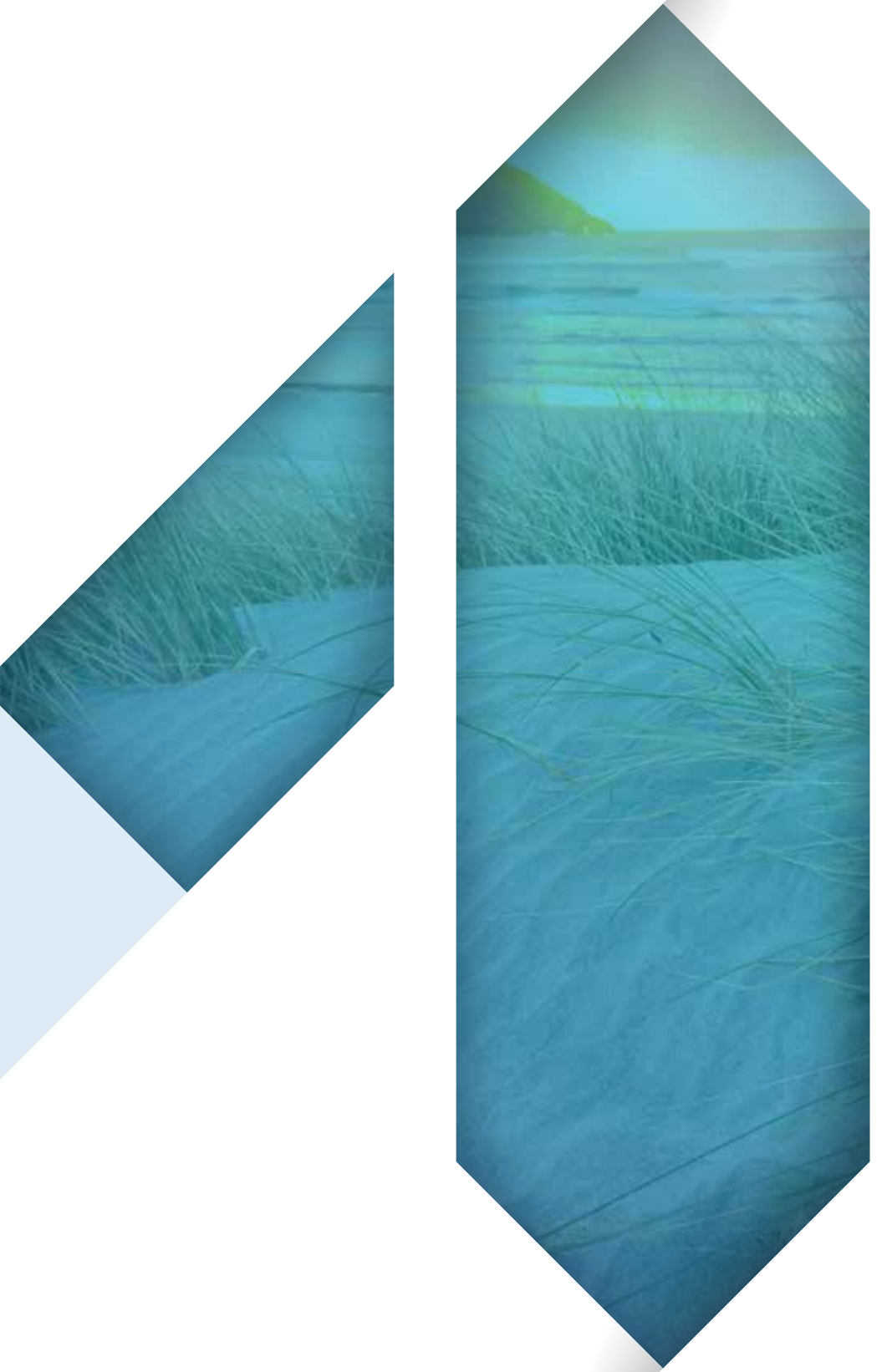
Identifying climate-related risks and opportunities is a key aspect of conducting climate scenario analysis. The health sector includes a diverse group of public and private organisations with multiple and diverse objectives. For that reason, many climate-related risks or opportunities may not be material to the entire sector but could be material to certain sector organisations.

Table 9.1 outlines the XRB standards' definitions of transition and physical risks, and climate-related opportunities, based on the TCFD framework.

Table 9.1: Definitions of risks and opportunities under the XRB's standards

Term	Definition
Transition risk	Risks related to the transition to a low-emissions, climate-resilient global and domestic economy, such as policy, legal, technology, market and reputation changes associated with the mitigation and adaptation requirements relating to climate change.
Physical risk	Risks related to the physical impacts of climate change. Physical risks emanating from climate change can be event-driven (acute) such as increased severity of extreme weather events. They can also relate to longer-term shifts (chronic) in precipitation and temperature and increased variability in weather patterns, such as sea level rise.
Climate-related opportunities	The potentially positive climate-related outcomes for an entity. Efforts to mitigate and adapt to climate change can produce opportunities for entities, such as through resource efficiency and cost savings, the adoption and utilisation of low-emissions energy sources, the development of new products and services and building resilience along the value chain.

A reference table of a range of relevant health metrics that relate to risks and opportunities is included within Appendix D.



Limitations

Section 10

10. Limitations and disclaimer

This section outlines the key limitations and considerations for the health sector climate scenarios presented in this report, and a disclaimer for using the sector scenario narratives.

10.1 LIMITATIONS

10.1.1 CONSOLIDATION OF INFORMATION IN SCENARIOS

The scenarios presented here have been developed based on input from the Technical Working Group (TWG), Te Ao Māori Roopu, and the Leadership Group (LG), and compiled by T+T. While every effort has been made to ensure the scenarios are reflective of the information collated from the workshops, relevant external data, and the feedback provided, not all information collated from these engagements could be included. Information has been prioritised for inclusion that relates to the priority drivers discussed during the workshops for the health sector, voted on by the TWG (Appendix C).

The consolidated information included in each scenario may not be a direct representation of all comments collected from the workshops, but each scenario attempts to incorporate all key perspectives from the TWG and LG.

10.1.2 PURPOSE OF SECTOR SCENARIOS

The scenarios have been developed at a sector level to primarily illustrate how the external environment could change in the future, based on those driving forces that were shortlisted. The narratives have been developed to elaborate and explore how these driving forces may impact the sector in general, on population health outcomes, on other driving forces, or on specific entities and organisations within the sector. It is not, however, possible to explore all possible direct and indirect implications resulting from future climate change impacts for all sectoral organisations/entities. This is the purpose of entity-level scenario analysis and should be undertaken separately, as needed. For the climate scenario analysis, CREs should use the long narratives contained in the ***full scenarios section*** (Section 8).

10.1.3 PURPOSE OF QUANTIFIED VARIABLES AND INDICATORS

The purpose of quantifying variables and indicators in the scenarios is to enable the evaluation of strategy resilience and to complement the scenario narratives. The variables and indicators in the scenarios are not intended to demonstrate precise future values and should not be used to conduct probabilistic calculations. The variables and indicators provided are from both peer-reviewed sources (when a relevant source is available) and formulated by the T+T specialists and TWG members. The plausibility of the variables and indicators formulated by the authors has been reviewed by experts on the TWG.

10.2 DISCLAIMER

10.2.1 THIRD PARTY RELIANCE

This report has been prepared by T+T, on the instructions of the LG and TWG established for this project, for the purpose of assisting entities within the health sector to assess the resilience of their operations, services, and strategies under various future climate-related scenarios. For CREs, which need to make climate-related disclosures under NZ legislation, these scenarios have also been developed to support entity-level scenario analysis under this process.

By its nature, the report outlines plausible future scenarios, which are not intended to be probabilistic or predictive, and accordingly the TWG and LG representatives and their respective organisations, other experts and specialists consulted for this project, and T+T accept no liability to any entity or any other person in respect of any reliance they may place on this report. The information contained in this report is not intended to address the circumstances of any particular entity or individual.

CREs are independently responsible for ensuring they meet XRB requirements and NZ legislative requirements when preparing their climate-related disclosures. Although every effort has been made to ensure the scenarios presented here meet current XRB standard requirements (as of February 2024), T+T and the individuals and organisations involved in this project do not accept liability under any circumstance for CREs independently ensuring that they meet XRB Standard disclosure and NZ legislative requirements.

Individuals and entities using these scenarios for any reason should read this report in its entirety, including the limitations and disclaimers section, appendices, and footnotes.

These scenarios may require updating as new data or information becomes available, or in the event of changes to the XRB Standard requirements. T+T is under no obligation for any reason to update this report, in either oral or written form, for reasons or events occurring after this report has been issued in final form.

10.2.2 DISCLAIMER ON DATA AND INFORMATION USED IN THE SCENARIOS

The information presented here is based on publicly available information, including published reports and academic literature; information provided by the TWG, LG and experts consulted as a part of this project; and expert judgement from T+T specialists. Other than the aforementioned review process undertaken by the TWG and LG, unless otherwise stated, the accuracy and completeness of any information provided in connection with this project has not been independently verified.

The scenarios presented here have been developed based on the best available information and data at the time and in line with present XRB Standard requirements (as of February 2024). There is no guarantee that the information or data provided here is accurate as of the date it is received or will continue to be accurate in the future.

Appendices

Appendix A. Acknowledgements

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Appendix B. Scenario development methodology

The following details the six step methodology used for developing the health sector scenarios (please refer to Section 6 of the main report, Figure 6.1).

1. AGREE FOCAL QUESTION AND SCOPE

The *focal question* guides the process by providing clarity, direction, and boundaries. A focal question should be specific, short, precise, and reflect the desired outcomes and the domain of the project. A focal question should be both broad enough to ensure the scenarios are applicable to the health-sector as whole, but specific enough to ensure that the scenarios are relevant and capture the critical climate impacts.

The scenario *scope* (value chain) is used to describe the scenario 'boundaries' and complements the focal question. Refer to Figure B.1 for diagram illustrating the scope as relates to driving forces (determinants of health), the health sector and health outcomes.

2. AGREE SCENARIO ARCHETYPES AND TIME HORIZONS

Under the XRB standards, entities are required to development, at minimum, three climate change scenarios:

- A greater than 3°C, aligned high warming scenario.
- At least one 1.5°C, Paris Agreement-aligned scenario.
- An additional scenario.

The Leadership Group, Technical Working Group and Te Ao Māori Roopu, each consisting of health sector experts, agreed on the following three scenarios:

- Scenario 1: A 'Hothouse world' (> 3°C).
- Scenario 2: A 'delayed and disorderly' transition (2.7°C).
- Scenario 3: An 'ambitious and orderly' transition (1.5°C).

Time horizons were agreed as:

- Short-term 2023 (present day) – 2030.
- Medium-term 2030 – 2050.
- Long-term 2050 – 2100.

3. IDENTIFY AND RANK DRIVING FORCES

Driving forces are key to the scenarios. They are the factors that are key external and influential factors that can influence outcomes in relation to the focal question.

Driving forces were identified via workshops by exploring the focal question across different dimensions relating to the determinants of health and STEEP categories (Figure B.1).

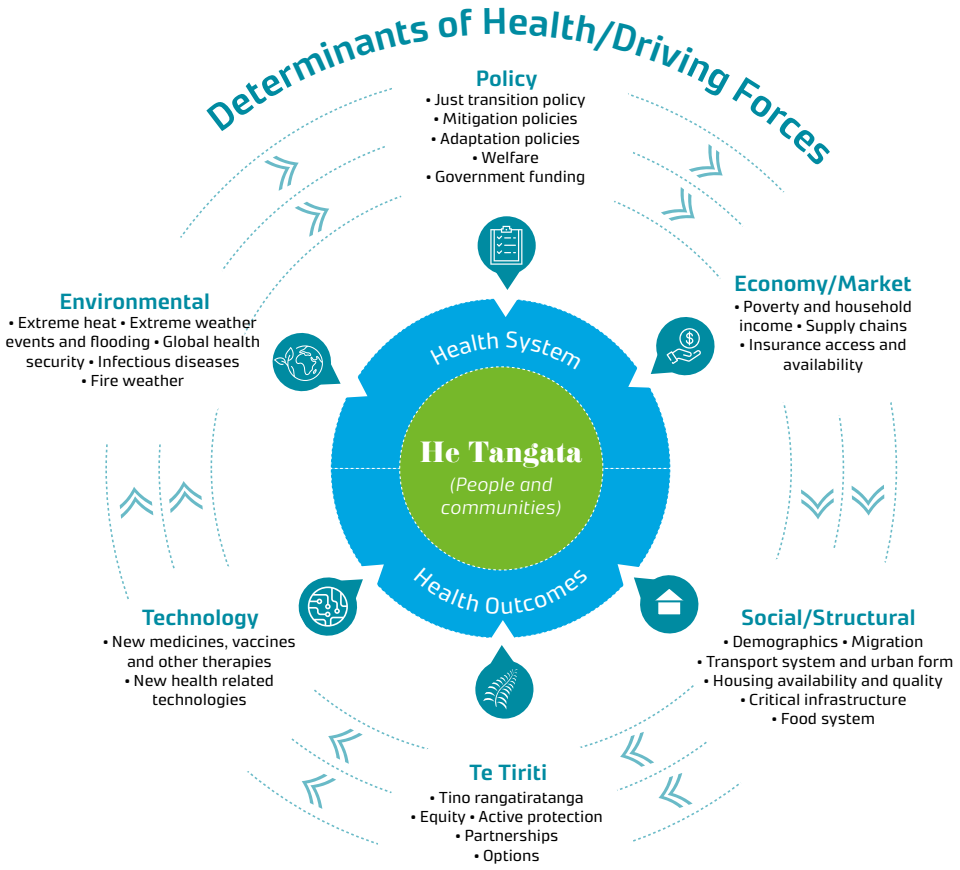

Figure B.1: Scope and framework for identifying drivers.

Once the driving forces were identified, a series of workshops were held to rank and short list the drivers.

A small focus group of five individuals ranked each driving force out of ten based on the positive and/or negative influence of the driver on the health sector. The scores were averaged to identify which drivers were ranked highest. Appendix B Table 1 provides an example of this process.

Appendix B Table 1: Example of the process of shortlisting the drivers with five individuals

Driver	Driver explanation	Score: influence/impact on sector (positively or negatively)						
		Person 1	Person 2	Person 3	Person 4	Person 5	Variance	Average
Poverty	*Insert explanation*	7.7	8.0	10.0	9.0	7.7	0.8	**8.5**

Drivers that were above an average score of 5.5 were short listed. The scores for the short-listed drivers were tested with the TWG during a workshop to reach a consensus on the short-listed drivers (please refer to the main report Section 6.5, Table 6.1 for the short-listed drivers).

4. MAPPING DRIVERS TO ARCHETYPES

This step involved mapping each of the shortlisted drivers against the three archetypes and describing how each driver may manifest under each of the 'worlds'.

5. DRAFT NARRATIVES

A narrative is not simply a list of assumptions. It should be a richly developed and evocative 'movie of the future'. Good scenario narratives should focus on what matters most to key stakeholders and describe challenging, compelling, plausible, and internally consistent visions of how the operating context may evolve over time.

The last step in the process was to build on the driver mapping and create detailed narratives for each of the three scenarios.

6. QUALITY CHECK AND REVIEW

The scenarios were reviewed by the TWG and the Roopu. Edits and changes were made and final versions were developed.

Appendix C.
Long list of driving forces

No.	Scenario scope	Driver	Driver explanation
T1	Technology	Development of new medicines, vaccines, and other therapies	Can result in changes to health outcomes in relation to climate-related diseases and health impacts (e.g. vaccines for vector-borne diseases).
T2	Technology	Development of virtual health technology	New technologies are developed and adopted, including virtual health services, and innovative healthcare solutions (e.g. AI technology to improve disease prediction and forecasting). This may result in healthcare services becoming more resilient to climate impacts and potential emissions reductions (e.g. increased virtual health leading to reduced transport emissions).
T3	Technology	Ability to forecast acute climate hazards	This may improve heatwave and flood preparedness (e.g. early warning systems, surveillance of infectious disease and forecasting of air pollution).
T4	Technology	Development of low carbon technologies	Low-carbon technologies may be developed and adopted (e.g. electric ambulances, building materials, and medical technologies), which could reduce health sector emissions. This may lead to increased electrification needs, and other impacts on the health system.
E1	Environmental	Changes in the severity, frequency and duration of fire weather	This may increase smoke-related morbidity and mortality (e.g. respiratory disease) from reduced air quality, fire-related injuries and mortalities, and other health impacts (e.g. long-term psychological impacts and indirect health effects from property damage and loss). Impacts on buildings and health facilities, particularly in rural areas, and on indoor air quality (e.g. from failing air filtration systems in offices).
E2	Environmental	Changes in the severity, frequency and duration of extreme heat and heatwaves	This may lead to health impacts to children, people older than 65, people with pre-existing conditions (e.g. diabetes), and people engaged in outside activities (e.g. outdoor workers and athletes). A large proportion of exposure is related to indoor housing temperatures (related to housing design, access to cooling, and housing condition), which is a key contributor to health inequities. Vulnerability is due, in a large part, to prevalence of pre-existing health conditions. Heat exposure is also a function of the urban environment, with a lack of urban vegetation exacerbating exposure (due to urban heat island effect). Extreme heat can also result in increased urban pollution (e.g. ozone), increase in pollen production (allergies), and may lead to an increase in water-borne and vector-borne diseases.
E3	Environmental	Changes in the severity, frequency and duration of extreme weather events (storms, high winds, high rainfall) and associated flooding	This may lead to direct health impacts from increased exposure to water-borne diseases (e.g. cryptosporidium and leptospirosis), and flooding may result in an increase of injuries and mortality. Loss and damage to housing and property resulting in mental health effects (e.g. anxiety and PTSD), and long-term economic impacts (particularly in rural communities). Impacts on health access due to infrastructure disruptions and damage (e.g. road damage and power outages), impacts on supply chains (e.g. ports/airports and rural areas accessing medication), and specialist health services (e.g. access to specialist surgical services in rural communities). Long-term health impacts as a result of trauma to affected populations, possible reductions in public services (e.g. from compounding weather events), impacts on recreational activities (e.g. damage to parks and walking tracks), and broader negative impacts on social cohesion and economic wellbeing.
E4	Environmental	Changes in the severity, frequency and duration of drought events	This may lead to increased impacts on drinking water quality and availability, rural health (e.g. the mental health of people working in the agricultural and horticultural sectors), airborne and dust-related diseases, and food security.
E5	Environmental	Changes in the distribution and ecology of infectious diseases, water-borne and vector-borne diseases, insects and pests	Climate hazards (particularly temperature and rainfall patterns) result in a changed distribution of disease vectors and other organisms, which may result in exposure to novel pathogens (e.g. mosquito-borne diseases in NZ).
E6	Environmental	Changes in planetary health	Impacts on global health due to climate change hazards and associated changes (e.g. food insecurity and antibiotic overuse), which leads to negative health impacts in NZ. This could include the spread of novel infectious diseases (e.g. global pandemics), and impacts on pharmaceutical discovery/production (from biodiversity loss). This also may contribute to several global issues (e.g. financial, economic and political instability) and population health impacts in NZ (e.g. eco anxiety).

No.	Scenario scope	Driver	Driver explanation
S1	Social/ Structural	Changes in global food systems	Climate hazards (e.g. drought) and economic drivers (e.g. trade agreements) may impact global food supply chains and production patterns. This could impact the volume and type of food goods exported and imported (e.g. imports of processed food and low-carbon foods - such as lab grown meat substitutes from international markets). Reduced international demand for dairy and meat products grown in NZ, resulting in potential health impacts in rural communities.
S2	Social/ Structural	Changes in local food security	Climate hazards may result in changing growing conditions across the country, which impacts domestic food supply and cost. Meeting the 2050 net-zero target will likely require a decline in domestic meat and dairy consumption, and an increased focus on food sovereignty to reduce food emissions (e.g. food miles). Access to food is affected by increasing cost (e.g. following extreme weather events), particularly in low socioeconomic status (SES) communities.
S3	Social/ Structural	Changes in local water security (driven by physical hazards e.g. drought)	Water quantity and/or quality may be impact by changing climatic conditions (e.g. drought/flooding) or policy changes (e.g. pricing of water as a result of scarcity). Contaminated water may result in health related issues (e.g. Hawkes Bay campylobacter outbreak), resulting in additional workload for public health services.
S4	Social/ Structural	Changes in global water security (driven by physical hazards e.g. drought)	Climate hazards, international governance and regulation may impact global water availability. This could result in health impacts (e.g. water intensive pharmaceutical production). Global water contamination may result in health impacts (e.g. through contamination of food imports to New Zealand).
S5	Social/ Structural	Demographics	The population age structure may be driven by changes in migration policy and future population growth. Future demographic changes may result in population health impacts and potential health inequities (e.g. disabilities, CVD, diabetes, mental health, dementia in elderly individuals). This may also result in an increased demand for health services (e.g. disability services and aged care), particularly as a result of the projected increase in people aged over 80.
S6	Social/ Structural	International migration	Policy settings could result in increased climate-induced migration, particularly from Polynesia (given high climate vulnerability and strong political and people-to-people relationships with NZ), but also potentially from other areas globally (such as SE Asia, South Asia and Africa). The health outcomes in migrants may be related to the health status of migrants on arrival, degree of support provided after moving to NZ, and whether migrants moved voluntarily (e.g. wealthy individuals/professionals) or due to displacement/ conflict (e.g. individuals moving to NZ under the New Zealand Refugee Quota Programme). Migrants to NZ may have better health outcomes than the domestically born population due to the "Healthy Migrant Effect".
S7	Social/ Structural	Domestic migration	There may be changes to internal migration within NZ due to climate hazards/ risks (e.g. sea level rise) and policy responses (e.g. managed retreat). There may also be impacts to health services, particularly in areas with significant changes in population over a short period (e.g. increased demand for health services).
S8	Social/ Structural	Stability of electricity system, and cost	The transition to a low carbon economy may result in increased electricity demand, which would require increased investment in renewable energy generation. Insufficient investment in electricity infrastructure could lead to grid instability, which could impact the health system. A response to this impact may include the increased use of generators and back-up power systems in health facilities.
S9	Social/ Structural	Housing	Housing may be directly or indirectly impacted by climate risks (e.g. flooding and temperature extremes), which impacts population health. The climate related health impacts from housing (e.g. mould levels and rheumatic fever) will depend on housing design, access, and condition. Housing also impacts broader socio-economic determinants of health (e.g. household spending on healthcare, food, and education), which results in health equity impacts. Housing may also be impacted by insufficient public investment, insurance withdrawal, and inadequate planning regulations. Achieving net zero by 2050 would also necessitate the use of low-carbon building techniques and inputs.
S10	Social/ Structural	Building requirements	Achieving net zero by 2050 will necessitate the use of low-carbon building techniques and inputs, may increase the cost of building and construction. This may lead to impacts on health services (e.g. higher cost of building health facilities) and may also increase the cost of housing (which would lead to health equity impacts).

No.	Scenario scope	Driver	Driver explanation
S11	Social/ Structural	Changes to urban form	Urban form may influence social cohesion, housing, food environments, and other factors (e.g. road safety and levels of noise). Achieving the net zero 2050 target in NZ is likely to require increased urban density, which could result in health benefits (e.g. from improved community relationships and increased walking). There could also be negative health impacts (e.g. reduction in green spaces, and risks to elderly and disabled individuals), and increased exposure to heat from both the urban heat island effect and increased air conditioning use in the urban environment.
S12	Social/ Structural	Changes to transport systems and travel modes	Achieving a low-carbon climate-resilient transport system will require changes in transport policy, including increased investment in electrified public transport/ vehicles and a shift to active transport modes. These changes would result in positive health impacts, such as reduced air pollution (particularly NO2 from ICE vehicles) and reduced incidence of NCDs (e.g. from increased walking/ cycling). These changes may also result in negative health impacts, including increased traffic volumes in denser cities and pedestrian injuries/mortalities from electric vehicles (which are presently heavier than ICE vehicles). There may also be negative impacts from a delayed transition to a new transport system, including health access impacts (e.g. from high cost electric vehicles and targets for banning ICE vehicle use) and associated health equity impacts. Health access could also be impacted by the presence of EV chargers and bike racks in healthcare facilities, changes in car parking availability, and the increased use of public transport (particularly for disabled and elderly individuals). Transport network resilience would also impact health service delivery and supply chains within NZ, particularly access to pharmaceuticals and other key health goods in isolated areas. Disruption to roads as a consequence of extreme weather conditions would impact economic, social and health outcomes, particularly in low SES and rural communities.
S13	Social/ Structural	Education	Education quality and access could be impacted by climate risks (e.g. access to education facilities during extreme weather events), resulting in negative health impacts (e.g. reduced employment opportunities and unhealthy behaviours).
S14	Social/ Structural	Misinformation/ disinformation	Changes in information as a result of increased climate risks (and associated social changes) could impact health behaviours and public trust. This could result in a range of impacts, such as reduced vaccine uptake, lower social cohesion, and reduced resilience during climate-related disasters.
S15	Social/ Structural	Changes in geopolitical stability	This may result in a range of political and economic impacts, such as the effectiveness of the multilateral rules-based system (e.g. WTO and UN treaties), functioning of supply chains (e.g. influencing pharmaceutical prices and imports), and risk of conflict between countries.
F1	Economy/ Market/ Finance	Changing insurance access and availability	Increased climate risks result in changes in insurance premiums and coverage for buildings, people (e.g. home, health, life and vehicle insurance), and professionals (e.g. indemnity and liability insurance). This may result in difficulties accessing finance (e.g. home loans) and an increased cost of delivering health services in high risk areas. The difficulty insuring new technologies (e.g. low carbon technologies) may impact the cost and pace of transition to net zero.
F2	Economy/ Market/ Finance	Access to funding and financing (government financing)	Public debt and inflation may rise due to increased government spending on mitigation and adaptation actions. This could result in reduced public sector expenditure, resulting in challenges funding healthcare services (e.g. costs associated with an ageing population). This could also result in reduced spending on preventative actions (e.g. health promotion), and more funding to health responses (e.g. tertiary care). These funding issues could also result in difficulties for private sector providers and households (e.g. due to higher interest rates), which could contribute to reduced health access (including aged care). Financial instability could result from domestic and international transition and physical risks, including from high dependence on foreign funding in NZ (e.g. dominance of Australian owned banks in NZ).
F3	Economy/ Market/ Finance	Household income (inequities)	Changes in household income (as a result of climate change) may lead to health access impacts. This could result in health inequities, as lower SES groups are less likely to be able to afford healthcare and key determinants of health (e.g. healthy diets and secure housing). Economic inequality could be influenced by government adaptation response to climate risks (e.g. managed retreat in particular communities) and achievement of a just transition.
F4	Economy/ Market/ Finance	Poverty	Both physical and transition risks may result in increased poverty and economic inequality. Low SES individuals are less likely to experience adverse health outcomes, including from health access (with particular impacts on Māori health equity). Poverty can impede the capacity of a whānau/family to eat healthy, live in climate-resilient housing, and impact financial wellbeing. The disproportionate impact on low SES communities will result in further inequities.

No.	Scenario scope	Driver	Driver explanation
F5	Economy/ Market/ Finance	Health sector staffing	Health staffing may be impacted by migration policy, ability for NZ health sector to pay competitive salaries, and number of NZ trained staff moving offshore.
F6	Economy/ Market/ Finance	Supply chains	The distance of NZ from markets affects access to key health sector inputs/ goods (such as building materials, pharmaceuticals, and medical equipment), particularly if other countries implement policies of increased trade protectionism due to global fragmentation. Due to NZ's high reliance on imports (e.g. 99% of pharmaceuticals are produced offshore), disruptions to supply chains could result in major health impacts. The cost of transporting goods could increase due to both increased risk from climate hazards (e.g. extreme weather events) and a movement to low carbon options.
F7	Economy/ Market/ Finance	Welfare (including superannuation)	The provision of superannuation and welfare may be impacted by fiscal constraints and high public debt (e.g. from extreme weather conditions causing the government to re-direct spending to disaster impacted areas). This could also pose risks to the provision of welfare, which could result in negative health impacts (particularly to low SES groups).
P1	Policy	Government policy on transition to low emissions economy	Decarbonisation policy could be influenced by domestic politics, international pressures (e.g. trade partners), and global geopolitical and economic challenges. The policy position of the NZ government could impact population health and the broader health sector through regulatory settings (e.g. carbon pricing), building/construction requirements, and other impacts (e.g. on transport system and urban form). Decarbonisation policies could also result in changes in the global production system, and could lead to changing patterns of production (e.g. production of pharmaceuticals locally).
P2	Policy	Carbon price	The carbon price is impacted by domestic policies, market settings, and international regulations (e.g. Article 6 of the Paris Agreement). The use of regulations, such as carbon border taxes, could impact the import and export of goods (particularly carbon-intensive food products). A higher carbon price could result in impacts to building of health facilities due to increased costs (e.g. from use of low carbon building materials).
P3	Policy	Government policy on a just transition	This may impact health equity, particularly for individuals engaged in carbon-intensive occupations (such as truck drivers and farmers).
P4	Policy	Government policy on adaptation	Adaptation policy could be influenced by multiple factors (e.g. domestic politics and economic challenges). Economic issues could result from recurrent climate disasters, which may impact government investment in adaptation. Adaptation actions could also result in unintended consequences, such as managed retreat resulting in mental health impacts.
P5	Policy	Changes in social cohesion/norms	Changes in social cohesion/norms could result reduced public trust (e.g. in government), which may lead to increased community vulnerability during climate events (such as extreme weather events) and reduced community resilience over the long term. Declining social cohesion could lead to direct action (e.g. protests), particularly if there is an increase in inequities and economic inequality.
P6	Policy	Emissions removals (e.g. afforestation)	Reliance on emissions removals, such as exotic forests, could result in health impacts from increased fire risk, reduced biodiversity, and potential land instability. In rural communities, increased afforestation could also result in downstream health impacts during flood events (e.g. from forestry slash).
P7	Policy	Capacity of professionals to manage climate risks	There is a limited capacity of professionals across the sector, including health professionals, to manage climate risks (as this is currently not a part of professional development or formal education).
C1	Cultural	Te Tiriti o Waitangi	How principles of Te Tiriti o Waitangi are honoured/given effect to (e.g. via government policy) will have a significant bearing on Māori health equity and outcomes. Examples of health inequities for Māori in relation to climate change: - Socioeconomic status (SES) exacerbates climate impacts - Demographics and age structure - Remote/rural communities have issues regarding access to healthcare - Pre-existing health conditions Impacts to Māori will connect across all STEEP categories, with direct impacts on cultural capacity to sustain social organisational structure (marae, iwi, hapū, whānau). The capacity to enact cultural values such as manaakitanga, whānaungatanga will be challenged as the environment changes and traditional ways of provision that are inter-reliant on the environment are disrupted and/or changed (seafood beds, hunting). Rongoā is likely to be impacted through extreme weather.

Appendix D. Health metrics

Overview of population health risks and impacts[xix]

Risk factor	Trend of risk factor in scenarios over 2025-2100			Major causes of health loss Morbidity, mortality, and disability linked to risk factor
	Hothouse	Disorderly	Orderly	
Temperature extremes Mortality & morbidity	Extreme increase 	Major increase 	Moderate increase 	**Heat related health loss:**[37,72,73] Heat illness (e.g. heat stroke and exhaustion), cardiac-related illnesses, respiratory disease, accidental deaths, mental health issues, work-related accidents and mortality, injuries and physical trauma (e.g. car accidents and sports accidents). **Cold related health loss:**[37,72] Hypothermia, cardiac-related illnesses, respiratory disease, work-related accidents and mortality, injuries and physical trauma (e.g. car accidents).
Extreme weather events and associated floods Mortality & morbidity	Extreme increase 	Major increase 	Moderate increase 	**Extreme weather events and associated floods related health loss:**[29,80] Major depressive disorder, anxiety disorders, post-traumatic stress disorder, other mental health impacts (including suicides), CVD, water-borne illnesses, respiratory diseases, injuries and physical trauma (e.g. drowning).
Air pollution and urban from changes Mortality & morbidity	Moderate increase 	Moderate decrease 	Major decrease 	**Transition related health gains (for Orderly and Disorderly Scenarios):**[83] Decline in the prevalence of cancers (e.g. lung cancer and other cancers), and reduced morbidity/mortality from respiratory and cardiac-related illnesses (e.g. asthma and heart attacks). **Fire related health loss:**[31] Cardiovascular diseases (e.g. heart attacks), respiratory diseases, mental health impacts (e.g. post-traumatic stress disorder), injury and trauma (e.g. burns).
Diets and food system Non-communicable disease incidence	Moderate increase 	Minor increase 	Major decrease 	**Transition related health gains (for Orderly and Disorderly Scenarios):**[86] Decline in the prevalence of cardiovascular diseases, type 2 diabetes (and its renal complications), and certain cancers. **Diet-related health loss:**[86] Cardiovascular diseases, type 2 diabetes (and its renal complications), and certain cancers.
Infectious and vector-borne disease Exposure to pathogens	Major increase 	Moderate increase 	Minor increase 	**Health loss from infectious disease:** All-cause and bacterial diarrhoea, mosquito-borne and other vector borne diseases (e.g. dengue fever), emergence of new zoonotic pathogens (e.g. new diseases from animals).

[xix] *This table shows the predicted trend in population health risk factors under scenarios, which is based on a qualitative assessment by report authors. The major causes of health loss are identified from peer-reviewed studies, and are for the overall population – the causes of health loss will likely differ for vulnerable populations. Where possible, quantitative metrics on climate-related risks and impacts are provided. These metrics are not, unless otherwise specified, related to specific scenarios or future projections. The inclusion of these metrics is intended to provide the reader with an overview of the scale of the impact of a particular risk factor, and a peer-reviewed source for further reading.*

Metrics

Quantitative estimates

- Heat-related illness morbidity increases by 18% and heat-related mortality increases by 35% for every 1°C increase in temperature (from baseline levels).[38]
- A 1°C increase in temperature is positively associated with cardiac-related mortality – risk increases with heatwave intensity.[74] Exposure to cold is also associated with increased cardiac-related mortality, particularly for older people.[75]
- People aged over 90 are at extremely high risk of cardiac-related mortality.[44] The proportion of cardiac-related deaths attributed to extreme heat in Spain were three times higher for people aged over 90 than those aged 60–74 years, while those aged 75–89 years experienced twice as many deaths as the lower age cohort.[76]
- There is an estimated 2.2% increase in mental health-related mortality and a 0.9% increase in mental health-related morbidity per 1 °C rise in temperature.[77]
- There is an estimated 5.2% increase in risk of traffic accident injuries with increased daily mean temperatures.[55]
- Globally, there is an increased risk of ambulance dispatches in low-intensity (6% risk), severe (7%), and extreme (18%) heatwaves.[78] In Germany, research has found that ambulance dispatches for cardiac-related illnesses are 37% higher on a day with a mean temperature of 30°C relative to days with a mean of 18°C.[35]
- Over 2000-2019, non-optimal temperatures accounted for an estimated 9.5% of all deaths globally – an estimated 8.5% were cold-related and 0.9% were heat-related.[79]

- Studies have found that flooding has a long-lasting health effect that causes more people to seek medical attention for psychological distress between 6 and 24 months following the event. Flood victims have an increased risk of long-term mental health issues of four to eight times that of non-flooded people – and heavy rain has been shown to trigger anxiety years after the event.[28]
- Cyclones and associated flooding are associated with an increased risk of mental health morbidities and mortality (e.g. post-traumatic stress disorder), injuries and physical trauma (e.g. drowning), respiratory disease morbidity (e.g. from increased indoor mould and allergens), and increased infectious and parasitic disease morbidity (e.g. contaminated water or bioaerosols). Children and older adults were generally found to be more susceptible to direct outcomes (e.g. injury and infection), and indirect outcomes (e.g. psychological stress). Women appear to be more likely to suffer psychological distress (e.g. anxiety, gender-based violence) than men following cyclone exposures.[29]
- Prevalence of cardiac-related illnesses increases after extreme weather events. For flooding, there is a high increase in the first week after exposure and then decrease in the weeks thereafter. Poor CVD outcomes are also commonly associated with a lack of medication for people with pre-existing conditions (e.g. in evacuation centres).[81]
- In NZ, there are health impacts from drinking water contamination following extreme weather events. Research in NZ has demonstrated that with every heavy rainfall event comes a surge in hospital admissions for children with gastroenteritis. Parts of NZ have also seen an increase in the incidence of leptospirosis and cryptosporidiosis during flood events, including in the Queenstown district in 2023.[54,82]

- **For the Orderly and Disorderly Scenarios:** Modelling has been completed on the long-term health effects in the NZ population from removing road injury and transport related air pollution and increasing physical activity to recommended levels through active transport. The modelling found an improvement in life expectancy across the population, and that Māori people would likely have small but important reductions (2–3%) in present gaps in life expectancy.[64]
- **For the Orderly and Disorderly Scenarios:** Modelling has also been completed on the population of health impacts from vehicle pollution. Based on data from 2016, removal of transport related air pollution is estimated to result in an annual reduction of an estimated 2,250 adult deaths, 2,500 cardiovascular hospitalisations (all ages), and 7,000 respiratory hospitalisations (all ages).[65]
- It is estimated that 81% of mortality from wildfires is due to chronic long-term exposure and 19% is due to short-term sporadic exposure.[84]
- In Australia, the 2019 wildfires were associated with a 6% increase in emergency department visits for respiratory diseases and a 10% increase for cardiovascular diseases.[85]
- Long-term impacts of wildfire exposure were associated with mortality (e.g. cardiovascular disease mortality and heart attacks), morbidity (mainly respiratory diseases), mental health disorders (mainly post-traumatic stress disorder), and other health impacts (e.g. reduced lung function and poorer general health status).[31]

- **For the Orderly and Disorderly Scenarios:** Foods that are health-promoting, such as vegetables, fruits, legumes, and whole grains, also tend to be those that are climate-friendly.[87]
- **For the Orderly and Disorderly Scenarios:** Based on modelling for the NZ population, shifting population-level consumption to climate-friendly diets could confer diet-related emissions savings of 4–42%. Climate-friendly dietary scenarios would also confer large health gains in NZ (1.0–1.5 million quality-adjusted life-years).[67]
- Sub-optimal diets are responsible for one-fifth of the annual deaths worldwide.[67] In NZ, low fruit and vegetable intake and high salt intake are the leading health risks, accounting for 2.5% and 1.3% of total disability-adjusted life-years respectively.[86]
- The consumption of red and processed meat is associated with increased risk of cardiovascular disease, type 2 diabetes, and certain cancers.[86]

- Climate change may alter the range of global pathogens, allowing infections, particularly vector-borne infections, to expand into new locations (particularly the north of the North Island).[30,88] There is growing evidence that suggests the further spread of dengue fever worldwide is inevitable, and temperature and rainfall increases the risk.[89]
- In NZ, climate change may result in an increased prevalence of water-borne diseases (e.g. exposure to giardia, cryptosporidium, and campylobacter), tick and flea-borne disease, and toxin producing organisms.[54]
- There is research demonstrating a positive association between temperature and both all-cause and bacterial diarrhoea, but not between temperature and viral diarrhoea. This includes cryptosporidium, which is a major cause of diarrhoea in children and immune-compromised populations.[90]

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