Review of sectoral climate scenarios

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Policy Hub

Executive summary

New Zealand faces increasing frequency and intensity of severe weather events due to climate change. The level of increases and the impact of those increases will depend on global green house gas (GHG) emissions and the way we as a nation prepare for those changes.

12 of New Zealand's sectors have each developed scenarios which describe three or four possible futures for their sector. Individually the scenarios identify risks and opportunities ahead for each of the sectors.

This report is based on a review of the 37 sectoral scenarios included in the 12 sector reports. Key findings include:

- on the basis of the scenarios provided, there is no future where NZ achieves zero gross emissions by 2050
- all futures now face significant transition challenges from both mitigation and adaptation
- national cross sectoral planning and stability of regulation is needed to support a fair transition that minimises waste and social disruption
- fiscal challenges will grow, sectors should not assume that there will be additional taxpayers funding for their transition
- there should be consideration of how to use Māori frameworks to support long term planning for the impacts of climate change.

Key cross cutting issues identified were that New Zealand needs to:

- find the right balance between investments to reduce GHGs and investment for adaptation
- consider the use of a national spatial plan responding to future climate change to reduce the risks of stranded assets, unnecessary costs and social disruption
- explore opportunities to safeguard New Zealand's long term food security
- consider how to build resilience to disruptions to supply chains
- consider the implications of climate change for our approach to immigration policy.

Introduction

We are seeing an increasing number of severe weather events internationally and in New Zealand. These events have significant social and economic impacts. The future impacts of weather events are highly uncertain as it depends on the extent of climate change and the way that we prepare for those changes.

13 of New Zealand's sectors have created scenarios which explore these uncertainties to help identify the risks and opportunities from climate change for their sector. These sectoral scenarios provide a treasure trove of information and analysis of the climate risks and opportunities ahead for New Zealand.

This report draws from the 12 sectoral scenarios currently available (the general insurance report is not yet available) to consider the implications for New Zealand.

The author acknowledges both the quality of the sectoral scenarios and the value the set of scenarios provides. The set has allowed us to deepen our understanding of the challenges ahead for Aotearoa and identify the strategic choices ahead. All of those involved in the development of the scenarios should be recognised for the time and effort they have contributed to this invaluable body of work.

Indicative status of New Zealand sectors on scenario analysis

SECTOR	Planning	Stakeholder engagement	Analysis underway	Scenarios complete
Marine				
General insurance				
Tourism				
Banking				
Agriculture				
Property and construction				
Fund Managers, health and life insurance and KiwiSaver providers				
Retail				
Tertiary Education				
Health care				
Transport				
Energy				
Telecommunications				

https://www.xrb.govt.nz/standards/climate-related-disclosures/resources/sector-level-scenario-analysis/

What this report covers

This report starts with background information covering:

Why were these sectoral scenarios created

What are scenarios

What are the IPCC climate pathways which were key inputs to all of the scenarios

There is also a glossary of terms at the end of the report if the reader needs additional clarification on the meaning of the technical words

This report considers 4 key questions in relation to the sector-based climate scenarios

What issues do each of the scenarios consider?

What are the key conclusions for the future of New Zealand which can be drawn from the 12 sectoral scenarios?

What examples were there of good or innovative practice in the scenarios?

What are the key opportunities to improve the process for the future?

Large financial institutions and listed companies are required to disclose their climate risks

The XRB (External Reporting Board) sets financial disclosure standards for companies in New Zealand. In 2022 the XRB issued standards for large listed business to report on climate related risks.

The Taskforce for Climate-related Financial Disclosures (TCFD) has established a well-respected framework for assessing and reporting climate risks and opportunities. The XRB's standards build on this.

Stated objectives of the standards

The objectives of the XRB's Standards are to:

> enable primary users (investors) to asses the merits of how entities are considering those risks and opportunities, and then make decisions ((of whether to invest) based on these assessments; and
>
> support the allocation of capital towards activities that are consistent with a transition to a low-emissions, climate resilient future.

The standards include a requirement to develop scenarios

"An entity must describe the scenario analysis it has undertaken to help identify its climate related risks and opportunities and better understand the resilience of its business model and strategy. This must include a description of how an entity has analysed, at a minimum, a 1.5 degrees Celsius climate-related scenario, a 3 degrees Celsius or greater climate-related scenario, and a third climate-related scenario (see paragraph 11(b))."

The XRB provided valuable guidance on creation of the scenarios

The guidance suggested the development of scenarios by sectors to minimize effort whilst producing high quality outputs for all entities in that sector.

The guidance also recommends that the scenarios are built around two key uncertainties – the extent of climate change and the scale of transition risks.

What are scenarios

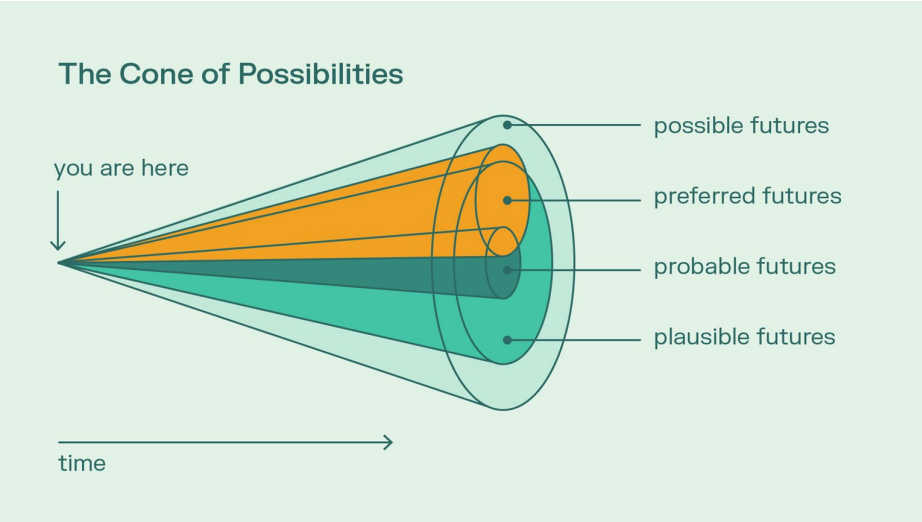
A scenario is a written description of what the future could be like.

Scenarios are not predictions of the future, they are descriptions of possible futures.

Scenarios should have an underlying logic and be based on what we know so that they are credible.

To be of value scenarios should:

- be plausible
- be internally consistent
- seek to answer a clear question (for example what is the future of energy generation)
- start from what we know (for example what are the current trends, for example change in prices for solar power)
- consider what could drive change in relation to the project question (for example increasing costs of carbon)
- be created as a set (a set is 3 or 4 descriptions of possible futures for the same issue) to test the reasonable bounds of possible futures. This allows policies to be robustly tested against a wide range of possible futures.



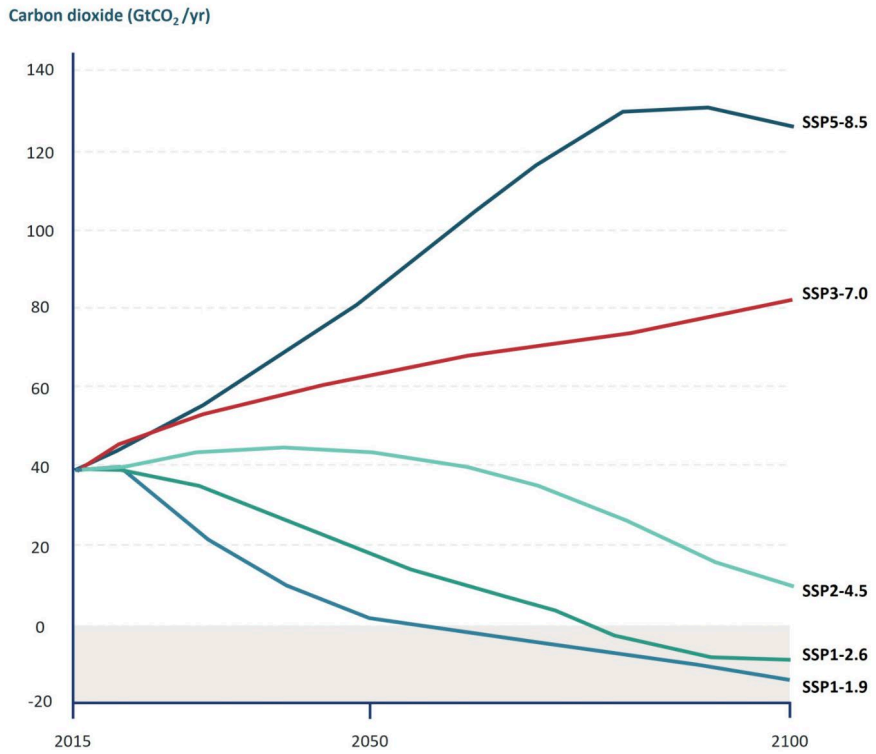
The use of scenarios is a socio technical process.

The development of credible scenarios with persuasive underlying logic is the technical part of the process. This has to be combined with a social process, if the purpose of the development of the scenarios is to support action.

What are the Intergovernmental Panel on Climate Change (IPCC) climate pathways?

The IPCC has modelled changes in climate depending on 5 different pathways of green house gas emissions. To achieve the lowest pathway there would need to be a 45% reduction in emissions of global green house gases (GHG) by 2030 and for GHG emissions to be globally neutral by 2050. The SSP 2-4.5 most closely reflects current international policies.

Having sectoral scenarios which explore either a 1.5C rise or of greater than 3.0C ensures that the scenarios consider the likely extremes of the good and bad of climate change. It should be noted that global temperatures are currently 1.1C above 1900 and each additional 0.1C increase has global impacts, so even if temperature rises are limited to 1.5C we will see increasing intensity and frequency of severe weather events.



	Near term, 2021-2040		Mid-term, 2041-2060		Long-term, 2081-2100	
Scenario	Best estimate (°C)*	Very *likely* range (°C)*	Best estimate (°C)*	Very *likely* range (°C)*	Best estimate (°C)*	Very *likely* range (°C)*
SSP1-1.9	1.5	1.2 to 1.7	1.6	1.2 to 2.0	1.4	1.0 to 1.8
SSP1-2.6	1.5	1.2 to 1.8	1.7	1.3 to 2.2	1.8	1.3 to 2.4
SSP2-4.5	1.5	1.2 to 1.8	2.0	1.6 to 2.5	2.7	2.1 to 3.5
SSP3-7.0	1.5	1.2 to 1.8	2.1	1.7 to 2.6	3.6	2.8 to 4.6
SSP5-8.5	1.6	1.3 to 1.9	2.4	1.9 to 3.0	4.4	3.3 to 5.7

*Temperature differences relative to the average global surface temperature of the period 1850-1900 are reported in °C.

https://environment.govt.nz/what-you-can-do/climate-scenarios-toolkit/climate-scenarios-list/ipccs-ssp-rcp-scenarios/#combined-ssp-rcp-scenarios

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What issues do each of the sectoral scenarios consider?

Each scenario report considers the impacts of climate change for their sector

This table provides the specific question that each sector report considered, or the stated purpose for the use of the scenarios by the sector.

Sector	Issue being explored
Agriculture	To "support the industry's ability to respond to the impending challenges of climate change. And provide tools for industry and sector participants (farmers and growers) to develop an adaptive, resilient and sustainable industry that will continue to flourish in an uncertain and ever-changing world."
Energy	How could climate change plausibly impact the Aotearoa New Zealand's energy sector?
Health	How could climate change plausibly affect population health and the health and disability sector over the short, medium and long term?
Tertiary Education	How will climate change impact Aotearoa New Zealand's tertiary education sector between now and 2100?
Marine	"to explore the nature of climate-related risks at either end of a spectrum." (For aquaculture and fisheries)
Retail	How could climate change plausibly affect NZ's retail sector? And what are the critical uncertainties the sector needs to prepare for?
Property and construction	"The Climate Scenarios presented here have been developed for use by the Construction and Property sector to undertake climate scenario analysis."
Telecommunications	How could climate change plausibly disrupt the Telecommunications Sector over the short (5 years), medium (15 years) and long term (30+ years)?
Tourism	"It is essential that the sector takes action to understand the risks, challenges and opportunities it could face in the future. With this firm grounding, the sector can explore how it could change to ensure it is an adaptive, regenerative, values-driven industry that can prosper in an uncertain and rapidly changing world."
Transport	How could climate change affect the transport sector and when?
Banking	"To support an increased understanding of how climate related risks may materialise, high-level climate risks were identified for the banking sector."
Financial service providers	"supporting fund managers, life insurers and health insurers to better understand and assess climate-related risks and opportunities"

Most of the sets of scenarios considered 3 emission pathways, two planned one unplanned

Most of the sector reports include 3 scenarios, which consider the implications for the sector at three levels of green house gas emissions and associated changes in climate. Most took their emissions pathways from the suite of climate pathways developed by the IPCC.

The scenarios were also differentiated by whether New Zealand takes a proactive approach to plan for changes to the climate or takes an unplanned approach – responding to changes as they occur.

The Energy and Tertiary sector reports developed 4 scenarios, using a two-by-two matrix to explore the implications for the sector for planned and unplanned approaches for each of the low and high emission futures. The Marine* sector produced two scenarios.

	Low (planned)	Low (unplanned)	High (planned)	High (unplanned)
Energy	Coordinated effort	Trailblazers	Slow followers	Hot House
	1.56C (2050)	1.90C (2050)	1.97C (2050)	2.2C (2050)
Tertiary	Low physical impacts			High physical impacts
	1.5C (2090)	1.5C (2090)	>3C (2090)	>3C (2090)
Marine	Kawahai			Mako
	<2.0C (2100)	N/A	N/A	4C (2100)

	Low planned	Mid unplanned	High planned
Agriculture	Orderly	Disorderly	Hothouse
	Tū-ā-pae	Tū-ā-hopo	Tū-ā-tapape
	1.6C (2050)	2.0C (2050)	2.5C (2050)
Health	Ambitious and orderly transition	Delayed and disorderly transition	Hothouse world
	1.6C (2050)	2.0C (2050)	2.1C (2050)
Retail	Orderly	Disorderly	Hot House
	1.6C (2050)	1.7C (2050)	2.0C (2050)
Property	Orderly/Net Zero 2050	Disorderly/Delayed Transition	Hot House World
	1.6C (2060)	1.7C (2060)	2.1C (2060)
Telecom	Orderly transition	Disorderly	Hot House World
	1.4C (2100)	2.7C (2100)	3.6C (2100)
Tourism	Orderly	Disorderly	Hothouse
	Hiahia	Pokanoa	Wharewera
	1.6C (2050)	2.0C (2050)	2.5C (2050)
Transport	Fully Charged	Short detour	Bypass to breakdown
	1.6C (2050)	1.7C (2050)	2.1C (2050)
Banking	Orderly	Too Little Too Late	Hot House
	1.4C (2100)	2.7C (2100)	4.4C (2100)
Financial services	Orderly (2050)	Too little too late (2050)	Hothouse (2050)
	1.5C	>2C	>3C

*The marine sector scenarios, has now been super ceded by the integrated climate, nature and ao Māori scenarios (assets.kpmg.com/content/dam/kpmg/nz/pdf/2025/08/integrated-seafood-scenarios.pdf)

All considered a broad range of drivers. If scenarios are used again, it would be good to put this analysis alongside general sectoral trends

All sectors developed high quality scenarios focusing on the impacts of climate changes and actions to mitigate or adapt to climate change. All considered the impact of a range of other drivers of change in their scenarios.

However, it would be useful if the reports considered and set out recent trends in their sector. For example, what are the historic trends in tourist numbers, what are recent trends in engine type of private vehicles or what has happened to the structure of the telecommunications sector over the last 10 years.

If trends are considered it is useful to look back as far as the reports look ahead, which provides a valuable sense of the possible scale of change ahead. For example, in 2015 the number of EVs in NZ was negligible, this increased to around 19,000 by 2020 and at year end 2025 was around 84,000 of over 4.4million light vehicles.

Common drivers considered alongside climate drivers

Most common drivers	Number of sectors that considered this driver
NZ Government approach	10
Domestic leadership	10
Technology	10
Shape of the economy	10
Social expectations	9
Changing patterns of demand	9
Global context	8
Cost of carbon	7
Global markets	7

What are the key conclusions for the future of New Zealand which can be drawn from the 12 sectoral scenarios?

On the basis of the scenarios provided there is no future where NZ achieves gross zero emissions by 2050.

The low emission scenarios present the best case situation for reducing the impacts of climate change. To minimize climate change impacts IPCC's best scenario assumes that globally the world will achieve net zero emissions by 2050. It is therefore interesting to consider how close the sectors consider we will come in New Zealand to reducing green house gas emissions to zero and the cost of remaining offsets. Five of the low emissions scenarios say that, while there would be reductions in emissions, up to 50% of emissions remain in their sectors. This is the gross emissions before any offsets are considered.

A rough assessment of the annual costs of paying for remaining offsets would be $15bn annually, roughly 6% of total NZ GDP. This would be equivalent to around a 17.5% increase in the amount each New Zealander pays in tax each year. And this cost does not consider the costs of the investments to support the transition to lower the emissions of these sectors. None of the scenarios provide estimates of the costs to the taxpayers of achieving these reductions. Scenarios typically refer to "government funding" distancing the price that would be placed on citizens through increasing levels of tax.

Sector	Reduction	Dependency	Remaining million tonnes	Cost per tonne $NZ	Offset cost $bn
Agriculture	50%	Taxpayer funding	20.3	277	5.6
Marine	50%	Taxpayer funding	13.1	(US $ 180) 303	3.9
Property	90%	Taxpayer funding	0.7	250	0.175
Transport	79%	Adequate investment	3.4	309	1
Energy	89%	Taxpayer funding	14.4	309	4.4
Total					15

Assumptions

% reduction and cost per tonne taken from sector scenarios as are the comments on dependency of funding to achieve these reductions.

Remaining tonnes are based on a proportion of 2023 MfE tonnes per sector except for the Marine and sector, which includes tonnes remaining in its report. The transport sector includes an MfE assessment that 9% of emissions are from international aviation and shipping. The amount has then been halved, assuming improvements in efficiency over the period

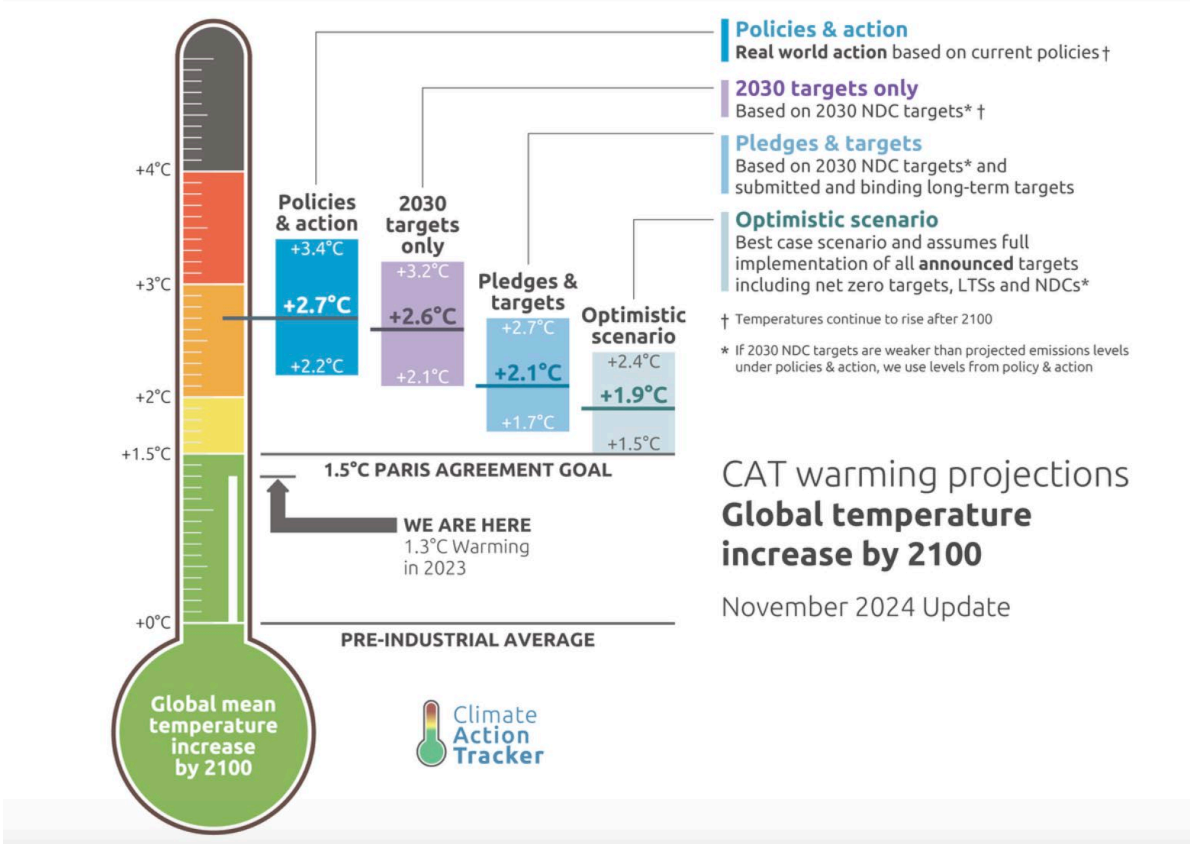
All futures now face significant transition challenges from both mitigation and adaptation

The Climate Action Tracker (CAT) is an independent scientific project that tracks government climate action and measures it against the globally agreed Paris Agreement's aim of "holding warming well below 2°C, and pursuing efforts to limit warming to 1.5°C.

CAT analysis, based on current international policies and actions, suggests that we are unlikely to limit global temperature rise by the end of the century to 1.5C. The XRB acknowledges this in the notes to its standards. This has become even clearer since the XRB issued its guidance and the sector reports were produced.

This does not mean that scenarios that consider a future where we limit temperature rise to 1.5C are no longer of value. Those scenarios explored a future where significant effort was put into reducing emissions and transition risks are high. Valuable insights can still be gained from those scenarios.

However, it does suggest that we no longer have the option of either facing the stress of mitigation or the stress of adaptation. There will now be significant challenges ahead from both the changes required for mitigation and changes required for adaptation.



https://climateactiontracker.org/global/cat-thermometer/

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National cross sectoral planning and stability of regulation is needed to support a transition which is fair and minimises waste and social disruption

The interactions between the sectors is clear, for example all need energy, transport and infrastructure. Ensuring an alignment in strategies and investments between these sectors can be effectively managed through regional plans, if the assumption is that the broad location of demand will remain similar today with steady and stable changes over the medium term.

However, the sectoral reports consistently assume that a greater degree of national level co-ordination will be needed under both a low emissions world and a high emission world.

In the low emissions world, central co-ordination is needed to ensure an equitable outcome and to provide businesses with clear signals to support certainty for investments.

In the high emissions world, it will be necessary to prepare for the scale of sea level rise, flooding and change in climate over the longer term. National cross sectoral planning will increase the chance that investments in infrastructure, social and economic opportunities are made that match future climate conditions.

This suggests that whether we see limited or significant climate change, national long-term planning, building from the regional plans, will be critical to support a transition which minimizes disruption, wasted investment and social angst.

Fiscal challenges will grow, sectors should not assume that there will be additional taxpayer funding to support their transition

Many of the sectoral scenarios assume that taxpayer funding would be provided to reduce emissions and also to adapt to changes in the climate.

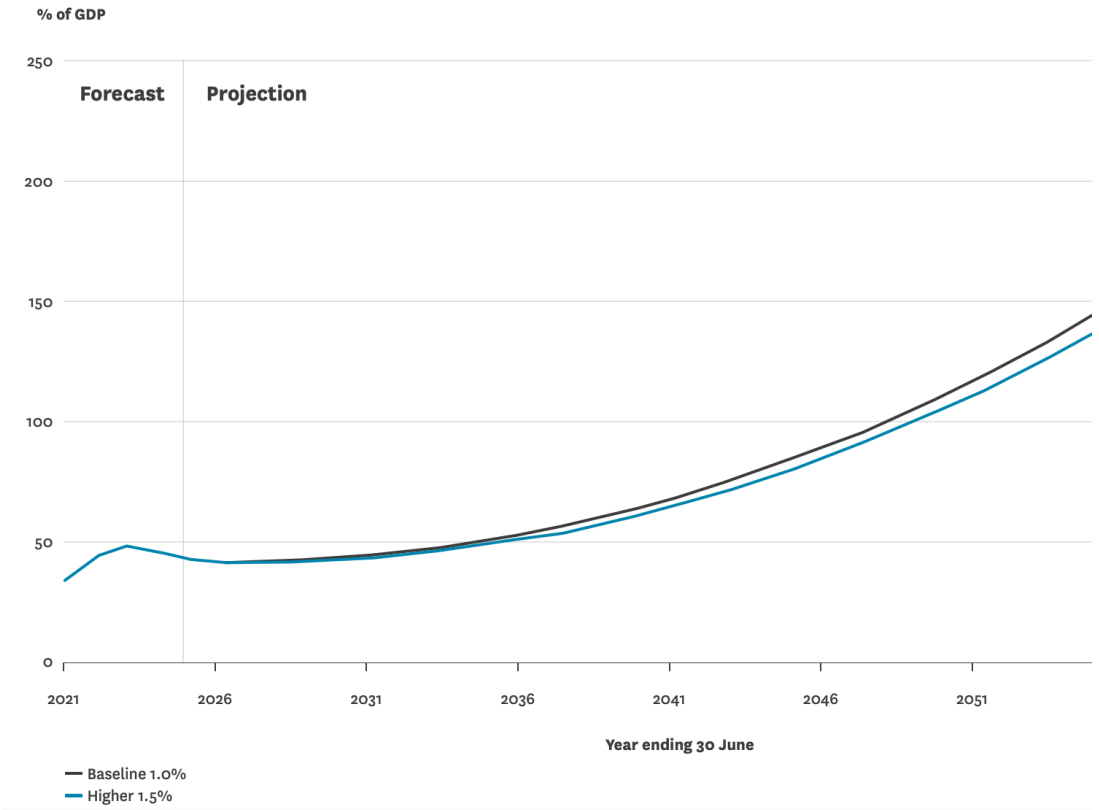
New Zealand was in strong fiscal position before COVID with national debt of 19% of GDP in 2018. The purpose of keeping national debt low was in part to allow flexibility for shocks. This in-built flexibility allowed New Zealand to respond well to the challenges of COVID. This and responding to other events has seen national debt rise to 44% in 2024.

Current fiscal flexibility to support sectors to transition to low emissions sectors and to adapt to changing weather would be difficult.

The Treasury's long term insight briefing suggests that the availability of taxpayer support for sectors to apdat will become more difficult over time. The Treasury estimated that national debt would increase to 197% by 2061 with current policy settings, driven by issues such as the rising costs of health and pensions and revenue expectations.

The health, retail, tertiary sector and transport reports recognize that there would be pressure on available funding in their areas, with possible tax increases to meet pressures.

Figure 15: *Net core Crown debt under different labour productivity assumptions*



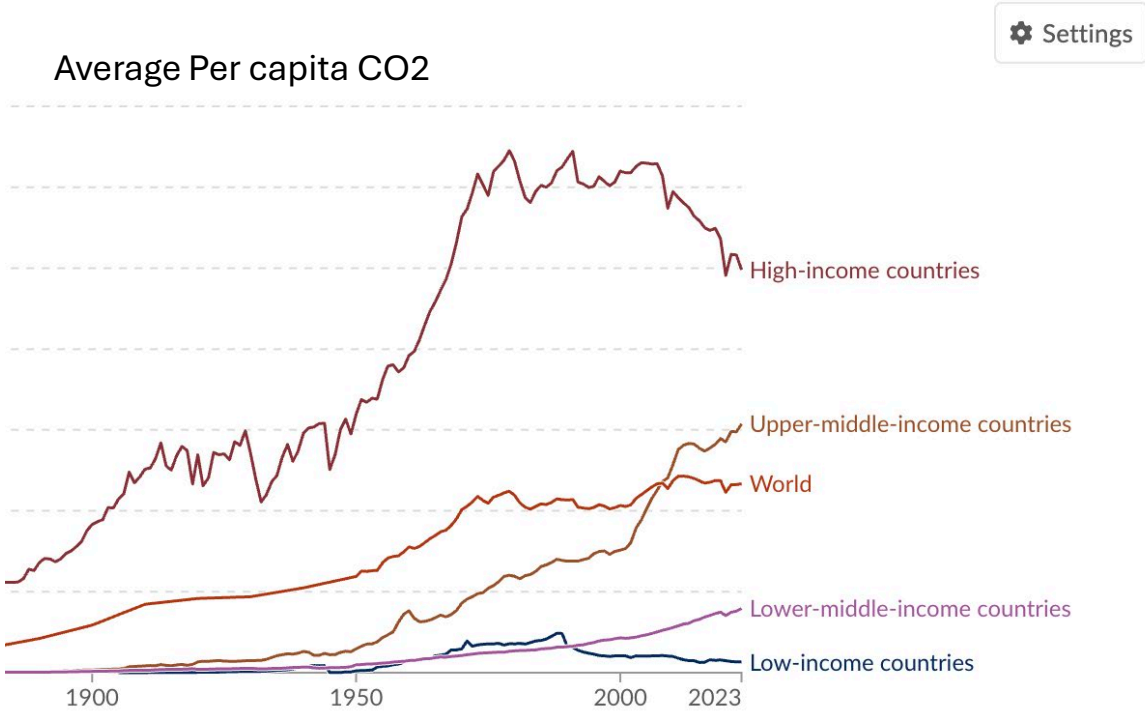
https://www.treasury.govt.nz/sites/default/files/2021-09/ltfs-2021_2.pdf

Without more funding to developing nations the low emission scenarios are not achievable. The international context must be considered to get a full understanding of the challenges ahead

None of the sectoral scenarios considered the costs of supporting developing nations to reduce emissions. Without this support achieving a low emission pathways is unlikely. The OECD estimated that while developed nations decreased emissions by 8% between 2010 and 2019, developing nations increased emissions by 22% over the same period.

Population growth and expectations of increasing standards of living in developing nations will continue this trend if there is not significant investment.

The funding to achieve this is estimated to be of the order of $2trillion a year. Much of this will come from domestic and private sector funding. But there is an estimated $600 billion gap.



https://ourworldindata.org/co2-and-greenhouse-gas-emissions

Country	Co2 per capita
Australia	15
United States	14.2
Singapore	9.4
China	8.8
Japan	8.6
Germany	8.0
Finland	6.7
New Z	6.4
UK	5
Argentina	4
Mexico	3.7
Vietnam	3.2
Indonesia	2.4
Brazil	2.2
India	1.8
Pakistan	0.8
Nigeria	0.5

https://www.worldometers.info/co2-emissions/co2-emissions-per-capita/

There should be consideration of how to engage with Māori frameworks as we plan for the long-term implications of climate change

Of the sectoral scenarios, 4 included Māori frameworks and principles, though it was not clear how these were applied in the scenarios.

It would be useful to consider whether it would be possible and helpful to have a Māori framework and principles that could be used by all sectors. This would need to be combined with suggestions of how to apply those frameworks and principles within the development of the scenarios and their application within a sector or by an individual organization.

	Core principles	Framework?
Agriculture	Our land, our water, our air, and all biological life must be able to thrive without over-use Any use is a privilege, not a right. If something is not healthy or well, we must fix it.	Mana o te Whenua, Mana Kai, Mana o te Tangata
Energy	Kotahitanga Tikanga Whanaungatanga Manaakitanga Tiakitanga	He Ara Waiora
Tertiary	Kotahitanga Māramatanga Whanaungatanga	
Tourism	Caring for the whenua is the first priority. Everything else must be measured against this. We are not the centre of the Universe, but we are part of it. The Mauri is the web of connections that sustains life. Te Tangata, people, are not the masters of the Mauri; we are part of the Mauri and embraced by it. No individual person is more important than any other. Each must contribute what they have to offer and receive what they need to be well. We give special care to the tiniest living creature.	Tiwaiwaka

The reports highlight five strategic issues for New Zealand

1. We need to find the right balance between investments to reduce GHGs and investment for adaptation.

2. A national spatial plan considering future climate change would reduce the risks of stranded assets and unnecessary costs and social disruption.

3. We need to explore opportunities to safeguard New Zealand's food security.

4. New Zealand must consider how to build resilience to disruptions to supply chains.

5. We need to consider the implications of climate change for our approach to immigration policy.

We need to find the right balance between investments to reduce GHGs and investment for adaptation

Getting the right balance between effort to reduce carbon versus action to adapt to climate change.

The Stern review in 2006 estimated if no action was taken to reduce emissions, then climate change would cost 20% of world GDP, but reducing emissions would cost 1% of GDP per year if the world made that investment from 2006 (he raised this to 2% per year in 2008).

The 1% of GDP investment has not been made over the last 20 years. So, we no longer face a choice between emissions reduction or climate change. A certain level of climate change is already locked in. We are on a pathway that will see global temperatures continue to rise, likely to levels between the bands considered in the sectoral scenarios. The changes in climate will lead to increasing frequency of extreme events and rises in sea levels in New Zealand.

While efforts to limit the extent of change are critical, action is needed now, both for mitigation and adaptation. The sector reports provide indications of areas of investment for mitigation and adaptation. We face the dilemma of how much to invest in reducing GHG emissions versus how much to invest to adapt to the climate changes that are ahead. For example, should there be investments in more wind and solar energy generation capacity to reduce GHG emissions or should there be more investment in flood defense to protect against increasing flood risks? In 2019 NIWA estimated that 700,000 New Zealanders and $135b billion of assets were already at risk from flooding, before consideration is given of increased flood risk from climate change.

One thing, though that is clear - New Zealand should not take actions which will increase the costs of mitigation or adaptation. For example, there should be no building on existing flood plains as the risk of flooding increases in all of the scenarios.

Graph showing % new build consented on flood plains in Auckland

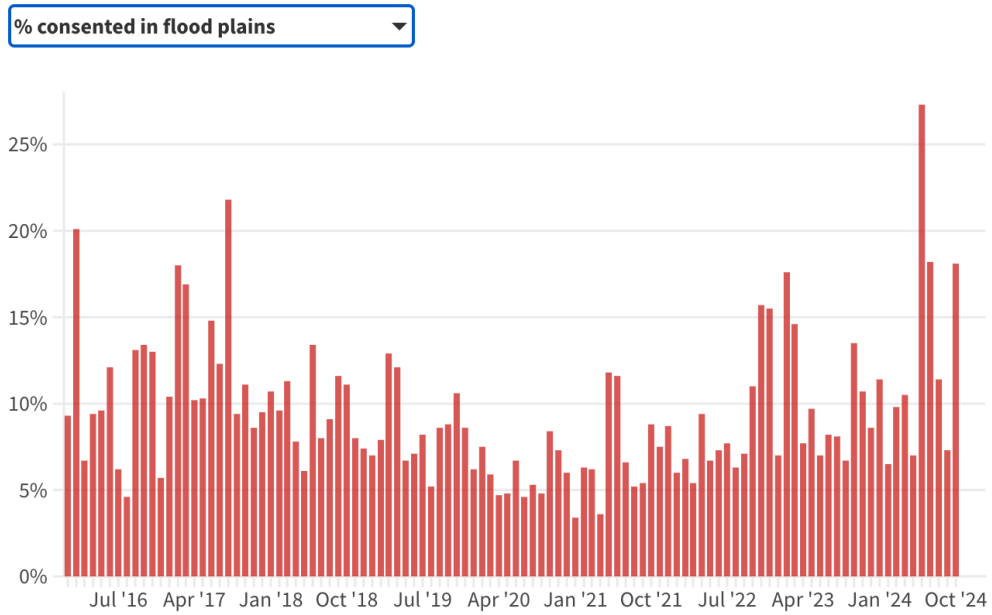


Chart: Kate Newton | Source: Auckland Council • *Some dwellings given consent may be located in both a flood plain and a flood prone area. Data for consents granted on land featuring overland flow paths, another potential source of flooding, is not reported by Auckland Council.*

A Flourish data visualization

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A national spatial plan considering future climate change would reduce the risks stranded assets, unnecessary costs and social disruption

Sector reports highlighted the importance of investment to ensure resilience of critical infrastructure; but also noted the risks of stranded assets.

The importance of maintaining physical access is mentioned in six of the sector reports (energy, health, telecommunications, tourism, transport, banking) with a number specifically suggesting that investment should be made to make critical transport infrastructure more resilient to weather events.

A 1 in a 100-year extreme weather event would become an annual event in the more extreme scenarios by the end of the century. As the frequency and intensity of weather events will increase, the standard against which new infrastructure should be built will need to change. This will increase the costs of new infrastructure and would require a national programme of investment for infrastructure judged to be critical.

However, six of the sector reports (agriculture, energy, property, tertiary, tourism and banking) highlighted the risks of stranded assets. So simply hardening existing infrastructure may not be the best investment if the extent of climate change is such that some of the hardened infrastructure has to be abandoned due to sea level rise or pluvial or fluvial flooding.

Noting that improving the resilience of critical infrastructure to ensure access to key services goes beyond transport infrastructure to include hospitals, water treatment plants, energy networks and other key public facilities.

Investment needs to be balanced between hardening, assets the ability to restore services and community resilience

Figure 3-1: Resilient Communities Recover Faster (National Disaster Resilience Strategy, 2019)

https://www.civildefence.govt.nz/assets/Uploads/documents/lifelines/NVA-Part-B-Main-report-v1.0-Sept-2023.pdf

We need to explore opportunities to safeguard New Zealand's food security

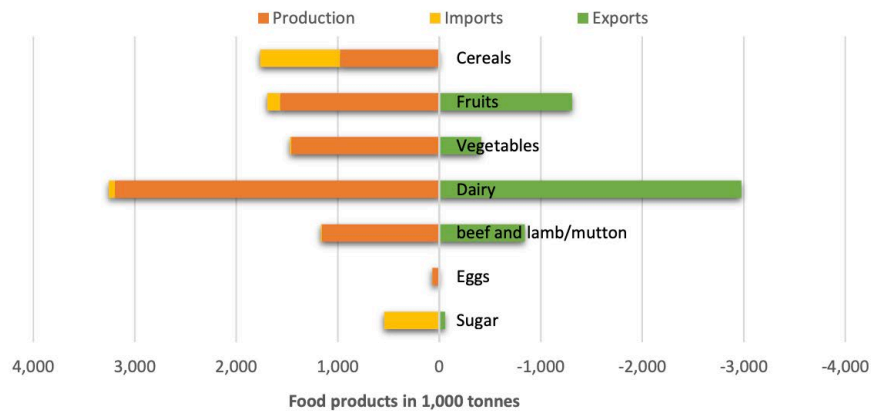
We depend on supply from overseas for certain key staples and availability of overseas supplies may be affected by climate events

Three of the sector reports highlight that climate change will increase the challenges of maintaining food supply in the long term. There was a variety of reasons: reducing international and domestic food crop yields; new pests; and disruptions to international or domestic supply chains.

Various approaches could be taken to manage these risks, One approach would be to change the balance of New Zealand's primary products and to introduce new farming methods. But doing so could reduce the amount of food we export and take land that might have been reforested as a carbon offset.

A recent report by Landcare provides a more detailed assessment of the issue noted in the sector reports. It considers current food security and the implications of projected population growth. Highlighted text to the right provides their broad conclusions. However, Landcare's work did not consider climate impacts either in terms of what New Zealand can grow or possible changes to population size through increasing numbers of climate refugees.

Figure 1. Domestic food production, exports, and imports in 2018



Source: Statistics NZ,[9,10] MPI outlook report, [11] Beef and Lamb NZ, [12] DairyNZ, [13] and horticulture fresh facts report [14]

Current state of security of food supply

New Zealand is a net food producer, with agriculture being a key component of the economy. We produce high volume, high-quality protein (meat and dairy) and some fruits (kiwi, apples and grapes) in abundance. However, there are certain key foods consumed in large quantities that cannot be grown in New Zealand, or for which we do not produce enough to meet domestic needs. These at-risk commodities include sugar, wheat, maize, rice, and coffee, which are staples in the New Zealand diet or for livestock production and are not easily substitutable. Furthermore, these foods are imported from only a small number of places, so any disruption in trade flows or production in those countries will severely affect New Zealand's food security. Looking to the future, changes in food production or consumption patterns for vegetables and fruits, in which we are now largely self-sufficient, will be required to meet projected population growth

https://www.landcareresearch.co.nz/assets/Publications/Policy-Briefing-Guidance-Papers/Policy-brief-27_Rethinking-NZs-food-security.pdf

New Zealand must consider how to build resilience to disruptions to supply chains

New Zealand has benefitted from its openness to international competition, This may need to be balanced with the need to ensure resilience to disruptions in supply chains

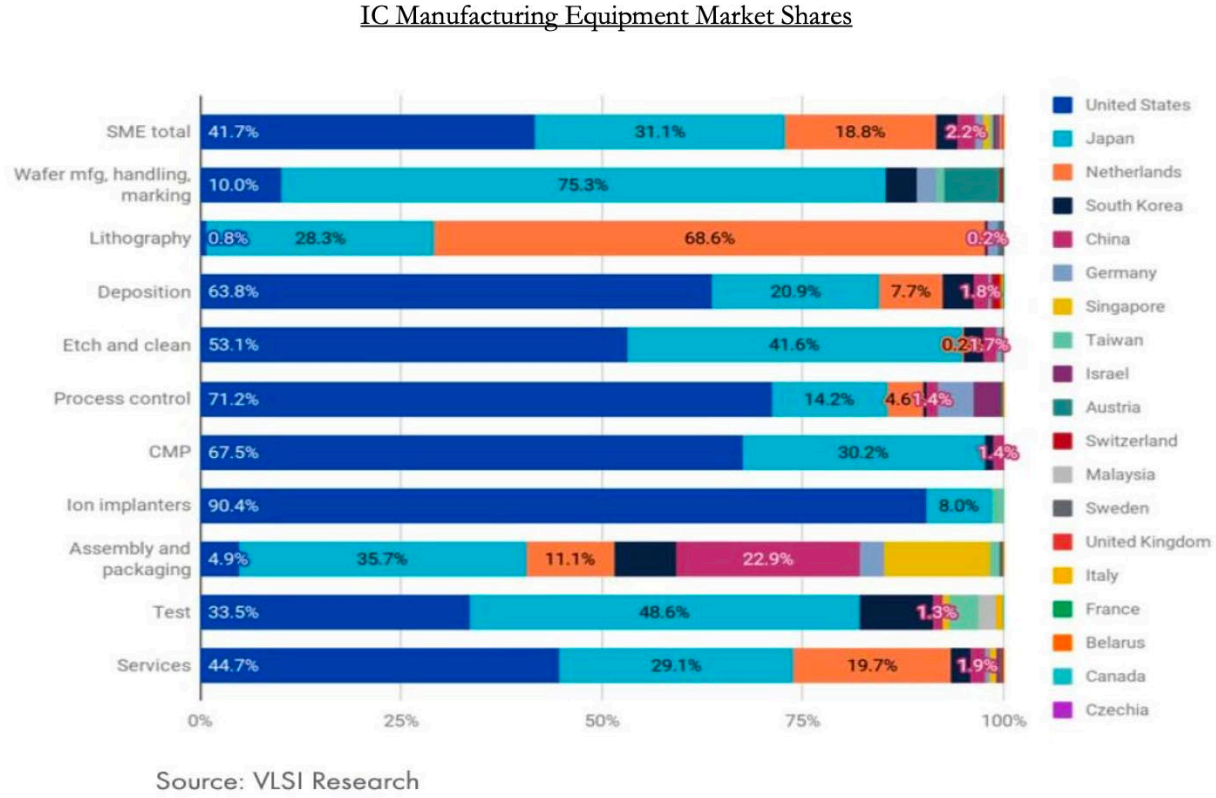
Six of the sector reports raised concerns about the security of international supply chains, whether for short periods because of severe weather, rising costs of transportation, global instability or contention for limited resources.

One issue of note was New Zealand's dependence on other nations for the provision of digital technologies, and others were mentioned such as vehicles which New Zealand doesn't manufacture.

The White House completed a thorough assessment of the vulnerability of its supply chains in 2021 Building Resilient Supply Chains, Revitalizing American Manufacturing and Fostering Broad Based Growth. It challenges the paradigm that it is always best to let markets operate as the best route to supply essential goods, recognizing that a nation might decide that there are some areas where resilience trumps efficiency.

Given our remote location there may be areas of our economy where the focus of effort should be on security of supply rather than openness of our markets to international competition.

Shares of semi conductor manufacturing equipment



Source: CSET (based on VLSI Research data)[132]

https://cset.georgetown.edu/wp-content/uploads/The-Semiconductor-Supply-Chain-Issue-Brief-1.pdf

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We need to consider the implications of climate change for our approach to immigration policy

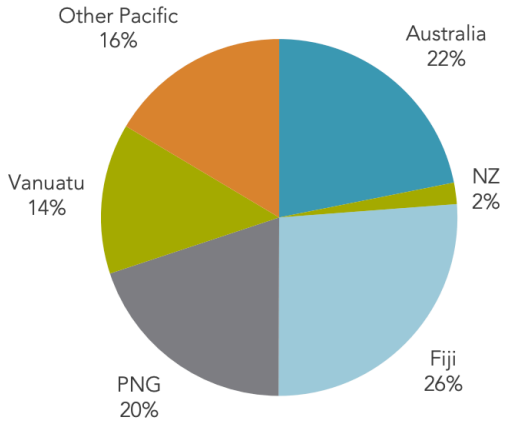
All of the scenarios emphasized the importance of having an equitable outcome, whether we are moving to a low emissions society or responding to a high emissions world. But the scenarios did not explore whether the equitable outcome was solely for New Zealanders, or extended to our pacific island neighbours, or further afield to climate refugees from our region of the world.

New Zealand needs to consider where it sits on the question of what are our regional and global responsibilities and what this would mean for long term immigration policy, population expectations and the consequent demand likely to be placed on public institutions, infrastructure and food and water supply.

Five of the sector scenario reports (agriculture, energy, property, telecom, tourism) highlight skills shortages as a key risk for their sector. The areas identified could be used to support a focused effort for education and training of New Zealanders. Or, if there is not focused effort to address medium term skills shortages through education, immigration policy could be adjusted to attract people to meet the skills shortages identified in the sector reports.

50,000 already displaced per year in the Pacific by extreme weather

Figure 3-12 Distribution of new displacement due to weather events across the Pacific, 2010s



Source: NZPC calculations using IDMC's (n.d.) data.
Note: This figure presents total displacements (internal and cross-border) across the Pacific countries.

https://www.treasury.govt.nz/sites/default/files/2024-05/pc-wp-international-migration-to-nz-future-opportunities-and-challenges.pdf

Common risks

The sector reports noted a range of common risks which would be created by climate change

Assets
Stranded assets
Damaged assets and cost of repair

Access
Difficulty maintaining access
Breakdown in supply chains
Isolation of communities

People
Skills shortages
Mental health challenges
Social tensions

Finance
Capital constraints
Difficulty getting insurance
Rising costs

Competitiveness
Reputational damage
Reduction in demand
Changes in demand
Business failures

More details of the risks identified in the sector reports is attached on slide 40 for anyone wanting a deeper dive into the risks.

What examples were there of good or innovative practice in the scenarios?

Noting that there were many great examples in all of the reports. The following slides provide a small selection of the helpful approaches used in these reports which others might find useful.

Metrics to understand the scale of potential changes ahead

The **agriculture sector*** included key metrics on the make up of the sector for each of the scenarios. This allowed users of the scenarios to get an understanding of the scale of uncertainty for their sub sectors and extent of changes that they may face.

The agriculture sector also demonstrated the benefit of having the involvement of senior decision makers in the process. The process did not stop at producing a set of scenarios, it went on to the next stage with the development of a roadmap to respond to the findings of the work in the Agriculture Adaptation Roadmap.

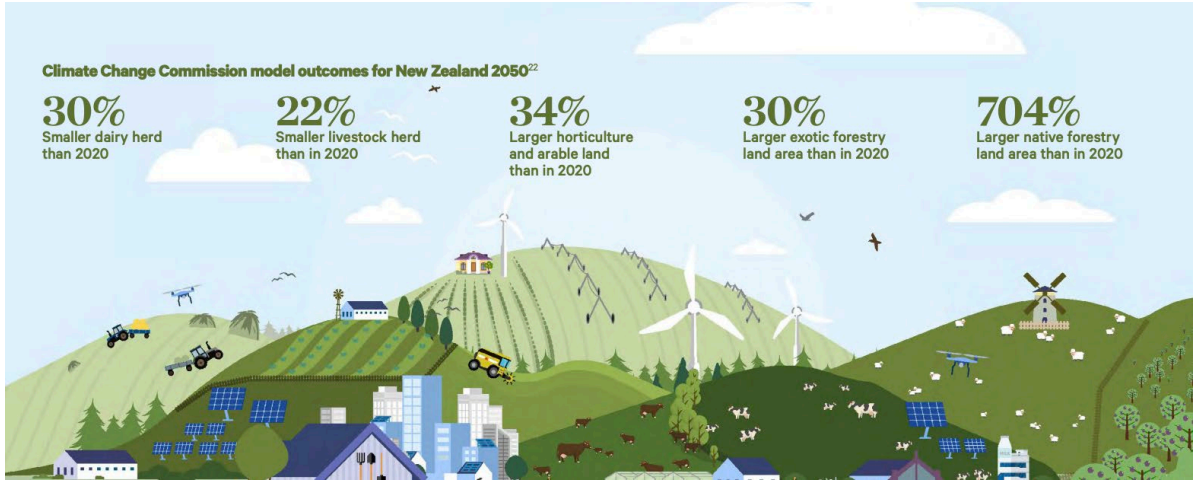


Table 6: Key climate-related risks and opportunities under Slow Followers

The energy sector climate-related risks and opportunities are present across all scenarios. The table holds those identified as most significant for the Slow Followers scenario. This scenario provides the conditions for these risks to be most challenging, and for these opportunities to be most successful. Physical climate risks are present under all scenarios and will vary in severity.

T1	Failure to adequately build, upgrade, and maintain long term infrastructure to handle the energy transition.
T4	Inability of the sector to affordably access financial services, including insurance and debt markets.
T5	Politicisation of the energy transition, competing regulation, and limited political stability for prioritisation of investment across the sector.
T6	Increased volatility and/or cost of carbon as a result of regulatory intervention such as changes to the Emissions Trading Scheme (ETS) or inclusion of NZ Emissions-Intensive Trade Exposed Industries (EITEs) in the ETS.
T7	Supply chain and labour market constraints in a highly competitive global market are a barrier for the transition to low-carbon energy.
T9	Inability to manage increased inequity and impacts on community wellbeing associated with cost and access to low-carbon energy.

Clarity of key risks for each of the scenarios

The **energy sector*** included helpful tables which set out the key risks for each of the scenarios. This allows the user to consider where to focus their efforts to manage risk, if they make an assessment of which of the set of the scenarios is the one which is the most likely future outcome. It also allows the user to quickly see which risks occur in all or many of the scenarios, hence identifying risks most likely to need to be managed whichever future materializes.

*This scenario was prepared for this sector by the Aotearoa Circle

A great summary of the key aspects of each of the scenarios

The **construction and property sector** scenarios provide a valuable “at a glance” summary of each of the three scenarios developed for the sector. This allows the reader to quickly understand the key aspects of each of the scenario as they consider the implications for their sector and organization.

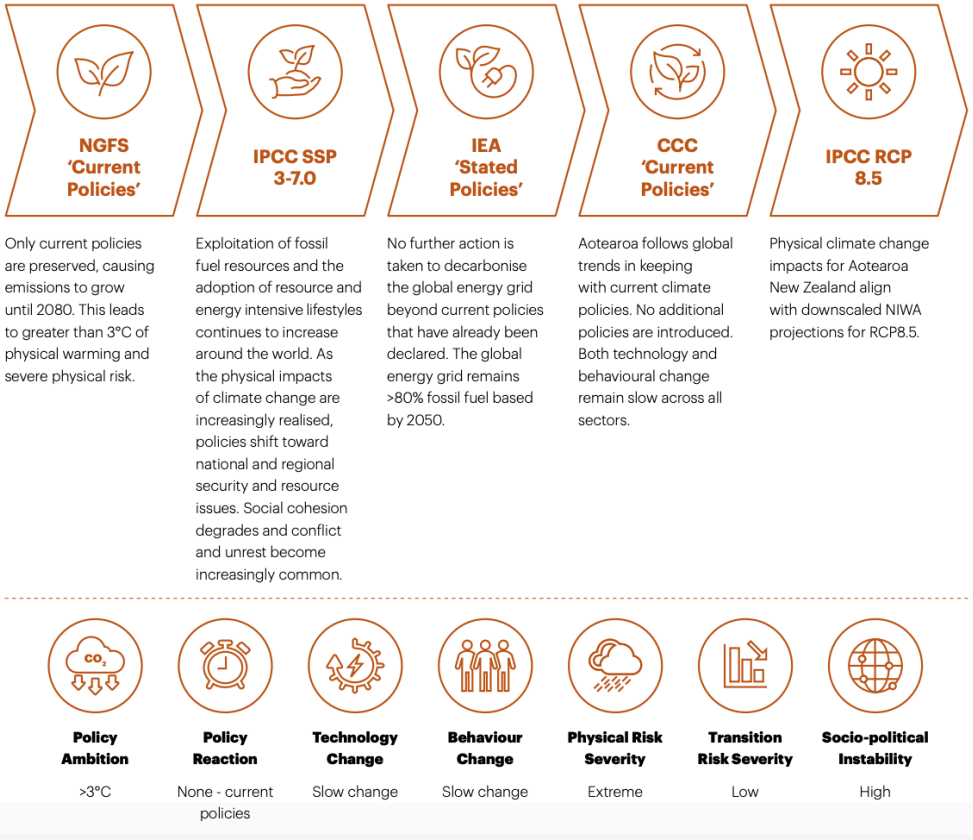
The particular scenario shown, explores a “worse case” future where there is little change to policy and technical advances are slow. Some of the consequences are stated in the scenarios as:

> Centralised infrastructure will show failures and stresses, with some assets becoming stranded due to the physical impacts of climate change.
>
> A significant breakdown of social cohesion occurs, with heat stress and mental health impacts from climate change at record levels.
>
> Food insecurity and growing populations drive retreat from cities.
>
> Spikes in demand for housing occur due to climate-driven immigration from other parts of the world and increasing numbers of climate refugees.

– Hot House World

Scenario Three describes a world where no additional policies are introduced to curb greenhouse gas emissions. This results in emissions continuing to rise and global warming reaching >3°C above pre industrial levels by 2100.

Scenario Three at a glance



Clarity of the implication for the reader

The **marine sector*** report was the easiest to engage with quickly. It included at the start of the report the high-level findings of the work. In particular, there was great value having a page which included the key insights for each sector. For time poor businesses, being able to pick up key insights in 2 pages would be invaluable. However, the Marine sector developed the fewest number of scenarios. This highlights the challenge between balancing accessibility with comprehensiveness.

Insights for key stakeholders

Aquaculture	1. Significant growth in output to meet the needs of a growing global population is a factor in both scenarios for aquaculture, but the nature of growth required may differ substantially. **Effective early collaboration with policy makers at national and local level will be necessary** to establish a sound platform for growth. 2. It is highly likely that **costs will rise** as new locations and methods of production become necessary in response to changing physical conditions and consumer preferences. 3. To be resilient, organisations may not only need **strong R&D capability**, but also the capacity to **connect with domestic and international stakeholders** in new ways in order to navigate the challenges that expansion may bring.
Fisheries	1. The **scope for expansion in volume may be limited** in many fisheries if climatic impacts or changing consumer preferences alter supply or demand side dynamics, but strong consumer demand for safe, secure and sustainable protein could reward **innovative ways of creating value**. 2. Relative to global competitors, **New Zealand's fisheries are favourably placed to meet climate-related risks** because of our mature governance mechanisms under Te Tiriti o Waitangi and the Fisheries Act, and the biophysical advantages of our 'goldilocks' geographical position. Flexible, responsive policy and regulation will be critical to the sector's future success in maximising this comparative advantage. 3. Change in the fisheries sector will likely be swift and profound – **strategic foresight and operational agility** will be key to avoiding risks and maximising opportunities.
Policy makers	1. Climate and socioeconomic change will bring both acute and chronic disruptions to marine social-ecological systems, triggering industry, NGOs and the public to demand immediate action. Early investment in **research and policy options which anticipate disruptive change** will likely pay dividends. 2. Policy makers have taken positive steps to prioritise transparency within the fishing industry. Encouraging **greater transparency across the marine governance system** as a whole will build trust, collaboration and the establishment of shared adaptation objectives, creating the space necessary for innovation and experimentation. 3. Ensuring that **marine governance objectives are firmly embedded within those of Te Tiriti o Waitangi and the Zero Carbon Act** will position New Zealand's fisheries and aquaculture exporters strongly on the world stage.

*This scenario was prepared for this sector by the Aotearoa Circle

Systems thinking provides underpinning logic to the scenario narratives

The **health sector** report included a great diagram on page 10 illustrating the value of systems thinking to understand how one aspect of climate change can have various effects on the sector.

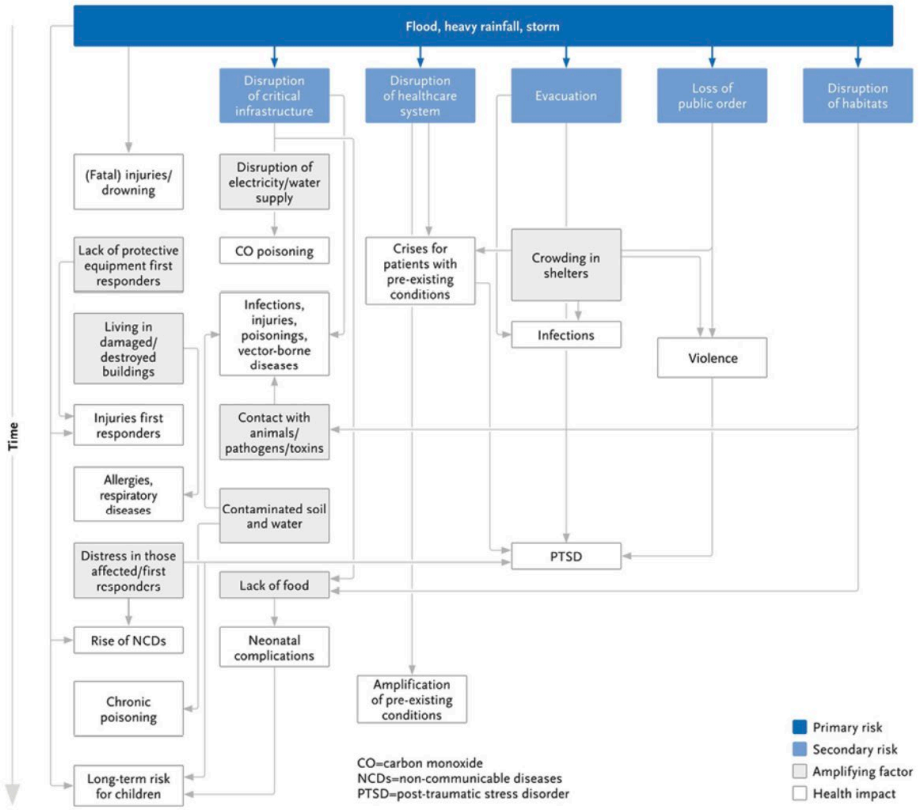


Figure 5.2: Cascading risks triggered by floods, heavy rainfall and storms. Arrows indicate possible casual relationships between risks, amplifying factors and health consequences. Adapted from source.[16]

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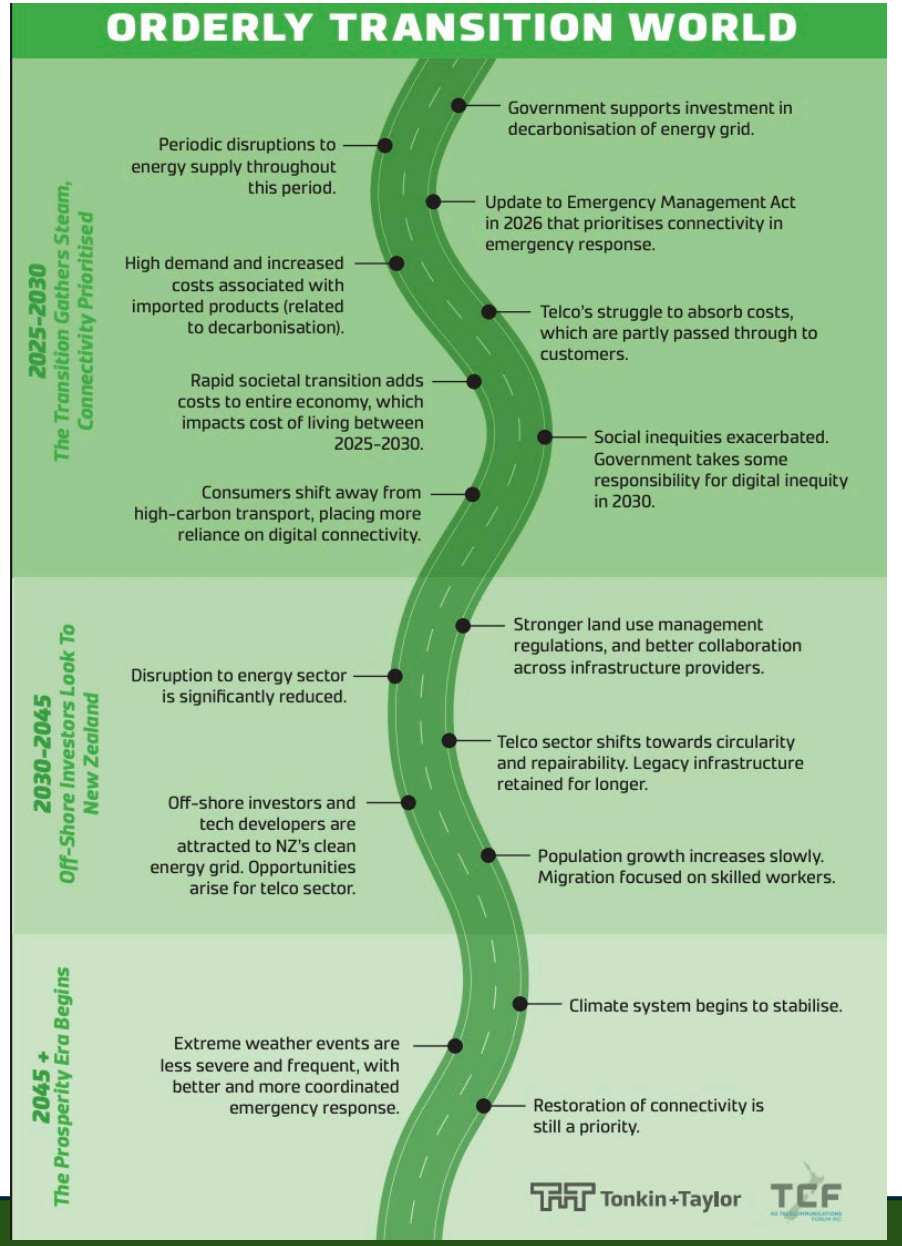
Ensuring a comprehensive understanding of transition risks

The **telecommunication sector's** report included a very clear definition of what constitutes a transition risk which recognises that transition risks come both from action to lower emissions and from action to adapt to changes in the climate.

Some of the sector reports do not consider adaptation transition risks, creating a gap in the identification of risks and opportunities.

> "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."

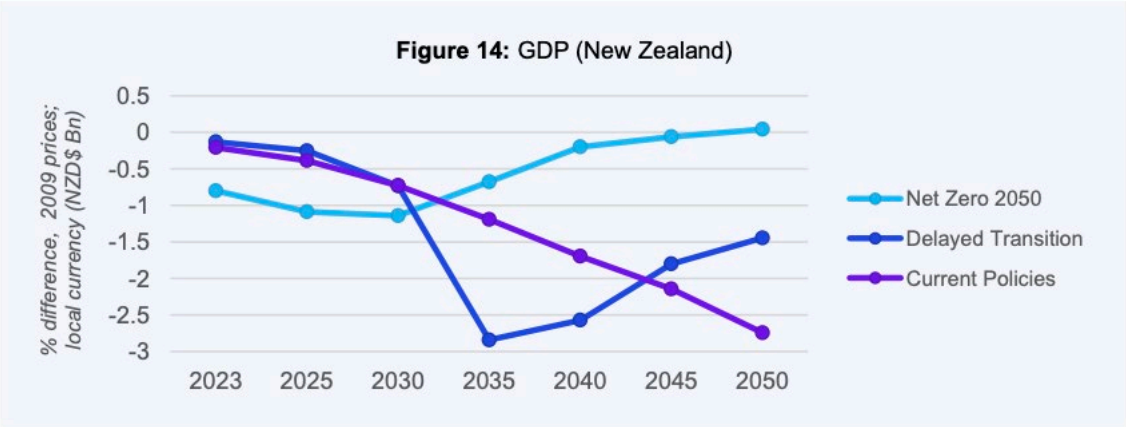
The report also has a helpful simple timeline visualisations for each scenario.



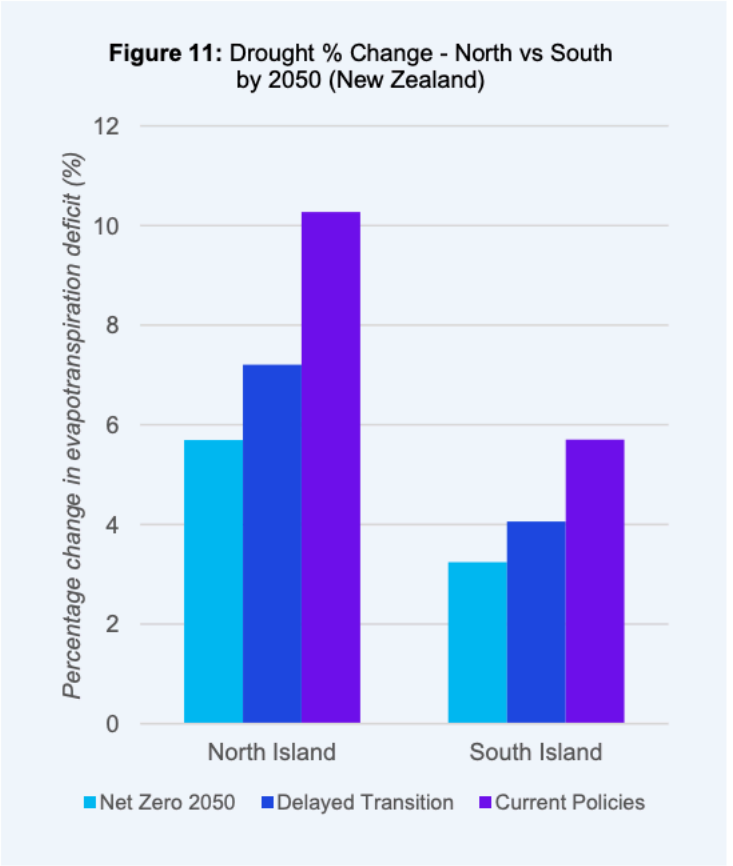
Including valuable visualisation of changes in key sector metrics

The **retail sector** scenarios included a useful series of visualizations of changing patterns of the key ordinates of each of the scenario. This allows the reader to get a quick sense of the changes ahead.

Source: NGFS, 2022a



Source: NGFS, 2022a



Source: CLIMsystems, 2023

Providing valuable metrics to help a sector understand how demand for services could change

The **transport sector*** scenarios include useful indicative metrics on key aspects of transport demand, which would allow operators in the various markets to assess plausible ranges of demand for products and services in the transport sector.

Bypass to Breakdown transport parameters

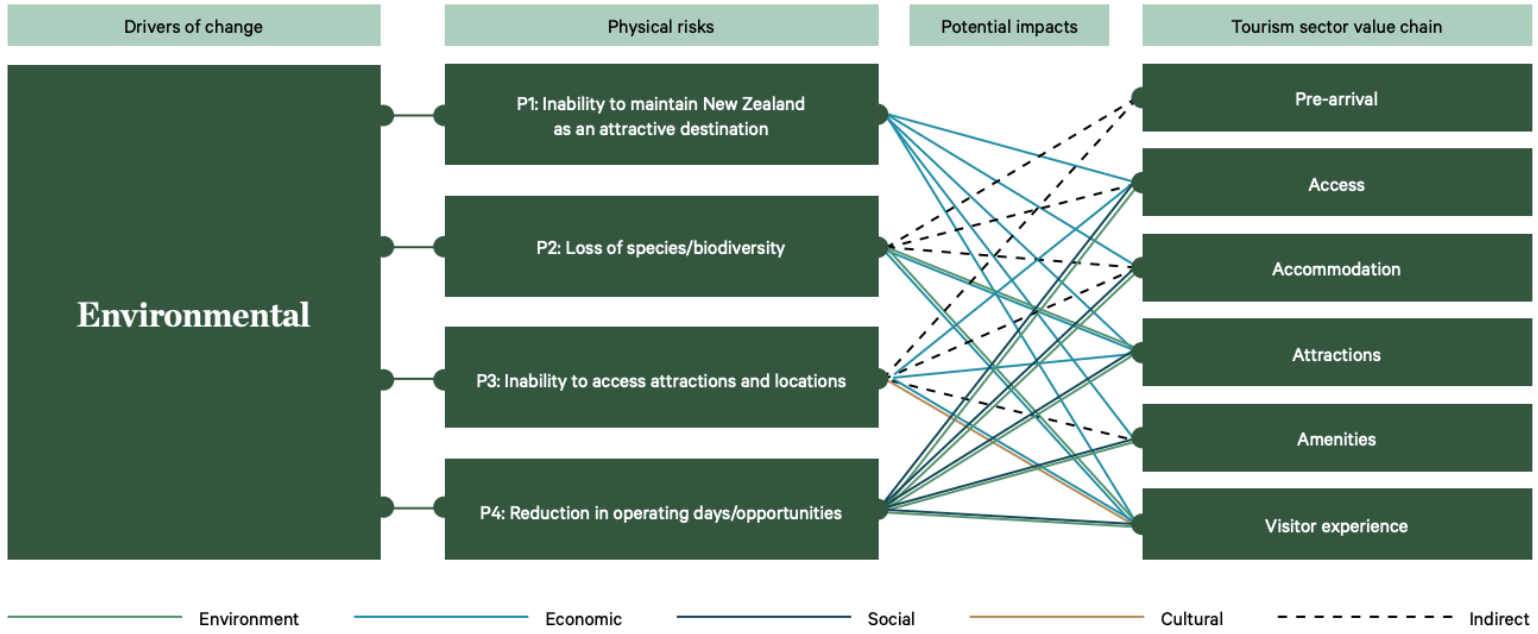
TRANSPORT VARIABLE	LOCATION	MODE	2030	2040	2050
Total Transport CO_2 Emissions *(Global = $MtCO_2e$)* *(NZ/Domestic = $ktCO_2e$)*	Global	-	8,282	7,954	8,060
	NZ	-	15,204	11,760	6,012
Road Vehicle Kilometres Travelled by Vehicle/Engine Type *(Total = billion kilometres)* *(Type = % share)*	NZ	Total	58	63	67
		ICE Vehicle	92	64	25
		EV	4	36	75
Household Person Kilometres Travelled by Mode *(Million kilometres)*	NZ	Active Transport	1,381	1,454	1,502
		Public Transport	3,268	3,916	4,538
		Private Transport	60,550	63,630	65,597
Total Number of Vehicles in Fleet *(Thousands)*	NZ	-	5,350	5,592	5,700
Freight Mode Shares *(% share)*	NZ	Rail	13	13	13
		Costal Shipping	12	12	12
		Road	75	75	75

*This scenario was prepared for this sector by the Aotearoa Circle

Understanding the impact of climate change on all aspects of a sector's value chain

The **tourism sector*** scenarios recognized that in there are many parts of the tourism value chain, such as those who sell holidays, those delivering accommodation and those providing entertainment to tourists. They provided a helpful visualization that maps the different impacts of climate change to the different parts of the value chain.

Figure 3: Physical impact pathways

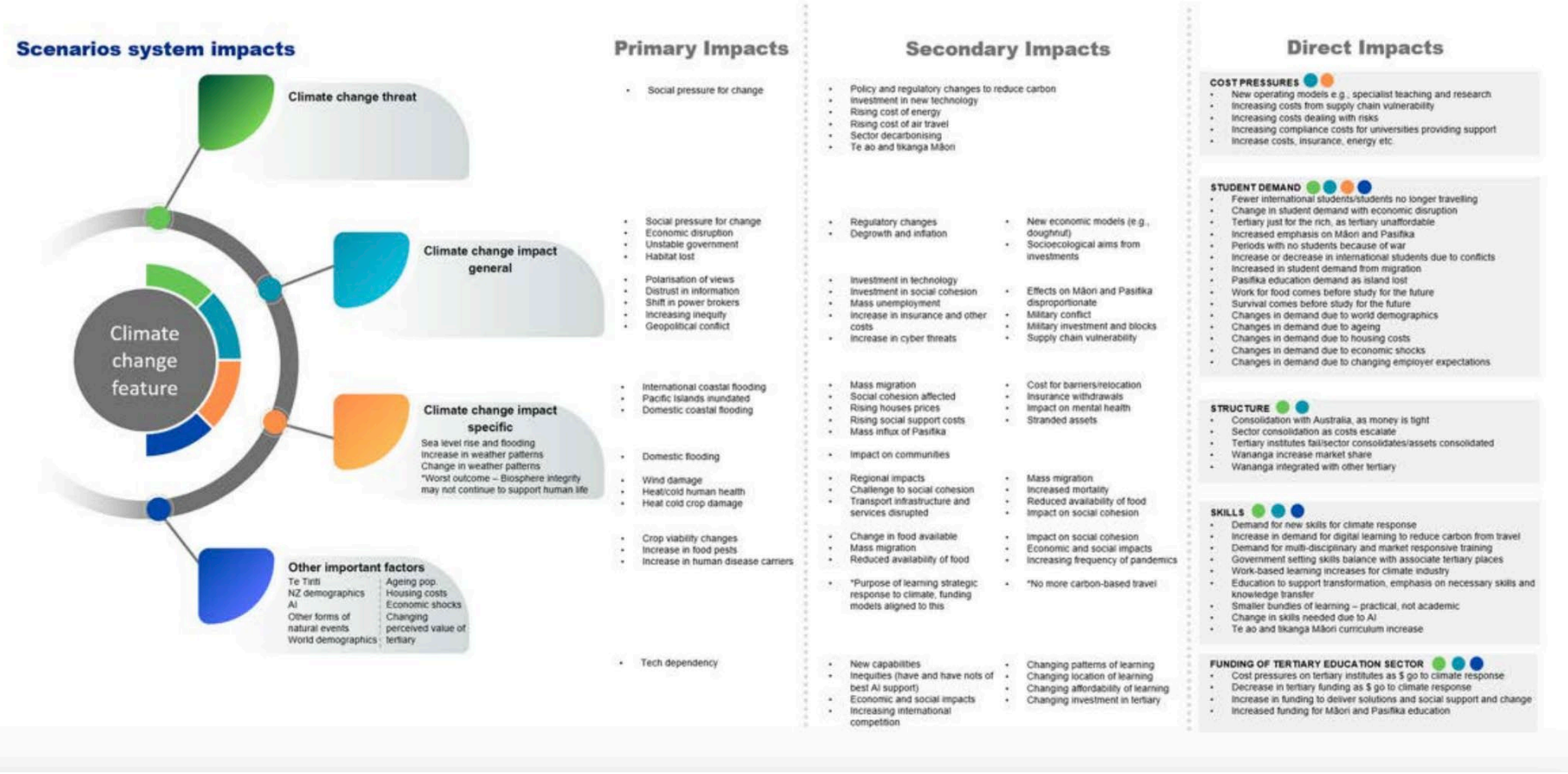


*This scenario was prepared for this sector by the Aotearoa Circle

Ensuring a full understanding of the impacts of climate change

While most understand the broad types of impact of climate change such as increased flood risk, heatwaves and rising sea temperatures, it is not obvious what all of the effects of such changes will be on a sector.

The **tertiary education** sector mapped out primary and secondary impacts of climate change as the starting point to assess sectoral impacts. This approach reduces the risk that key opportunities or risks are missed.



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Providing clarity of assumptions

The XRB requires there to be a clear explanation of the time horizon chosen for the scenario. **The financial services scenarios** provide a clear, easy to understand explanation of the time horizons considered in their scenarios.

One of the challenges with assessing climate risks is that the divergence in impact of the different IPCC emissions pathways does not become pronounced until the second half of the century. Most of the sectors have focused on the uncertainties over the next 25 years. This is fully understandable for 2 reasons:

organisations are considering what they need to do now, so want to understand the opportunities and challenges that relate to their normal planning cycles.

while we have the benefit of the IPCC climate modelling out to the end of century, it is difficult for any sector to assess general changes in their sectors beyond the 25 year time horizon.

	SHORT TERM	MEDIUM TERM	LONG TERM
TIME HORIZON	1-3 YEARS	5-10 YEARS	>30 YEARS
YEAR RELATIVE TO 2022	2025	2030	2050+
Rationale for selection	Aligned with current regulator stress-testing time horizons and the timeframes over which the health insurance sector offers its products to customers.	Aligned with interim emissions reductions targets. Aligned with medium-term investment horizon such as those for individuals saving for marriage or KiwiSaver withdrawal for a first home. Will capture intermediary exposure to carbon price.	Aligned with international emissions reductions targets. Aligned with long-term investment horizons such as individuals saving for retirement or KiwiSaver withdrawal. Individual entities can extend time horizons if desired (likely more impactful in quantitative modelling).

Table 5: Time horizons chosen by the Working Group

What are the key opportunities to improve the process for the future?

Six key changes will improve the value and impact of the scenarios

Good foresight is a socio technical process. While there is no such thing as evidence from the future – a systematic approach provides the logic to support action. A good technical process is not sufficient. The value from the work is the action that follows; not just the rigor of the approach, the insights nor the beauty of the presentation. To ensure that scenarios have impact, it must be a social process. The sectoral scenarios were all of high quality, there are six areas for many of the reports where there is opportunity to build on that quality if the process is repeated.

A good technical process will

start from what we know with trend analysis and facts and figures about the sector. All of the sector reports considered climate trends, few included information on the current state of the sector and recent trends within the sector.

seek to answer a clear question, where the answer will lead to action. For example, how should New Zealand change its transport infrastructure between now and 2050 to support a low emissions society rather than what is the future of transport in New Zealand. Half included a question, none considered how to respond.

consider shocks and the impacts of the shocks, most considered broad trends, few considered the impact of non weather related shocks, whether good shocks such as a new technology or bad shocks such as the next pandemic.

A good social process will

answer a question posed by the decisions makers, it was only clear in 2 reports that senior stakeholders had oversight of the process.

involve decision makers in the development of the scenarios so the insights are their insights. It was not clear what level of stakeholders were involved in the process.

include indicative metrics of the scale of change that the sector could experience. A few included valuable estimates to the change in critical numbers in the sector.

Moving to 4 scenarios will improve the value from the scenarios

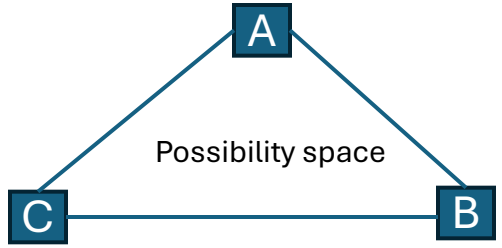
Develop 4 rather than 3 scenarios

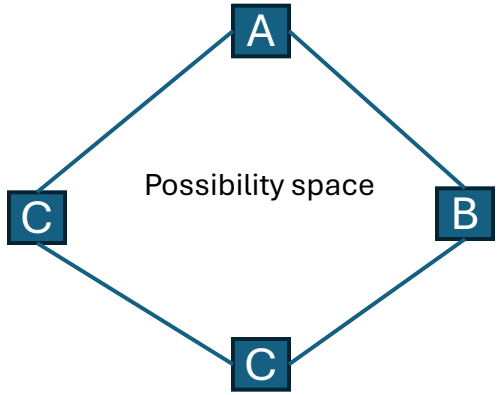
Scenarios present a range of plausible futures. None of them is likely to happen. But the reason a set of scenarios is produced is to create a "possibility space", with each scenario providing an indication of what could happen at the bounds of the possibility space.

If a good set of scenario is developed it gives a high degree of confidence that the future will lie somewhere within that possibility space. This provides confidence to the decision maker, that policies robust in all scenarios will be robust to the future. It also helps the decision maker assess the range of opportunities and risks ahead.

Using 4 scenarios doubles the size of the possibility space. Creating 3 also creates the risk that a linear possibility space is developed, limiting the value of the set of scenarios.

Increasing the number of scenarios has to be balanced against the increase in complexity and cost of the development of the additional scenario. This cost increase could be mitigated by central provision of material for use by all sectors – see the next slide.





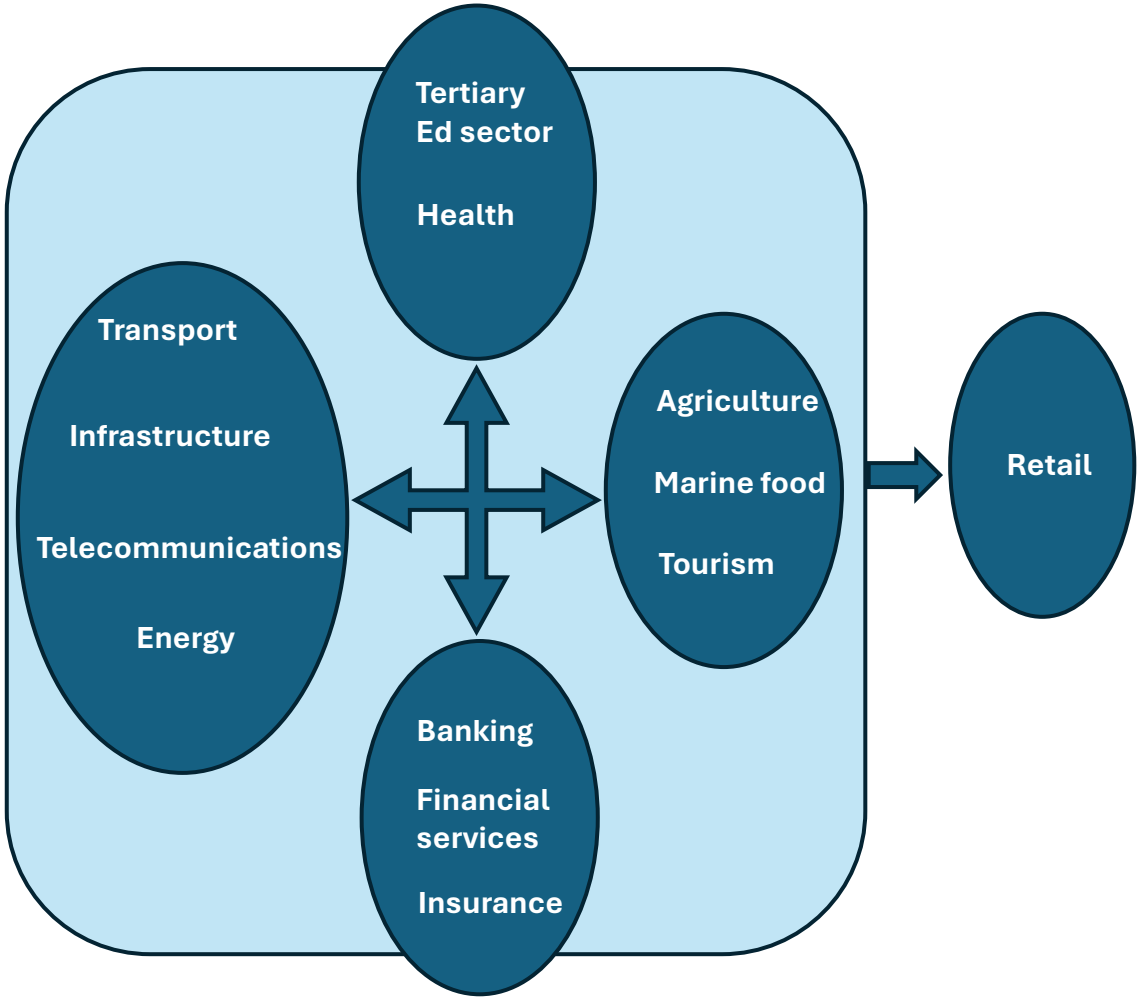
More centralized effort will reduce costs and improve the depth of the scenarios

Time could be saved by providing standard text on what scenarios are, what the XRB standards and expectations are and how to use scenarios. All reports included this information.

There would be significant benefit, building from existing material to create an overarching set of national climate change scenario covering

- changing regional climate
- regional spatial impacts of climate changes
- global and domestic economic health
- global supply chains
- NZ demographics
- immigration
- energy
- infrastructure
- telecommunications
- transport
- NZ fiscal situation
- insurance

All sector reports consider some of these issues. But there is a massive amount of repetition, with each report considering a set of these issues. An alternative approach would be the central creation of a single overarching set of generic economic, social and environmental scenarios. The sectors and organisations could then focus their efforts on considering the consequences for their sector and how to respond.



Risks identified in the sector reports

This is a table of many of the common risks identified in the sector reports.

The sector reports identified many sector specific risks.

The full table of the risks as well as a table covering opportunities is in the attached excel spreadsheet alongside some of the other information drawn together during the analysis of the reports.

	Ag	Energy	Health	Marine	Retail	Property	Telecom	Tertiary	Tourism	Transport	Banking
Stranded assets	Stranded assets as the types of crops change to match demand and climate conditions	Stranded assets				Stranded assets		Stranded assets if move to regional focus or move to more hybrid	Stranded assets		Stranded assets as buildings withdrawn as in flood risk areas
Damaged assets		Damaged assets				Damaged properties from weather events		Damage to key infrastructure – affecting ability to deliver	Assets destroyed by weather		Damage to buildings and other infrastructure
Tax payers funding needed	Needed for investment to move towards sustainable farming practices. Assumes public funding	Assumes government funding to support transition		Public funding to support transition		Assumes public funding of the transition to greener buildings	Assumption Government with fund decarbonisation or maintenance as an essential service	Increasing levels of taxation to cover the costs of lowering emissions	Assume government investment in protecting areas, connecting to those areas and for innovative approaches; assumes tourism levy, assumes government invests in destination management; finance subject to green conditions	Stress on government funding due to increasing costs of weather events	
Tax changes needed to fund changes			Should increase Superannuation to 75years old and means tested to help manage fiscal challenges		Less public funding as $s focussed on repairing infrastructure	Rates increases to cover costs of recovery/decarbonisation	Increases in tax	Fiscal tightening, so less money for things other than climate response			
Contention for capital	Contention for capital to invest in the changes needed	Capital constraints				Difficulty accessing capital	Finance hard to get				
Labour constraints	Insufficient labour supply	Labour market constraints				Skills gaps using the new approaches to construction	Skills shortages –		Access to labour and rising unemployment in the sector		
Insurance costs increase and then withdrawn	Withdrawal of insurance as weather events increase uncertainty over crop yields	Insurance costs rise	End of ACC as costs rise too high		Increasing insurance costs	Rising insurance costs to buildings at risk of flooding		Rising insurance and energy costs	Can't access either capital or insurance due to risks	Changes in what is insurable	
Supply chain challenges	Food insecurity from changing climate and global trade barriers and conflict	Supply chain challenges		Under this scenario, New Zealand's distance to markets grows in significance until innovative solutions to supply chain emissions are developed.	Supply chain vulnerability		Supply chain issues – critical as NZ does not manufacture			Impact on NZ's exports of challenges to supply chains or rising costs of shipping (marine and aviation)	
Isolation of communities		Distribution challenges	Isolation of some communities from healthcare and other services				Rural Communities become isolated as networks are disrupted		Inability to access attractions and locations	Risk of isolation of rural communities from weather events	Difficulty customers accessing services
Social tensions	Rising calls for compensation from weather events	Social divide and consequent social unrest			Increasing social inequity		Social inequity	Civil unrest			
Rising cost of living		Rising prices to deliver and also purchase energy	Challenges accessing healthcare because of weather events and increasing costs of travel	Increasing costs to maintain water side infrastructure	Rising input costs as externalities priced	Contention of low carbon materials – slows construction and drives up prices	Rising costs as carbon impact fully costed	Impact of AI on future form of teaching	Increase in climate change regulation drives increased costs pressure on visitors Inability for the tourism sector to keep up with the rate of change	Wider spread difficulty accessing work and social activities as costs of travel rise	Costs of reducing emissions and meeting other regulatory requirements

Glossary of terms and abbreviations

Term	Definition
Scenario	A scenario is a written description of what the future could be like.
Trend	A trend is a historical pattern of change, for example increasing numbers of Electric Vehicles being bought.
Driver	A driver is a factor that is shaping what is happening, for example government subsidy of Electric vehicles driving an increase in uptake of EVs.
Transition risk	Risks related to the transition to a low-emissions, climate-resilient global and domestic economy, and risks related to adaptation to the changing climate such as policy, legal, technology, market, access, infrastructure and reputation changes.
IPCC	Intergovernmental Panel on Climate Change – a panel of scientists who provide policymakers with regular scientific assessments on climate change, its implications and potential future risks.
XRB	External Reporting Board – which develop and issue reporting standards on accounting, audit and assurance, and climate, for entities across the private, public, and not-for-profit sectors.
ISBB	International Sustainability Standards Board – which recommends financial disclosure standards in relation to sustainable investment.
GHG	Green house gases
NIWA	National Institute of Water and Atmospheric Research