



# The futures of retail

**Integrated Climate Change  
Scenarios for New Zealand's  
Retail Sector**

September 2023





GLASSONS



Dear Reader,

The 'Retail Sector Shared Scenarios Project' is a collaboration between major Aotearoa New Zealand-based retailers and KPMG New Zealand, initiated in response to new mandatory requirements for public companies to detail their preparations for climate change-related risks and opportunities.

Together, our businesses touch the lives of most, if not all, New Zealanders. This gives us a level of influence that few other sectors can match - but it is therefore also our responsibility to lead in adapting, transitioning and transforming our sector to a low-carbon and resilient future.

Retail is engaged in every aspect of global value chains and their associated carbon emissions. From sourcing and production - including raw materials, manufacturing processes and supply chains - to transport and logistics, retail operations, and ultimately the end of life of products. Through our consumer interactions, we also directly influence the lifestyles and behaviours that can contribute to meaningful emissions reductions.

The climate scenarios we are sharing in this report are asking us to confront a new reality where finite planetary boundaries and climate change are impacting the abundance and convenience we have enjoyed freely over the past decades. They set out the potential risks and opportunities arising from climate change today and into the future. They are a catalyst for us to reimagine how we, and our value chains, operate.

The message we want to share with you is the following:

**We are deeply concerned about the impacts of climate change** on our country, our customers, and our team members. We believe that addressing climate change is about protecting the quality of life of all people and places touched by our businesses. It is not just a 'nice to have', it is connected to our purpose as businesses that seek to generate long-term value.

**We need to face the new reality in which we operate.** The three scenarios examined in this report offer reference points that will inform how we prepare our businesses for climate change. They are not static scenarios with absolute trajectories; rather, they are potential outcomes which will inform our thinking and planning. In addition, they also present opportunities to harness the capacity - inherent in retailing - to change and innovate.

**We must rapidly take action** to reimagine and reengineer our value chains. From the way we design and source products, to how we package, ship, store, and sell them to our customers. We must also consider product use by customers and the imperative to move from linear to circular systems. We are already undertaking actions and initiatives to achieve these outcomes, but we need to extend beyond our direct sphere of influence and take a leadership role in proportion to our impact.

This work is just the beginning. These scenarios can be used by any retailer, whether public or private, large or small, and we hope to see our sector, and adjacent sectors, collaborate pre-competitively to meet the challenges ahead. There is a significant opportunity for all of us to be part of a retail sector which contributes to the long-term resilience and prosperity of Aotearoa New Zealand.

**Te toto o te tangata, kai,  
te oranga o te tangata, he whenua**

While food provides the blood in our veins,  
our health is drawn from the land

**Briscoe Group Limited, Hallenstein Glasson Holdings Limited, KMD Brands Limited, Michael Hill New Zealand Limited, Restaurant Brands New Zealand Limited, Smartpay Limited, The Warehouse Group Limited, and Woolworths New Zealand Limited.**



# Disclaimers

This report was prepared by KPMG, a New Zealand partnership (**KPMG, we, us, our**) solely in accordance with the terms set out in the KPMG's Engagement Letters with The Warehouse Group Limited, Restaurant Brands New Zealand Limited, Woolworths New Zealand Limited, Smartpay Limited, KMD Brands Limited, Michael Hill New Zealand Limited, Briscoe Group Limited, and Hallenstein Glasson Holdings Limited (collectively, the **Clients**) and for no other purpose.

Other than KPMG's responsibility to the Clients, none of KPMG, any entities directly or indirectly controlled by KPMG, or any of their respective members or employees undertakes responsibility arising in any way from reliance placed by a third party on this report. Any reliance placed is that party's sole responsibility. KPMG and its controlled entities expressly disclaim any and all liability for any loss or damage of whatever kind to any person acting on information contained in KPMG's report, other than to the Clients.

KPMG's report is based upon qualitative information provided by the Clients and certain third parties. KPMG has considered and relied upon this information. KPMG believes that the information provided was reliable, complete and not misleading and has no reason to believe that any material facts have been withheld. The information provided has been evaluated through analysis, enquiry and review for the purpose of KPMG's report.

However, KPMG does not warrant that these enquiries have identified or verified all of the matters which an audit, extensive examination or due diligence investigation might disclose. Nothing in this report constitutes legal advice or legal due diligence and no one should act upon any such information without seeking independent legal advice.

This report contains hypothetical scenarios for illustrative purposes only. The scenarios are not intended as a basis for assessing portfolio-level risks. Scenarios are not a forecast or projection, and we make no statement as to whether any scenario will, or is likely to, occur, or whether the assumptions and data underlying any such scenarios are accurate, complete or reasonable.

There will usually be differences between hypothetical and actual scenarios, because events and circumstances frequently do not occur as expected or predicted, and those differences may be material.

The Network for Greening the Financial Systems (NGFS) scenarios that underpin the scenarios in this report developed for the Clients are a subset of models (e.g. REMIND MAgPIE, GCAM and MESSAGE) which make particular assumptions about long term technology pathways that are highly uncertain.

The statements and opinions expressed in KPMG's report have been made in good faith and on the basis that all relevant information for the purpose of preparing KPMG's report have been provided by the Clients and certain third parties and that all such information is true and accurate in all material aspects and not misleading by reason of omission or otherwise.

Accordingly, none of KPMG, its controlled entities, or any of their respective partners, directors, employees or agents, accept any responsibility or liability for any such information being inaccurate, incomplete, unreliable or not soundly based, or for any errors in the analysis, statements and opinions provided in this report resulting directly or indirectly from any such circumstances or from any assumptions upon which KPMG's report is based proving unjustified.

KPMG's report was prepared based on the information available at the time. KPMG has no obligation to update the report or revise the information contained therein due to events and transactions occurring subsequent to the date of the report.



01.

**Executive  
summary**



02.

**The three  
scenarios**



03.

**Comparative  
visualisations**



04.

**Technical  
appendices**



Our reading guide:

**Executive reader** *Read executive summary*

**Overview reader** *Read executive summary and the overviews of the scenarios*

**Technical reader** *You are welcome to read the full report*



# Figures

<a href="#">Figure 1</a>	Indicative profile of physical risks	<b>pg. 14</b>
<a href="#">Figure 2</a>	Indicative profile of transition-related risks	<b>pg. 14</b>
<a href="#">Figure 3</a>	Annual Mean Temperature Increase (Global)	<b>pg. 63</b>
<a href="#">Figure 4</a>	Annual Mean Temperature Increase (New Zealand)	<b>pg. 63</b>
<a href="#">Figure 5</a>	Mean Sea Level Rise (New Zealand)	<b>pg. 64</b>
<a href="#">Figure 6</a>	Relative Change in Annual Expected Damage from Tropical Cyclones (New Zealand)	<b>pg. 64</b>
<a href="#">Figure 7</a>	Average Annual Number of Days Exceeding 25°C (New Zealand)	<b>pg. 65</b>
<a href="#">Figure 8</a>	Mean Number of Frost Days (New Zealand)	<b>pg. 65</b>
<a href="#">Figure 9</a>	Increase in likelihood of Extreme Precipitation Events –3hr duration (New Zealand)	<b>pg. 66</b>
<a href="#">Figure 10</a>	Increase in likelihood of Extreme Precipitation Events –24hr duration (New Zealand)	<b>pg. 66</b>
<a href="#">Figure 11</a>	Drought % Change - North vs South by 2050 (New Zealand)	<b>pg. 67</b>
<a href="#">Figure 12</a>	Annual Mean Drought by 2050 (New Zealand)	<b>pg. 67</b>
<a href="#">Figure 13</a>	GDP (Global)	<b>pg. 68</b>
<a href="#">Figure 14</a>	GDP (New Zealand)	<b>pg. 68</b>
<a href="#">Figure 15</a>	Inflation Rate (New Zealand)	<b>pg. 69</b>
<a href="#">Figure 16</a>	Long-term Real Interest Rate (New Zealand)	<b>pg. 69</b>
<a href="#">Figure 17</a>	Energy Price (New Zealand)	<b>pg. 70</b>

<a href="#">Figure 18</a>	Oil Price (New Zealand)	<b>pg. 70</b>
<a href="#">Figure 19</a>	Carbon Price (New Zealand)	<b>pg. 70</b>
<a href="#">Figure 20</a>	Summary of Phase 1 and 2 processes	<b>pg. 75</b>

# Tables

<a href="#">Table 1</a>	Scenario architecture	<b>pg. 10</b>
<a href="#">Table 2</a>	Physical Parameters – Net Zero 2050	<b>pg. 30</b>
<a href="#">Table 3</a>	Socio-Economic Parameters – Net Zero 2050	<b>pg. 31</b>
<a href="#">Table 4</a>	Physical Parameters – Delayed Transition	<b>pg. 45</b>
<a href="#">Table 5</a>	Socio-Economic Parameters – Delayed Transition	<b>pg. 46</b>
<a href="#">Table 6</a>	Physical Parameters – Current Policies	<b>pg. 60</b>
<a href="#">Table 7</a>	Socio-Economic Parameters – Current Policies	<b>pg. 61</b>
<a href="#">Table 8</a>	Integration with higher-level, publicly available scenarios and projections	<b>pg. 76</b>
<a href="#">Table 9</a>	Scenario Parameters	<b>pg. 77</b>





# Acronyms and abbreviations

<a href="#">AEP</a>	Annual Exceedance Probability
<a href="#">AI</a>	Artificial Intelligence
<a href="#">ARI</a>	Annual Recurrence Interval
<a href="#">ASPAC</a>	Asia-Pacific
<a href="#">CBAM</a>	Carbon Border Adjustment Mechanism
<a href="#">CC</a>	Climate Change
<a href="#">CCC</a>	Climate Change Commission
<a href="#">CCS</a>	Carbon Capture and Storage
<a href="#">CDR</a>	Carbon Dioxide Removal
<a href="#">CMIP 6</a>	Coupled Model Intercomparison Project Phase 6
<a href="#">CRE</a>	Climate Reporting Entity
<a href="#">CS</a>	Carbon Sequestration
<a href="#">D&amp;O</a>	Directors and Officers (Liability Insurance)
<a href="#">EEZ</a>	Exclusive Economic Zone
<a href="#">ESG</a>	Environmental, Social and Governance
<a href="#">ERP</a>	Emissions Reduction Plan
<a href="#">ETS</a>	Emissions Trading Scheme
<a href="#">EV</a>	Electric Vehicle
<a href="#">FMA</a>	Financial Markets Authority (New Zealand)
<a href="#">FMCG</a>	Fast Moving Consumer Goods
<a href="#">GDP</a>	Gross Domestic Product

<a href="#">GHG</a>	Greenhouse Gases
<a href="#">IAM</a>	Integrated Assessment Model
<a href="#">IMO</a>	International Maritime Organisation
<a href="#">IoT</a>	Internet of Things
<a href="#">IPCC</a>	Intergovernmental Panel on Climate Change
<a href="#">LLM</a>	Large Language Model
<a href="#">OECD</a>	Organisation for Economic Co-operation and Development
<a href="#">NAP</a>	National Adaptation Plan
<a href="#">NDC</a>	Nationally Determined Contributions
<a href="#">NGFS</a>	Network for Greening the Financial System
<a href="#">NZ CS 1</a>	New Zealand Climate Standard 1 (XRB)
<a href="#">PED</a>	Potential Evapotranspiration Deficit
<a href="#">RBNZ</a>	Reserve Bank of New Zealand
<a href="#">RCP</a>	Representative Concentration Pathway
<a href="#">SMCG</a>	Slow Moving Consumer Goods
<a href="#">SLR</a>	Sea Level Rise
<a href="#">SSP</a>	Shared socio-economic Pathway
<a href="#">TCFD</a>	Task Force on Climate Related Financial Disclosures
<a href="#">UNEP</a>	United Nations Environment Programme
<a href="#">XRB</a>	External Reporting Board (New Zealand)



Section 1

# Executive summary





# Context



**The choices and actions implemented in this decade will have impacts now and for thousands of years. For any given future warming level, many climate-related risks are higher than (previously) assessed.**

Continued emissions will further affect all major climate system components, and many changes will be irreversible on centennial to millennial time scales.

In the near-term, global warming is more likely than not to reach 1.5°C even under a very low emission scenario.

Without a strengthening of policies, global warming of 3.2°C is projected by 2100.

Adverse impacts and related losses and damages from climate change will escalate with every increment of global warming.

AR6 Synthesis Report: Climate Change 2023, Intergovernmental Panel on Climate Change.<sup>1</sup>



## Aotearoa New Zealand's climate-related disclosures regime

New Zealand's Financial Sector (Climate-related Disclosures and Other Matters) Amendment Act 2021 introduced mandatory climate-related disclosure (CRD) requirements for approximately 200 of New Zealand's largest businesses.<sup>2, 3</sup> While aligning with the Task Force on Climate-related Financial Disclosures (TCFD) recommended framework,<sup>4</sup> the External Reporting Board (XRB) has developed New Zealand-specific disclosure standards and guidance.

The aim of New Zealand's CRD regime is to provide markets with the information required to understand how large organisations are managing their climate-related risks. Towards this end, the XRB's Climate Standard (NZ CS 1) requires covered entities to undertake scenario analysis and disclose how the process was conducted. To support this disclosure, paragraph 13 of NZ CS 1 states:

*"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."*<sup>5</sup>

The XRB recommends that sectors collaborate to develop shared, qualitative scenarios to help achieve consistency and comparability between organisation that will be analysing, improving, and reporting on the resilience of their respective organisations.<sup>6</sup> This collaborative approach to scenario development offers several advantages in addition to more rigorous, coherent, and comparable analysis, including cost savings, and the potential to significantly accelerate sectors' adaptation to climate change.

## Shared scenarios for Aotearoa New Zealand's Retail Sector

Over the past 50 years, economic activities including the consumption of fossil fuels, industrial processes, and deforestation have released greenhouse gasses responsible for trapping an explosive amount of heat energy in Earth's atmosphere - the equivalent of about 25 billion atomic bombs.<sup>7</sup> As a result, the average air temperature at the planet's surface is at least 1.15°C hotter than in the pre-industrial era<sup>8</sup> and could exceed 3°C heating by the end of this century if we fail to slash greenhouse gas emissions.

In order to meet the Paris Agreement's goal of limiting global warming to well below 2°C, and preferably 1.5°C, the United Nations recently concluded that we need to reduce emissions 45% (compared with projections based on current policies) by 2030.<sup>9</sup> Achieving this scale and speed of emissions reductions will require system-wide transformation. Because we continue to procrastinate making real changes, the sudden re-calibration required of our society and economy is likely to be jarring and profoundly disruptive.

The integrated scenarios presented in this report were developed by a consortium of major Aotearoa New Zealand-based retailers and KPMG New Zealand. The scenarios' primary purpose is to support strategic decision-making by the leadership teams of New Zealand retail businesses and their value chain partners. The scenarios reflect sector-level guidance<sup>10</sup> from the XRB and, as such, provide a solid foundation for the further work required at the entity level to enable entities to communicate clear, consistent, and comparable assessments of their climate-related risks, opportunities, and strategic response in-line with the mandatory climate disclosure regime in Aotearoa.

## An integrated approach

Integrated scenarios are projections of future climate conditions that take into account various factors such as greenhouse gas emissions, regulatory change, land use change, population growth, technological advancements, and evolving mental models. This approach considers the physical and societal impacts of climate change, as well as how diverse factors might interact with each other to trigger a cascade of compounding risks or unlock new opportunities for value creation.

## Scenario analysis

The anticipated impacts of climate change are deeply uncertain due to the indeterminacy of future greenhouse gas emissions, ambiguity of decarbonisation pathways, complexity of the Earth system, unpredictability of socio-political choices, and limited historical data. Scenario analysis helps businesses understand and make decisions about how best to prepare for the impacts of climate change despite such deep and dynamic uncertainty.

Scenario analysis is a common tool for businesses to explore the limits of “what could happen?” in order to be better prepared for whatever does happen. In the context of climate change, scenario analysis involves:

1. Creating different scenarios based on factors such as greenhouse gas emissions, temperature increases, sea level rise, extreme weather events, policy-response, and socio-economic consequences.
2. Analysing how resilient an organisation’s current business model and strategy are to these scenarios.

## Key takeaways

Individual retailers need to interrogate the scenarios through the lens of their unique business models, strategies, and value chains to assess anticipated impacts.

However, the scenarios suggest a number of cross-cutting takeaways:

- The physical impacts of climate change present real and growing challenges to domestic and regional retailers under all plausible scenarios. These impacts include operational and supply-chain disruptions as well as macroeconomic headwinds and may progress in a non-linear manner. Every 0.1°C increase in global heating matters, and retailers should prepare for the physical impacts of a >1.5°C future.
- The world has already begun transitioning to a lower-emissions economy.<sup>11</sup> The magnitude of transition-related impacts, which include changing consumer preferences/prejudices, are likely to grow under all plausible scenarios. Under a ‘Net Zero 2050’ scenario, these impacts immediately accelerate, reach a relatively moderate crescendo around 2030, and then subside. Under a ‘Delayed Transition’ scenario, these impacts grow slowly until 2030, at which point they spike upwards, reaching high magnitude within just a few years and potentially remaining greater than under a ‘Net Zero 2050’ scenario through mid-century. Under a ‘Current Policies’ scenario, transition-related impacts continue growing slowly until they are driven inextricably upwards by the mounting physical impacts of climate change.
- Under all plausible scenarios, climate change triggers and/or amplifies pressure across New Zealand’s retail sector to address broader environmental and social sustainability challenges.
- Under all plausible scenarios, the direct and indirect impacts of climate change are poised to radically disrupt the businesses of retailers and their value chain partners. This disruption may be sudden and non-linear. The key questions for leaders in the retail sector are how soon and what can be done to convert current and imminent threats into opportunities for long-term value.



The XRB defines a climate-related 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.<sup>12</sup>**

And scenario analysis as:

**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.<sup>13</sup>**



# Scenario architecture


Three integrated scenarios were developed that explored both the physical and transition-related impacts of climate change, as well as their potential interactions.

The overarching architecture and underlying assumptions within the three scenarios have been purposefully chosen to facilitate critical conversations with value chain partners – especially in the financial services. Though informed by a wide range of publicly available climate, macroeconomic, demographic, and sector-specific data, it is important to note that the future is highly unpredictable and is unlikely to unfold exactly as described by any single scenario.

The scenarios have, therefore, been developed as a complementary set wherein:

- **The first – Net Zero 2050** – is designed to explore retailers' readiness to rapidly transform their businesses in the short-term (2023-2030).
- **The second – Delayed Transition** – is designed to explore retailers' resilience to an especially condensed and disruptive transition in the medium term (2031-2040).
- **The third – Current Policies** – is designed to explore how the collective failure to slash emissions might steadily erode value in the long-term (2041-2050).

Table 1: Scenario architecture

Category	Orderly 	Disorderly 	Hot House 
Scenario	Net Zero 2050	Delayed Transition	Current Policies
Summary	An ambitious and coordinated transition to a low-emissions, climate-resilient future. Stringent climate policies, innovation, ambitious investment, and medium-to-high deployment of carbon removal solutions limit global warming to 1.6°C in 2050 and 1.4°C by 2100.	Ambitious action is delayed to 2030, followed by sudden and uncoordinated economic transformation. Extensive, stringent and punitive but late government intervention, in combination with some deployment of carbon removal solutions, limits global warming to 1.7°C in 2050 and 1.67°C by 2100.	Current emissions reduction policies are implemented. Current socio-economic trends continue, resulting in 2°C global warming by 2050 and more than 3°C by 2100.
Risk of surpassing critical tipping points in Earth's climate system	Low	Moderate	Very high
Severity of physical climate impacts	Lowest	Low to moderate	Highest
Severity of transition-related impacts	Moderate (greatest in short-term)	Highest (greatest in medium-term)	Lowest (steadily increasing, but also giving businesses more time to adapt)
Consumer sentiment	Rapid re-orientation towards sustainable lifestyles, as characterised by a focus on wellbeing and conscious consumption.	Current trends continue to 2030, then abruptly transition towards sustainable lifestyles as the physical impacts of climate change (and biodiversity loss) hit home.	Current consumption trends continue, including the adoption of more sustainable lifestyles by successive generations.
Macro-economic conditions	Immediate, orderly transition generates short-term economic turbulence but pronounced benefits in the medium and long-term. Physical impacts of climate change exert measurable but limited downward pressure on economy.	Delayed and disorderly transition generates sharp economic downturn but eventually supports economic stability. Physical impacts of climate change exert moderate downward pressure on economy.	No 'green bump' from the transition to a low-emissions economy. Physical impacts of climate change exert increasingly significant downward pressure on economy, potentially growing to destabilise financial institutions and systems by mid-century.
Financial impact of supply chain disruptions	Lowest	Low to moderate	Highest
Policy reaction to climate change	Immediate and smooth	Delayed	Current policies only
Regional policy variation	Medium	High	Low
Speed of technology change	Fast	Slow, then fast	Slow





# Orderly Scenario - Net Zero 2050

## The Retail Sector in 2050

**Key characteristics:** New Zealand's retail sector is nearly unrecognisable from what it had been a mere thirty years ago. Retail business models based on the rapid churn of soft and hard consumer goods are long dead. Retailers have transformed their role in the economy from pushing conspicuous consumption to business models that purposefully promote and support conscious consumption. They are at the heart of New Zealand's rich shared economy, enabling households to easily access and use many high-quality goods without the environmental cost or financial burden of individual ownership.

**Structural forces:** Data is omni-present throughout retail value chains, from sourcing, to point of sharing and/or sale, to end-of-life. This enables retailers, their partners, and customers to make informed decisions about what they buy, how they buy, and from whom in order to minimise their carbon footprint. Legislative frameworks have been established in New Zealand, as in all other OECD countries, to prevent the externalisation of environmental and social costs while supporting the environmentally sound management of retail products and materials over their life. New Zealand's early investment in regenerative agriculture and irrigation has safeguarded domestic food production and affordability despite increasingly unreliable weather.

**Mental models:** As the proportion of New Zealand's Māori and Pasifika population grows – and as generations that have grown up within the context of an interwoven climate and biodiversity crisis gain political, economic and cultural power – Aotearoa undergoes a seismic shift in dominant worldview. A long-term, interconnected view of the world that considers the wider social, cultural, and environmental impacts of all we do has become the norm.

**Key outcomes:** Most of New Zealand's domestic and regional retailers have kept pace with rapidly evolving market imperatives and customer expectations. Major brands that couldn't interpret and respond in time failed to survive. Brands that adapted 'ahead of the curve' built customer and employee loyalty, triggering a virtuous spiral that attracted the top talent required to succeed in a complex, non-linear, and extremely fast-moving world.

Under this scenarios, retailers' operating environment is characterised by seven pervasive trends





# Disorderly Scenario - Delayed Transition

## The Retail Sector in 2050

**Key characteristics:** Most large New Zealand-based retailers have been displaced or bought-out by quicker-to-act international competitors. Those that remain have transformed their role in the economy from pushing conspicuous consumption to purposefully promoting and enabling conscious consumption.

**Structural forces:** In order to compensate for yet another lost decade, government regulation is far more extensive, invasive, and punitive than under a Net Zero 2050 scenario. New Zealand's late investment in regenerative agriculture and irrigation has had limited success in safeguarding domestic food production and affordability. Materials and energy are increasingly expensive worldwide, but particularly in New Zealand and other small countries - driving up the cost of goods and services while the economy is only beginning to recover from a sudden and uncoordinated economic transformation that significantly eroded most households' spending power.

**Mental models:** A 'long-term, interconnected view of the world that considers the wider social, cultural, and environmental impacts of all we do' has become the norm. However, New Zealand's delayed, abrupt, and highly disruptive transformation has taken a heavy toll on people's mental wellbeing. Anxiety is both acute and chronic across most social groups.

**Key outcomes:** New Zealand's sudden and uncoordinated transition to a low-emissions, climate-resilient economy has placed retailers in the limelight. Since the 2030s, consumption has become an increasingly political activity, with activists targeting the directors and officers of slow-moving retailers. As a result, Kiwi retailers had to make faster, riskier decisions whilst losing market share to larger, greener, and more advanced global companies who had begun their decarbonisation journey earlier.

Under this scenarios, retailers' operating environment is characterised by seven + two pervasive trends





# Hot House Scenario - Current Policies

## The Retail Sector in 2050

**Key characteristics:** New Zealand's retail sector has made steady but only incremental improvements in its environmental and social sustainability. Despite financial constraints driving significant growth in New Zealand's shared economy, individual ownership is still the predominant model – exacting a heavy toll on the environment and household finances. Consumers can access detailed information about products' environmental and social footprint, but most don't. Instead, price, social status, and point of origin are primary purchase considerations.

**Structural forces:** Aotearoa New Zealand's degraded soils, limited investment in irrigation, and increasingly chaotic weather are placing significant strain on domestic food production and affordability. As the volume of New Zealand's agricultural exports has declined and global supply chains become brittle, the complexity and cost of importing retail goods has risen – posing particularly significant challenges to the importers of fast moving consumer goods.

**Mental models:** Amidst all the evidence of accelerating environmental and societal decay, the majority of Kiwis persist in closing their eyes and telling themselves, 'She'll be right.'

**Key outcomes:** The physical impacts of climate change have destroyed significant economic value and are injecting ever more uncertainty into the global economy. These economic headwinds are exacerbated by the continuing degradation of nature and international competition for resources. The energy and transport infrastructure systems underpinning New Zealand's retail sector value chain were not designed to withstand the increasingly extreme realities of climate change and are beginning to buckle under extreme heat, wildfires, and floods. Investments in resilience – both within New Zealand and abroad – were too little and too late.

Retailers around the world are contending with increasingly disrupted and costly supply chains, but New Zealand is disproportionately affected due to its geographic location and small market size. Relative to their European peers, Kiwi politicians and retail brands were slow to address the interwoven challenges posed by climate change and the destruction of nature. As a result, many local retailers have been bought out or displaced by international retail groups that were early movers in reducing energy/material intensity and building supply chain resilience. Still-independent national and regional retailers have incorporated low-input sourcing, design and manufacturing, distribution, point of sale, and waste solutions...but not as well as global brands.

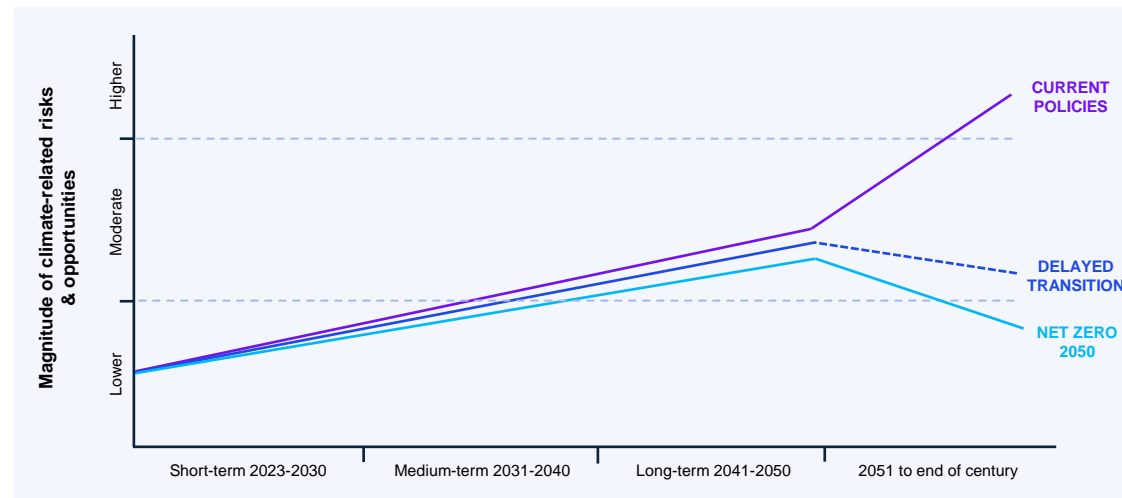
Under this scenarios, retailers' operating environment is characterised by five pervasive trends





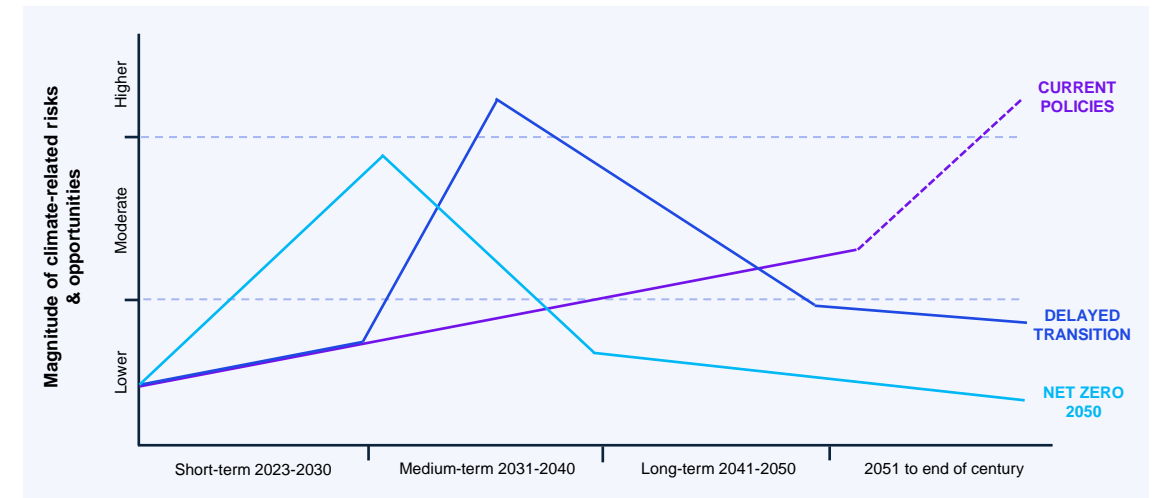
# Impact profiles

Figures 1 and 2 illustrate the distinct and complementary impact profiles of physical and transition-related risks over the short, medium, and long term for the Scenarios Net Zero 2050, Delayed Transition, and Current Policies scenarios.



**Figure 1:** Indicative profile of physical risks

The physical impacts of climate change include increasingly intense and/or frequent acute events (e.g. hurricanes, floods, and wildfires) as well as chronic, gradual and long-term sea level rise, rising temperatures, shifting seasons and changing precipitation patterns. Anthropogenic greenhouse gas emissions have already warmed the Earth by about 1.15°C above pre-industrial levels. Additional warming over the next 20-30 years is largely 'locked-in' by legacy emissions.<sup>14,15</sup> As a result, the physical impacts of climate change are broadly similar through mid-century under Net Zero 2050, Delayed Transition, and Current Policies scenarios. What matters, is what happens next: emissions over the next 20-30 years will determine whether we surpass critical tipping points in the Earth system and whether the severity of physical risks spikes upwards or slowly diminishes in the second half of this century.



**Figure 2:** Indicative profile of transition-related risks

Transition-related risks stem from the speed and scale of New Zealand's transformation to a low-emissions, climate-resilient economy. They include risks and opportunities arising, inter alia, from new public policies, regulations, market preferences, technology changes and climate adaptation interventions. Under a Net Zero 2050 scenario, an orderly and rapid transition results in moderate impact levels peaking in the late 2020s/early 2030s. Under a Delayed Transition scenario, transition-related impacts peak later, higher, and subside more slowly. Under a Current Policies scenario, transition-related impacts increase slowly but steadily through mid-century. In the latter half of the century, some transition-related risks could accelerate in response to the mounting impacts of physical change and social backlash against high emissions sectors.

## Section 2

# The scenarios

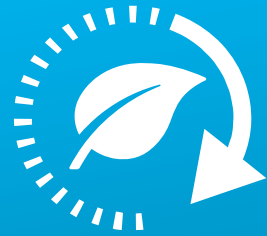




# Guide

The following scenarios reflect guidance from the Task Force on Climate Related Financial Disclosures (TCFD)<sup>1</sup> and have been designed to constructively confront commonly held expectations about the future. However, this is not a license for the imagination to run wild. “Good scenarios” are:

- **Distinctive** (i.e. include unique combinations of key factors and provide differentiated messages).
- **Plausible** (i.e. describe credible, possible, and believable futures).
- **Consistent** (i.e. exhibit a strong internal logic, with interactions between factors, actions, and reactions having logical explanations).
- **Challenging** (i.e. confront business-as-usual assumptions).
- **Relevant** to decision-makers (i.e. enable dynamic risk management and strategic planning).



## Scenario 1 Orderly

[OVERVIEW](#)[DETAIL](#)

## Scenario 2 Disorderly

[OVERVIEW](#)[DETAIL](#)

## Scenario 3 Hot house





# Orderly Scenario – Net Zero 2050

## GLOBAL POLICY AMBITION:

1.4°C<sup>2</sup>

## GLOBAL WARMING AT 2050:

1.6°C<sup>3</sup>

Severity of physical risk

Low

Severity of transition risk

Moderate

Policy reaction to climate change

Immediate & smooth

Regional policy variation

Medium

Technology change

Fast

Carbon dioxide removal

Medium-high use

International and domestic policy settings aim to limit total warming by end-of-century to less than 1.5°C. This entails halving greenhouse gas emissions by 2030 and reaching net zero emissions around 2050.

Though ambitious, these targets are insufficient to avoid crossing the Paris Agreement's 1.5°C threshold by mid-century. Medium to high deployment of carbon removal solutions dials the heat back to 1.4°C warming by end-century. Accordingly, the physical impacts of climate change are limited and affordable. We have avoided a tipping point in our climate system, beyond which greenhouse gas emissions would lead to a shutdown of large ocean circulation systems and massive permafrost melting.

## Trajectory of warming by 2100<sup>3</sup>

## Average



Global warming at 2100  
(relative to 1850-1900 baseline)

1.4°C



New Zealand warming at 2100  
(relative to 1850-1900 baseline)

1.3°C

## Our World <sup>4</sup>

The world shifts *immediately* and *smoothly* toward a more sustainable path, emphasizing more inclusive development that respects recognised environmental boundaries. Management of the global commons rapidly improves, educational and health investments accelerate the demographic transition, and the emphasis on economic growth shifts toward a broader emphasis on human well-being.

- **Consumption:** Oriented toward low material growth and lower resource and energy intensity. Consumers are increasingly committed to sustainable lifestyles.
- **Society:** Driven by an increasing commitment to sustainable development goals, inequality is reduced both across and within countries.
- **Economy & trade:** By 2050, the physical impacts of climate change have shaved roughly 5% off global GDP. However, transition-related macroprudential risks peak in the 2020s and a 'green wave' of growth is set to add US\$43 trillion, or approximately 3.8%, in net present value to key economies by 2070 (with growth in the Asia Pacific region eclipsing growth in Europe and the Americas).<sup>5</sup> Major markets impose additional costs on trade from countries failing to do 'their fair share' in the transition to a sustainable future. **Land use and nature:** Historical trends are reversed, including a gradual, global-scale, and pervasive expansion of forests and other natural habitats. Forests become a net sink by mid-century. An increasingly circular economy, efficient use of natural resources, and investment in productive landscapes has transformed the vitality of terrestrial and marine ecosystems.
- **Technology:** The uptake of sustainable technologies (e.g. renewables and carbon capture and storage), as well as technologies to better manage climate-related risks, is fast.



## Our Home <sup>6</sup>

New Zealand invests in strategic, transformational mitigation and adaptation measures with innovation playing an important part. New Zealand's response to the climate challenge is recognised and respected by the international community, including major trade partners. As a result, New Zealand has secure access to critical markets.

- **Policy:** Central and local government policy settings align with the global goal of limiting total warming to no more than 1.5°C. Domestic policies support transformational decarbonisation and meaningful adaptation. Adaptation is focused on sustainable land use and urban design. Policies ensure the protection of vulnerable populations during the transition to New Zealand's low-emissions, climate-resilient future. This allows Aotearoa to maintain a relatively high degree of social cohesion.
- **Trade:** The Pacific participates in an effective global trade regime through a growing service industry and niche products. There is strong market demand for New Zealand's 'green' primary products and services.
- **Behaviour:** Changes in people's and businesses' preferences encourage more behaviour changes away from high emitting activities and practices. People and businesses want to adopt existing low-emissions technologies.
- **Land use and nature:** New Zealand is effectively preserving, and even beginning to restore, its fragile ecosystems and limited natural resource base. As a result of strong, successive Natural and Built Environments, Strategic Planning, and Climate Change Adaptation Acts, degraded hillsides return to native forest, coastal ecosystems are re-established throughout their range, and New Zealand's air and waterways are renowned for their purity.



# Sector narrative

New Zealand's retailers and their value chain partners immediately begin working side-by-side to become low-emissions, climate-resilient businesses in-line with stakeholders' ambitious expectations.

## The Retail Sector in 2050

**Key characteristics:** New Zealand's retail sector is nearly unrecognisable from what it had been a mere thirty years ago. Retail business models based on the rapid churn of soft and hard consumer goods are long dead. Retailers have transformed their role in the economy from pushing conspicuous consumption to business models that purposefully promote and support conscious consumption. They are at the heart of New Zealand's rich shared economy, enabling households to easily access and use many high-quality goods without the environmental cost or financial burden of individual ownership. Hard goods are designed to last and be readily repaired. Soft goods are designed with enduring appeal. Both hard and soft goods are designed and manufactured to facilitate end-of-life recycling or upcycling. 'Active' and 'intelligent' packaging<sup>7</sup> are pervasive across the fast-moving segment of consumer goods, helping extend shelf-life, reduce waste, and provide information about product sustainability. Consumers can access detailed information about products' environmental and social footprint – but they feel less and less need to do so due to their trust in common New Zealand and regional brands.

**Key trends:** Retailers' operating environment has been re-shaped by seven pervasive trends: the declining material and energy intensity of products/services, declining per capita consumption, the expansion of product stewardship schemes, more conscious consumption, more local sourcing, more transparency, and more government regulation.

**Structural forces:** Data is omni-present throughout retail value chains, from sourcing, to point of sharing and/or sale, to end-of-life. This enables retailers, their partners, and customers to make informed decisions about what they buy, how they buy, and from whom. Legislative frameworks have been established in New Zealand, as in all other OECD countries, to prevent the externalisation of environmental and social costs while supporting the environmentally sound management of retail products and materials over their life. This includes 'right to repair' legislation and a combination of voluntary, mandatory and industry-wide product stewardship schemes backed up by a comprehensive, whole-of-New Zealand recycling infrastructure. The country's early investment in regenerative agriculture and irrigation has safeguarded domestic foods production and affordability despite increasingly unreliable weather. As a result of substantive government investment and our ability to attract regional talent, New Zealand's retail sector is benefitting from a global, low-emissions trade regime.

**Mental models:** As the proportion of New Zealand's Māori and Pasifika population grows – and as generations that have grown up within the context of an intertwining climate and biodiversity crisis gain political, economic and cultural power – Aotearoa undergoes a seismic shift in dominant worldview. A 'long-term, interconnected view of the world that considers the wider social, cultural, and environmental impacts of all we do' has become the norm. The wellbeing of individuals, communities, and nature, as well as inter-generational justice, is now valued by most people far more than the accumulation of material wealth. Our businesses find profitability and resilience in being purpose-driven. Their 'success' is no longer defined in singularly financial terms, but in broader terms reflective of stakeholder values and aspirations.

## Interaction between drivers

### *Physical Impacts → Social Expectations → International & Domestic Ambition*

Increasingly obvious and personal physical impacts of climate change propel wide-spread demand for government and businesses to quickly cut emissions.

### *International and Domestic Ambition → Finance → Technology*

Greater government ambition (e.g. more aggressive emissions reduction targets and action) drives the financial sector's confidence in the direction and speed of travel. This prompts banks and investors to redirect capital flows towards lower-emissions, more sustainable businesses, helping them access climate-positive technologies.

### *Technology ↔ Consumer Preferences*

Tech-enabled total product transparency provides consumers with the information they need to make informed decisions and 'invest' in the transition to a sustainability economy through every purchase. Innovative, tech-enabled packaging and delivery channels reduce costs, reduce emissions, and attract customers.

### *Social Expectations → Consumer & Employee Preferences*

Shifting mental models influence which brands consumers and employees want to associate with. Talent that puts a premium on working for a sustainable brand gravitate towards business that are already at the forefront, triggering a virtuous spiral.

### *Technology → Macroeconomic Conditions*

New technologies enable the decarbonisation of energy systems and save the global economy trillions of dollars.<sup>8</sup> Decarbonisation creates a wave of new jobs and keeps capital in New Zealand that would otherwise have been exported to purchase fossil fuels.





# Outcomes and indicators

## Key outcomes at 2050

- The world has warmed by 1.6°C since pre-industrial times. As a result, the physical impacts of climate change are significant and continue to grow. However, stringent climate policies, innovation, ambitious investment, and medium-to-high deployment of carbon removal solutions mean the world is on-track to achieve the Paris Agreement's 1.5°C target by 2100 – probably avoiding critical tipping points in the Earth system.
- The direct and indirect impacts of increasingly unpredictable and extreme weather, alongside other acute and chronic manifestations of climate change, have already destroyed significant economic value and continue to inject uncertainty into the global economy. However, these economic headwinds are overshadowed by tailwinds flowing from the global transition to a climate-smart, nature-positive economy.
- Retail brands have played a lynchpin role in this transition by providing environmentally and socially sustainable goods/services while enabling exponential growth in the shared and second-hand economies.
- Most of New Zealand's domestic and regional retailers have kept pace with the transition, incorporating low-carbon technology into the redesign, reformulation, or replacement of unsustainable products and doing the same with their business models to ensure enduring relevance. Those who failed to integrate new technologies and/or business models have collapsed or are struggling to attract customers and finance.
- Efficiency gains and economies of scale mean 'green' products no longer command a premium that might put them beyond the reach of households with limited purchasing power. 'Sustainability' is simply a hygiene factor in most consumer goods categories.
- Enabled by information technology and artificial intelligence that make hiding externalised environmental and social costs impossible, total product and brand transparency is the norm. To survive in this market, major retailers have entered into long-term, strategic partnerships with suppliers and (co)invested in technology solutions that enable innovative, low-carbon material, packaging and logistics solutions. New Zealand's domestic and regional retailers have found it difficult, but do-able, to remain relevant in a world where global brands have been able to invest far more (and exert far more pressure on supply chain partners) in the development of sustainable, circular products and logistics solutions.
- New Zealand's economy and transport system have been almost entirely electrified, opening up new opportunities for low-emissions manufacturing, distribution, and IoT-based logistics.
- Domestic and regional retailers supported their employees and communities through a 'Just Transition' in the 2020s and 2030s, creating trust and winning long-term loyalty. This has enabled leading brands to maintain market position despite incursions from mega-competitors. This same recipe of trust and loyalty has created a virtuous spiral, enabling familiar brands to attract and retain the top talent they require to continue succeeding in a complex, non-linear and extremely fast-moving world.

## Key indicators

1. International and domestic policy settings are effective in halving greenhouse gas emissions by 2030 and reaching net zero emissions by 2050, as evidenced by New Zealand meeting successive emissions budgets<sup>9</sup> and other countries meeting progressively ambitious Nationally Determined Contributions.<sup>10</sup>
2. The transition of the global economy to a low-emissions, environmentally sustainable, and socially just pathway triggers a sharp-but-short period of extreme market volatility peaking in the 2020s. Afterwards, markets stabilise and are buoyed by a 'green wave' of growth.
3. By 2030, the overwhelming majority of consumers are committed to sustainable lifestyles as evidenced by a fundamental shift in purchasing and sharing patterns.
4. By 2030, many low-emissions, nature-positive sourcing, design and manufacturing, distribution, point of sale and/or sale, and waste solutions are widely available and affordable to New Zealand retailers.



# Short term

## SHORT-TERM (2023 – 2030)

In response to mounting environmental and social crises, public pressure for immediate, transformative action explodes. New Zealand's retail sector finds itself at the epicentre of this blast. After decades seen promulgating and profiting from unsustainable consumption patterns, people demand that retail brands become agents of change and *enablers* of sustainable lifestyles.

Key social groups, especially women<sup>11</sup> and younger generations,<sup>12</sup> are quickly changing their consumption patterns - choosing to buy trustworthy green goods and services, rent through on-line and in-mall sharing platforms,<sup>13</sup> or simply go without. Slow-moving goods (when purchased rather than shared) are expected to be reliable and fixable. Fast moving goods are expected to be healthy for people and the planet.

Growing constraints on the unsustainable use of natural resources, long lead times, increasingly unpredictable supply chains, and zero social tolerance for waste sees retailers scrambling to optimise their supply chains.

Data comes to permeate every stage of the retail value chain, from sourcing, to point of sharing and/or sale, to end-of-life. This transparency enables retailers, their partners, and customers to make more informed decisions about what they buy, how they buy, and from whom.

Retailers align and collaborate with major global consumer goods brands who pivot away from relying on offsets to brand their products as 'carbon neutral'<sup>14</sup> and embrace more ambitious targets for true decarbonisation across scope 1-3 emissions. Global shipping costs<sup>15</sup> increase in the short term as the industry strives for an ambitious 45% reduction in emissions by 2030.

Legislative and regulatory frameworks have been established in New Zealand, as in all other OECD countries, to end the externalisation of environmental and social costs while supporting the sound management of retail products and materials from cradle to grave. This includes 'right to repair' legislation and a combination of voluntary, mandatory and industry-wide product stewardship schemes backed up by a comprehensive, whole-of-New Zealand recycling infrastructure.

Many of New Zealand's leading brands rise to the challenge posed by all the scope, scale, and speed of these changes, transforming their business models, strategies, and value chains to manage risks and seize emerging opportunities. Those that fail to adapt, perish. Many retail businesses and their value chain partners find profitability and resilience by becoming purpose-driven.

Their 'success' is no longer defined in singularly financial terms, but in broader terms reflective of stakeholder values and aspirations.

Directors and officers play a pivotal part in stewarding their businesses through the world's turbulent transition to a low-emissions, climate-resilient economy by providing vision and consistent leadership.

By 2030, New Zealand's leading retailers and their employees are seen as essential enablers of effective environmental action. Retailers that are seen as part of the problem rather than the solution are quickly abandoned by their customers, investors, and providers of financial services.





# Short term

## SHORT-TERM (2023 – 2030)

### Political factors

- Geopolitical stability and international cooperation begin to recover from the War in Ukraine and Pacific tensions in the mid-2020s.
- Governments take aggressive steps, supported by less partisan media and IT-enabled fact checking platforms, to re-build public trust.
- The world's biggest polluters meet their emissions budgets and commit to progressively ambitious Nationally Determined Contributions under the Paris Agreement.<sup>16</sup> The goal of limiting total global warming to no more than 1.5°C by end of century is alive... and inspiring a 'can do' attitude towards a wide range of other social and environmental goals.
- Governments in high and middle-income countries use international (e.g. trade policies and carbon border adjustment mechanisms, or CBAMs<sup>17</sup>) and domestic policies (e.g. carbon taxes, right to repair, and product stewardship legislation) to rapidly decarbonise the manufacturing and distribution of consumer goods.<sup>18</sup>
- As the cost of climate change and the balance of benefits from sustainability become increasingly evident, New Zealanders demand leadership. Political parties listen, and successive governments act. This includes working closely with consumer groups, retailers, and their value-chain partners to support behavioural change and decarbonisation.
- New Zealand re-calibrates its Emissions Trading Scheme to support the re-establishment of native forests with biodiversity, agricultural, and recreational co-benefits.

- As part of Te Rautaki Para,<sup>19</sup> waste-minimisation, recycling, and the transition to a more circular economy are established as key policy objectives.
- Central and local governments in New Zealand embark on long-term adaptation planning and investment, reducing vulnerability across the built environment.<sup>20</sup>

### Environmental factors

- Increasingly unpredictable and extreme weather begins to measurably impact:
  - Domestic infrastructure, forcing the government to divert financial resources to repair and/or harden (i.e. making more resilient) assets
  - The production of fast moving consumer goods
  - The supply chains of slow moving consumer goods
  - The domestic economy
  - Consumption patterns
  - Social sentiment
- Major retail brands, responding to consumer sentiment and increasingly invasive legislative frameworks, are driving the transformation of how fast and slow moving consumer goods are sourced, produced, distributed, and managed at end-of-life.

- The unsustainable production of fast and slow moving consumer goods continues to exact a heavy toll on the environment.<sup>21</sup> However, this is rapidly changing.
- Biodiversity and ecosystem integrity continue to decline globally, reducing yields and raising prices. However, many examples of early intervention in protection and restoration mean this trend is slowing.

### Social factors

- 'Boomers' retreat from the social stage, with significant implications for voting and consumption patterns.
- Public support for ambitious climate action has grown quickly across Aotearoa. Driven by diverse factors, including the growing influence of Te Ao Māori, and accelerated by social media, a seismic shift in the dominant worldview takes hold.<sup>22</sup>
- 'Consumers expect retailers to be working hard 'behind the scenes' to provide them with sustainable, transparent and price competitive products that meet their needs.
- New Zealand is an increasingly diverse and multi-cultural country, with the European/Pakeha share of the population decreasing whilst its Māori and Pasifika populations grow.<sup>23, 24</sup>

- A te ao Māori worldview, emphasising deep kinship between humans and the natural world, comes to permeate education, social discourse and social expectations in Aotearoa New Zealand, bolstering action on climate change and nature.<sup>25</sup>
- A critical threshold of New Zealand's politically and economically active population comes to value the wellbeing of individuals, communities, and nature, as well as inter-generational justice, more than the accumulation of material wealth.
- People seek to 'make a difference' by aligning their consumption patterns and values. In a deeply anxious world, most people find it comforting that they can 'do something,' however small, by choosing to buy sustainable goods, buy second hand, participate in sharing schemes, or not buy things they can do without.
- By 2025, high-earning top talent and younger generations of employees are choosing to work for a business that shares their values.<sup>26</sup> By 2030, most lower earners are making the same choice when they can afford to. Poor climate-performers find it almost impossible to recruit the talent they need to improve.
- As part of a broader shift in mental modals, employees place increasing value on their health and wellbeing, with many calling for a 4-day working week and an end to the 'open-all-hours' retail culture.<sup>27, 28</sup>





# Short term

## SHORT-TERM (2023 – 2030)

### Social factors continued

- By the mid-2020s, higher earning consumers accept paying a premium for more sustainable goods and services that reflect their full social and environmental costs. However, this premium fades as market economics drive more efficient production methods, materials, and logistics. Higher and lower earning consumers are increasingly eager to trying unfamiliar products from brands with strong sustainability credentials. These patterns are particularly pronounced in urban areas and amongst women and younger generations.<sup>29</sup>

### Technological factors

- By 2026, consumers can easily access information about most products' provenance and environmental impact through large language models (i.e. Large Language Models, or LLMs, including ChatGPT) accessed via smartphones. Unlike earlier product and brand information channels, LLMs cannot be controlled by retailers. As a result of LLMs, in combination with widespread disclosure standards and the auditing of claims, 'greenwashing' has become nearly impossible.
- Demand for technologies that reduce the energy and material intensity of consumer goods skyrockets. Businesses and investors, including governments, respond by ploughing resources into green-tech research, development, production, and diffusion.

- The government of New Zealand has developed an aggressive roadmap for the development and diffusion of low-emissions technologies across Aotearoa New Zealand's agricultural, manufacturing, distribution, and end-of-life systems.
- New technologies power diverse sales channels and enable niche providers of sustainable products with easy, inexpensive direct access to consumers.
- Many large retailers enter into power purchase agreements in order to support and benefit from investment in renewable energy generation, and to control the rapidly rising cost of electricity.
- Many large retailers enter into long-term, strategic partnerships with key suppliers to (co)invest in low-emissions material, packaging and logistics solutions. Circular capabilities are investment priorities.
- All large retailers invest in automation, the Internet of Things (IoT) and LLMs to improve efficiency, lower costs, reduce supply chain risks, and lower scope 1-3 emissions from materials, products and packaging.<sup>30</sup>

### Legal factors

- Government introduces and aggressively enforces a wide range of regulations aimed at improving environmental and social sustainability.
- Governments in manufacturing/growing countries also introduce and enforce sustainability requirements that either directly impact retailers' operations, or the consumer goods companies they supply.<sup>31</sup>
- Large businesses, directors, and officers that fail to comply with the spirit as well as the letter of the law are regularly targeted<sup>32</sup> and successfully prosecuted when warranted.
- Prominent retail businesses that are seen as out of step with rapidly evolving stakeholder expectations are hit with a succession of civil suits. Many of these cases have been unsuccessful in courts of law but highly damaging in the court of public opinion. Both outcomes are costly.<sup>33, 34</sup>
- By 2030, most directors and officers of large retailers have taken note and established robust systems to prevent greenwashing and ensure full compliance with sustainability-related regulations.
- Many directors and officers that felt their businesses couldn't move fast enough migrated to better performers – both to reduce legal risks and protect their personal brand.

### Economic factors

- The negative impacts of COVID and the war in Ukraine fade by the mid-2020s as the global economy catches a 'green wave' of growth. However, this growth is highly uneven. The Asia Pacific Region, in particular, surges forward.
- The world's rapid transition to a low-emissions, climate-resilient economy unleashes a storm of 'creative destruction'. Many slow-moving enterprises are broken – suddenly finding their core business models, strategies, and value chain relationships irrelevant or uncompetitive.
- Some more agile businesses pivot and grow. Many new businesses, unconstrained by legacy assets or ways of working, flourish.
- The physical and transition-related impacts of climate change exert moderate downward pressure on global, domestic, and Asia-Pacific economies.
- Households are under financial pressure in many parts of the world, including New Zealand. Per-capita consumption declines due to a combination of household economics and changing values. Slow moving goods have been hit harder than fast moving goods, while luxury items and brands have been hit hardest of all.<sup>35</sup>
- Downward pressure on household budgets, along with changing worldviews, has led to the dramatic growth in New Zealand's shared and second-hand economies. Households are under financial pressure in many parts of the world, including New Zealand. Per-capita consumption declines due to a combination of household economics and changing values.



# Short term

SHORT-TERM (2023 – 2030)

## Economic factors continued

- Some retail investors have left in search of safer havens, whilst others hunt for opportunity amongst businesses positioning themselves to catch the 'green wave' of growth.
- Banks are redirecting their lending portfolios towards customers that can demonstrate sustainable business models and practices.<sup>36</sup> This process was 'messy' at first but is becoming increasingly disciplined and reliable, facilitated by disruptive new information technologies.
- Sustainability linked loans and green bonds are playing a substantial role in enabling pro-active retailers and their value chain partners to adapt to market conditions.<sup>37</sup>
- Carbon prices rise steeply, making high-carbon economic activity less profitable.
- Business insurance rates have surged, and some retailers out of step with the transition to a sustainable economy cannot access directors and officers insurance at any cost.
- Air freight becomes too costly to rely on, both in terms of carbon-adjusted pricing and consequences for consumer acceptance.
- Sea freight prices increase as rapid decarbonisation agreed by the UN IMO sees shipping's operational costs increase by up to 10%.<sup>38</sup>



# Medium term

Experience, leisure, and lifestyle-focused consumers buy fewer, higher-quality, and more durable goods. Most people seek to limit the purchase of slow moving consumer goods – either foregoing or sharing through online platforms. Technology enabled low-impact products like 3D-printed homeware, digital fabrics,<sup>39</sup> and cultivated meat have become normal. Fast moving consumer goods are delivered by autonomous, battery powered vehicles or provided via hyper-efficient, low-employee stores. Luxury brands and items have moved into the heavily personalised wellbeing and lifestyle markets, with many retailers continuing the trend<sup>40</sup> towards ‘experience based’ physical location spaces. Social media drives change at pace.

Sustainable sourcing, manufacturing, distribution, point of sale/share, and waste solutions are widely available and affordable across New Zealand’s retail sector. ‘Direct to consumer’ and subscription models flourish. A rapidly growing proportion of retail revenues is derived from re-selling products (clipping the ticket twice), services (e.g. rentals and repairs), and the recycling of materials. The ‘sustainable premium’ on products has disappeared, with genuinely sustainable products now typically having lower cost bases: value creation comes from providing quality, affordable products.

Greenwashing is a brand-defining reputational risk, with many retailers now holding themselves and others to account. Retailers that have successfully re-designed their business models and strategies to enable sustainable lifestyles and supported employees through the turbulent 2020’s are highly valued and hold significant social license to operate.

Retail businesses are increasingly embedded within local communities, where employees are encouraged to play an active part in community-led responses to extreme weather events. Many retailers are playing an active part in the revitalisation<sup>41</sup> and social cohesion of New Zealand’s increasingly populous and diverse urban centres.

As a result of emissions trading schemes, carbon taxes and waste charges, energy and material-intensive products now reflect their environmental and/or social costs. This creates yet another layer of incentives to reduce consumption in lieu of more sustainable alternatives, sharing, or foregoing. Providing less energy and materially-intensive products and services is, therefore, key to profitability and competitiveness within New Zealand’s retail sector.

As a result of co-investment by retailers and suppliers in IoT, AI, and ‘smart’ packaging,<sup>42</sup> supply chain logistics are increasingly automated, efficient, and resilient. Leading retailers employ carbon-capture in their products, with a growing market for ‘carbon negative’ goods.

Government continues to work closely with retailers and other key sectors to implement Net Zero policies and restore New Zealand’s lived-in, productive ecosystems.

The foresight, bold business-models, early investment, and high social license of major Kiwi retailers has enabled them to stave-off incursions from equally sustainable international competitors.

## MEDIUM-TERM (2031 – 2040)







# Medium term

MEDIUM-TERM (2031 – 2040)

## Political factors

- Trust in political leaders and institutions is high as people begin experiencing the promised benefits of ambitious action on climate change and nature.
- Almost all countries continue to meet their emissions budgets and commit to progressively ambitious Nationally Determined Contributions. The goal of limiting total global warming to no more than 1.5°C by end of century is within our grasp and has inspired similarly ambitious approaches to tackle other social and environmental challenges.
- Government-led (social) marketing campaigns encourage 'laggard' consumers and business leaders to become active agents of change.
- Governments in high and middle-income countries work closely with consumers, retailers, and their value-chain partners to co-design policy instruments that ensure the continued decarbonisation of consumer goods, reduce waste, and create an ever-more circular economy.
- The widespread adoption of trade policies to decarbonise the global economy continues driving manufacturing/growing towards countries and domestic producers with the lowest environmental costs.

- The government of New Zealand has pushed through legislation to ensure a Just Transition as the country's economy shifts away from legacy industries and retailers adjusted to new technologies ... and lower relative sales volumes.
- Successive central and local New Zealand governments are implementing long-term adaptation plans, significantly reducing vulnerabilities within the built environment.

## Environmental factors

- Though greenhouse gas emissions have plummeted since their 2023/4 zenith, the inertia of historic emissions continues to warm our world. As a result, the physical impacts of climate change continue to mount and disrupt retail supply chains.
- The production of fast and slow moving consumer goods exacts a much lighter toll on the environment. Major retail brands have largely transitioned to sustainable food and manufacturing systems.
- Biodiversity loss has ended in high and middle-income countries. Some ecosystems are starting to regain integrity and re-establish resilience. By 2031, 30% of global land and sea areas are conserved for biodiversity and nature recovery.<sup>43</sup>

- New Zealand continues to expand its use of nature-based solutions to climate change (e.g. capturing carbon in forests and using healthy ecosystems to protect infrastructure from the increasingly intense storms).
- New Zealand's biosecurity and natural asset management regimes keep invasive pests and livestock disease to a minimum. There are no climate-induced global pandemics.
- Unavoidable emissions and negative impacts on nature are offset 100+ per cent through well-managed, well-vetted, and thoroughly transparent carbon and nature offset schemes.

## Social factors

- Environmental and social sustainability are important elements of everyday economic discourse in New Zealand.
- Environmental education is a normal part of school curriculum. Combined with the rise of te ao Māori, most people see their wellbeing and that of the natural world as interwoven. As a result, people expect public institutions and private enterprises – including retailers – to look after the environment for the good of current and future generations.
- Consumers expect circularity by design and second-hand, upcycled and recycled goods are now social norms – as is 'sharing' rather than owning expensive, materially intensive goods.

- Consumer spending patterns align further with sustainable lifestyles and investment in personal wellbeing. Customers consider broader outcomes (e.g. intergenerational justice) in their purchasing decisions, and expect options to share and repair rather than replace consumer goods.
- More and more sales are conducted online. Customers in urban areas rely on energy efficient home delivery systems for most routine purchases. Physical store locations are geared towards learning about products and brands.
- As Gen Z moves into middle management, sustainability and holistic mental and physical wellbeing become hygiene factors to attract and retain top talent. A 4-day work week becomes the norm in New Zealand. In retail, this applies to 'corporate' and (enabled by automation technologies as well as new sales and distribution channels) many frontline jobs. Most retailers reduce physical store opening hours in line with new social expectations.
- Employees are increasingly vocal and influential both within companies and in their local communities, demanding climate action, retraining, and financial support in the Just Transition to a low-carbon economy.
- New Zealand's human-centred transition to a low-emissions, climate-resilient economy has resulted in high levels of employee wellbeing and social cohesion. This is contributing to positive employee-customer interactions and high levels of workplace productivity.





# Medium term

MEDIUM-TERM (2031 – 2040)



## Technological factors

- As a result of co-investment by retailers and suppliers in IoT, AI, and 'smart' packaging,<sup>44</sup> supply chain logistics are increasingly automated, efficient, and resilient.
- The government of New Zealand is methodically implementing its roadmap to develop and diffuse low-emissions technologies across Aotearoa New Zealand's agricultural, manufacturing, distribution, and end-of-life management systems.
- Businesses and investors, including government, continues to plough resources into green-tech research, development, production, and diffusion.
- Investments made in the 2020s see circular technologies firmly embedded across retail value chains.
- Technology enables low-carbon delivery methods to evolve from electric cars to multi-retailer autonomous electric vehicles in urban areas. Many retailers use battery-powered drones to efficiently deliver goods.

## Legal factors

- Governments introduce and aggressively enforce regulations aimed at ensuring a Just Transition and protecting workers from the physical impacts of climate change (e.g. heat stress).
- Both government and civil society are intolerant of businesses, directors, and officers failing to comply with environmental and social regulation (including climate, nature, and modern slavery-related disclosures). Legal action against non-compliance, greenwashing, and misleading claims about product and brand sustainability is swift and harsh.

## Economic factors

- Though the global economy is still struggling to shake off the effects of rapid decarbonisation, New Zealand's economy is fully recovered and benefitting from the wave of green growth that has spread across the Asia Pacific Region.<sup>45</sup>
- Both inflation and interest rates have cooled.
- Households economics in New Zealand have improved, with increased purchasing power channelled towards wellbeing rather than a return to old consumption patterns.
- Banks have successfully redirected their lending portfolios towards customers that demonstrate sustainable business models and practices. The relevance of sustainability linked loans and green bonds has diminished as sustainability is part of business' new normal.

- New Zealand's shared economy continues to grow.
- Investors aggressively seek out 'future-fit' businesses, including retailers capitalising on trends in sustainable product sourcing, manufacturing, distribution, sales, sharing, and recycling. As a result, New Zealand's surviving retailers have long-term finance partners in place to support next steps in their transition to our net zero, nature-positive future.
- A reduced reliance on international energy sources sees more capital retained in New Zealand, boosting domestic prosperity.
- Carbon prices continue to rise. New Zealand's strong, nature-based carbon offset market sees capital inflows from global emitters.
- Large retail groups unlock new value by producing market savvy 'carbon negative goods' (i.e. products that capture more carbon than they emit) and selling carbon capture credits to other businesses.

# Long term

New Zealand's retail sector has undergone an extreme makeover. Instead of perpetuating linear, 'make-sell-use-waste' business models, surviving retailers are community-oriented enablers of a regional take-make-use-reuse system. Indeed, retailers are at the heart of Aotearoa New Zealand's strategic circular economy and provide the primary interface between consumer waste and recycling processes.

Supply chains are increasingly light-touch, with AI, IoT and smart packaging supporting adaptation to the physical impacts of climate change on commodities, manufacturing, and distribution. AI-enabled total product, packaging and provenance transparency is the norm.

The business models of most large retailers include subscription platforms that provide rental, sharing and on-demand service-based offerings as well as physical and digital products. A significant proportion of retail activity and advertising takes place in the Metaverse. Physical store locations become bifurcated into sites of immersive experience for brands, or hyper-functional pick-up locations for stock items. As urbanisation continues, physical retail locations play active roles in strengthening multi-cultural social fabric and community cohesion.<sup>46</sup>

Sustainability is rarely referenced in product labelling as the baseline for single-ownership/use physical products is typically 100% circular, environmentally regenerative, and delivered direct to consumers. 'Fourth-hand' products are commonplace.

Government intervention is now focused on assisting retailers to become 'net-positive' in their environmental and social impacts.

LONG-TERM (2041 – 2050)





# Long term

LONG-TERM (2041 – 2050)

## Political factors

- Almost all countries are on-track to meet or exceed their contributions to the global goal of Net Zero by 2050. Higher-income countries are increasingly focused on setting and achieving carbon removal targets.
- Climate and nature-based trade barriers and incentives become a normalised part of global trade protocols.
- In New Zealand, environmental restoration and social equity become solidly centrist political positions with near universal support from a population that can see and feel the benefits.
- Government has stepped back from aggressive shaping and policing of business as the private sector is largely seen as a trusted partner in delivering environmental and social goals.
- Successive central and local New Zealand governments continue implementing long-term adaptation plans. As a result, the vulnerability of New Zealand's built environment to the physical impacts of climate change is limited.

## Environmental factors

- The rate of global warming has slowed, and the world is on-track to limit total warming to no more than 1.5°C by end-of-century. This will require going beyond 'Net Zero' and removing historic emissions through a combination of nature and technology-based solutions.
- El Niño conditions are now common, redefining New Zealand's average temperatures and rainfall patterns, as well as flood, drought, and fire risks.
- The lower-income countries that New Zealand's retailers often rely upon for manufactured goods have been harder hit by the physical impacts of climate change.
- Most agricultural production is plant-based, regenerative, and biodiversity-positive.
- Biodiversity loss has been reversed and most of New Zealand's ecosystems have regained integrity and resilience. By 2050, there is a 15% increase in the area, connectivity and integrity of natural ecosystems.<sup>47</sup>
- Biohazards are well managed, with monitoring and responses tightly coordinated between governments.

## Social factors

- New Zealand has opened its borders (and economy) to those seeking shelter from sea level rise and other physical impacts of climate change. As a result, the country is increasingly diverse. Aotearoa successfully marries its bicultural underpinnings with this multicultural society.<sup>48</sup>
- The 'climate activist youth' of the 2020s are now in leadership positions across New Zealand's public and private sector.
- Consumer spending patterns are overwhelming aligned with sustainable lifestyles. However, customers rarely have to consider environmental or social sustainability in their purchasing decisions as brands are assumed to embed these outcomes across their goods and services.
- Kiwis feel deeply connected to place, and there is widespread pride in the wellbeing of Aotearoa New Zealand's environment and social fabric. Consumers seek out 'New Zealand made' products and value the recycling of materials 'on the motu.'

## Technological factors

- Technological advances in energy, transport, manufacturing, agriculture & carbon capture enable New Zealand's retailers and their value chain partners to reach their Net Zero targets.
- AI-based systems manage and effectively minimise environmental risks across retail value chains.

## Legal factors

- The introduction of sustainability-related regulations has slowed. Businesses find compliance easier than in recent decades, resulting in fewer infringements, lower legal costs, and lower direct and indirect reporting expenses.
- Directors' fiduciary duty is broadly recognised as spanning financial and non-financial value creation for a range of stakeholders including future generations.

## Economic factors

- The global economy is more sustainable and resilient than in the 2020s.
- Many countries have entered a period of clean, green and resilient economic growth, especially in the Asia Pacific Region.
- New Zealand's 2050 GDP is materially higher than under Delayed Transition and Current Policy scenarios.





# Physical parameters

**Table 2:** Net Zero 2050 physical parameters

VARIABLE	LOCATION	2005	2030	2040	2050
<b>Mean Annual Temperature Change</b> <i>(Average annual temperature vs pre-industrial baseline)</i>	New Zealand	0.87°C <i>(above pre-industrial levels)</i>	1.38°C	1.45°C	1.46°C
	North Island		1.40°C	1.47°C	1.48°C
	South Island		1.37°C	1.43°C	1.44°C
<b>Number of Days Exceeding 25.0°C Annually</b> <i>(% increase in days vs 2005 baseline)</i>	North Island	17.5 days/yr	41.0%	46.9%	47.5%
	South Island	9.2 days/yr	31.9%	36.5%	37.0%
<b>Number of Frost Days Annually</b> <i>(% decrease in days per year vs 2005 baseline)</i>	North Island	9.0 days/yr	-40.2%	-44.5%	-45.0%
	South Island	58.1 days/yr	-16.5%	-18.5%	-18.7%
<b>Mean Sea Level Rise</b> <i>(Increase in centimetres vs pre-industrial baseline)</i>	North Island	19.95cm	32.8cm	38.2cm	43.6cm
	South Island	17.4cm	30.1cm	35.5cm	40.9cm
<b>Extreme Precipitation Events Lasting 3hrs</b> <i>The Average Recurrence Interval (ARI) of a 3 hour extreme precipitation event (based on the rainfall volume in a 2005 '1 in 100 year' event).</i>	North Island	1 in 100 years	1 in 70 years	1 in 67 years	1 in 67 years
	South Island	1 in 100 years	1 in 70 years	1 in 67 years	1 in 67 years
<b>Extreme Precipitation Events Lasting 24hrs</b> <i>The Average Recurrence Interval (ARI) of a 24 hour extreme precipitation event (based on the rainfall volume in a 2005 '1 in 100 year' event).</i>	North Island	1 in 100 years	1 in 72 years	1 in 69 years	1 in 69 years
	South Island	1 in 100 years	1 in 70 years	1 in 68 years	1 in 67 years
<b>Extreme Wind Speed Events</b> <i>The Average Recurrence Interval (ARI) of an extreme wind speed event (based on the max wind speed in a 2005 '1 in 100 year' event).</i>	North Island	1 in 100 years	1 in 63 years	1 in 68 years	1 in 64 years
	South Island	1 in 100 years	1 in 51 years	1 in 57 years	1 in 54 years
<b>Drought (Annual Potential Evapotranspiration Deficit)</b> <i>(% increase in annual average deficit in millimetres vs 2005 baseline)</i>	North Island	144.94 mm	4.98%	5.62%	5.69%
	South Island	108.4 mm	2.80%	3.20%	3.24%

See Appendix E for further information to support reading of select parameters.

Source: CLIMsystems, 2023





# Socio-economic parameters

**Table 3:** Net Zero 2050 socio-economic parameters

VARIABLE			BASELINE	2030	2040	2050
	<b>New Zealand Economic Damage due to Extreme Weather</b> <sup>49</sup>	Annual expected damage from river floods (% at median line compared to the reference year 2015)	2.2% (2015)	42.7	31.1	31.1
		Annual expected damage from tropical cyclones (% at median line compared to the reference year 2015)	-2.3% (2015)	-11.7	-15.7	-15.7
		1-in-100-year expected damage from tropical cyclones (% at median line compared to the reference year 2015)	-1.8% (2015)	-14.3	-20.2	-20.2
	<b>Global GDP Per Capita</b> <sup>50</sup> <i>(measured in 2005 international US dollars, adjusted for inflation and cross-country price differences)</i>		8,791 (2005)	19,332	26,606	34,148
	<b>New Zealand GDP</b> <sup>51</sup> <i>(% difference, 2009 prices; local currency vs baseline)</i>		-	-1.14	-0.20	0.04
	<b>New Zealand Inflation Rate</b> <sup>52</sup> <i>(abs. difference % vs baseline )</i>		-	0.13	-0.22	-0.03
	<b>New Zealand Long Term Interest Rate</b> <sup>53</sup> <i>(abs. difference % vs baseline)</i>		-	0.78	0.54	0.39
	<b>New Zealand Energy Price</b>	Electricity <sup>54</sup> (\$/MWh)	68.1 (2020)	75.8	85.6	78.0
		Oil <sup>55</sup> (% difference, US\$ per barrel vs baseline)	-	157.72	370.58	625.07
	<b>New Zealand Carbon Price</b> <sup>56</sup> (NZD\$ 2022, per tonne of CO2-equivalent)		-	155	216	277
	<b>Global Population</b> <sup>57</sup> <i>(million)</i>		6869.324 (2010)	7999.914	8322.06	8459.401
	<b>New Zealand Population</b> <sup>58</sup> <i>(million)</i>		4.368 (2010)	5.308	5.700	6.044



# Disorderly Scenario – Delayed Transition

GLOBAL POLICY  
AMBITION:

1.6°C<sup>2</sup>

GLOBAL WARMING  
AT 2050:

1.7°C<sup>3</sup>

Severity of physical risk

Low/Moderate

Severity of transition risk

High

Policy reaction to climate change

Delayed

Regional policy variation

High variation

Technology change

Slow then fast

Carbon dioxide removal

Low-medium use

International and domestic policy settings aim to limit total warming to less than 1.5°C this century. However, decisive action is delayed. Global emissions peak in 2030, then drop sharply. As a result of delayed action, deeply destabilising policies are now required to keep total warming below potentially catastrophic levels.

Negative emissions (i.e. more greenhouse gases captured and stored than emitted) are necessary in the second half of this century. Low to medium deployment of carbon removal solutions dials the heat back to 1.6°C warming by end-century. Accordingly, the physical impacts of climate change are more likely than not to be limited and affordable. It is also more likely than not that we have avoided a tipping point in our climate system, beyond which greenhouse gas emissions would lead to a shutdown of large ocean circulation systems and massive permafrost melting.

Trajectory of  
warming by 2100<sup>3</sup>

Average



Global warming at 2100  
(relative to 1850-1900 baseline)

1.7°C



New Zealand warming at 2100  
(relative to 1850-1900 baseline)

1.6°C

## Our World

The world shifts late and abruptly to a more inclusive and sustainable development pathway that respects environmental boundaries. Management of the global commons eventually improves but needs to make up for (yet another) 'lost decade'. The global economy shifts from a focus on economic gain to broad human wellbeing.

- **Consumption:** Re-orientes belatedly and suddenly toward low material growth, lower resource use, and lower energy intensity. Younger consumers commit to sustainable lifestyles as 'Boomers' fade away.
- **Society:** Driven by an increasing commitment to achieving overdue development goals, inequality is eventually reduced both across and within countries.
- **Economy/trade:** By 2050, the physical impacts of climate change have shaved roughly 5% off global GDP. Transition-related macroprudential risks peak in the 2030s, higher and later than under a Net Zero 2050 scenario. A 'green wave' of growth is set to add trillions in net present value to key economies by 2070, with growth in the Asia Pacific region eclipsing growth in Europe and the Americas. Major markets impose additional costs on trade from countries failing to do 'their fair share' in the transition to a sustainable future.
- **Land use and nature:** Historical trends are eventually reversed, including a gradual, global-scale, and pervasive expansion of forests and other natural habitats. Forests become a net carbon sink, but their use for removals is limited (low-medium). Our increasingly circular economy, the efficient use of natural resources, and investment in productive landscapes is transforming the vitality of terrestrial and marine ecosystems.
- **Technology:** The uptake of sustainable technologies (e.g. renewables and carbon capture and storage), as well as technologies to better manage climate-related risks, is slow until 2030 then extremely fast.



## Our Home

New Zealand's climate change response is characterised by ambitious commitments but poor follow through and minimum improvements in land-use until panic begins to spread amongst the general population and businesses in the late 2020s/early 2030s. New Zealand belatedly invests in transformational mitigation and adaptation measures, with innovation playing an important role. New Zealand's response to the climate challenge is recognised by the international community, including major trade partners. As a result, New Zealand gains secure access to critical markets. However, its early lack of vision means that, by 2050, New Zealand's society and economy are less prepared for the future than many of its OECD peers.

- **Policy:** Central and local government policy settings were inconsistently aligned with the global goal of limiting total warming to no more than 1.5°C until 2030. Stringent domestic policies then drove transformational decarbonisation and meaningful adaptation. Adaptation is focused on sustainable land use and urban design, with high near-term costs but long term benefits.
- **Trade:** The Pacific participates in a global trade regime through a growing service industry and niche products. There is market demand for New Zealand's 'green' primary products and services.
- **Behaviour:** Commitment to low-emissions activities and practices, as well as the uptake of low-emissions technologies, follows current trends until the late 2020s/early 2030s, then grows dramatically.
- **Labour:** Immigration is part of a regional system taking into account refugees as well as voluntary migrants, with consideration of labour force development and addressing demographic bottlenecks.
- **Land use and nature:** New Zealand is preserving, and has begun restoring, its fragile ecosystems and limited natural resource base. As a result of successive Natural and Built Environments, Strategic Planning, and Climate Change Adaptation Acts, degraded hillsides are returning to native forest and coastal ecosystems are being re-established throughout their range.





# Sector narrative

New Zealand's leading retailers and value chain partners delay their transition to a low-emissions, climate-resilient future. More prescient international competitors sweep in to displace or buy-out backwards looking businesses.

## The Retail Sector in 2050

**Key characteristics:** Materially similar to Net Zero 2050 scenario. However, most large national and regional brands have been displaced or bought-out by quicker-to-act international competitors. Those that remain have transformed their role in the economy from pushing consumption-at-all-costs to purposefully promoting and enabling conscious consumption.

**Key trends:** Materially similar to key trends under a Net Zero 2050 scenario with two noteworthy exceptions:

- The speed, intensity, and punitive nature of environmental regulations introduced since the early 2030s.
- The rapid replacement of domestic and regional retailers by more sustainable international brands.

**Structural forces:** Materially similar to Net Zero 2050 scenario. However, late government regulation is far more extensive, invasive, and punitive. New Zealand's delayed investment in regenerative agriculture and irrigation has had limited success in safeguarding domestic food production and affordability. Materials and energy are increasingly expensive worldwide, but particularly in New Zealand and other small countries - driving up the cost of goods and services while the economy is only beginning to recover from a sudden and uncoordinated economic transformation that significantly eroded most households' spending power. As a result of delayed government action, the ability of domestic retailers to attract talent and benefit from a global, low-emissions trade regime is limited.

**Mental models:** Materially similar to Net Zero 2050 scenario. However, New Zealand's delayed, abrupt, and highly disruptive transition to a low-emissions, climate-resilient economy has taken a heavy toll on people's mental wellbeing. Anxiety is both acute and chronic across most social groups.

## Interaction between drivers

### *International Ambition → Domestic Ambition → Finance → Technology*

Delayed international ambition delayed domestic ambition, slowing climate-related finance flows into New Zealand and the feasibility and affordability of new, low-carbon, technology opportunities.

### *Political Ambition → Technology*

A delayed, uncoordinated and abrupt transition resulted in retailers having to take riskier bets in their choice of low-emissions technologies.

### *Consumer Financial Strain → Consumer preference*

A delayed, uncoordinated and abrupt transition eroded household spending power and dampened demand for luxury goods while encouraging consumers to buy second-hand, share, or go without.

### *Physical impacts → Societal Expectations → Domestic Ambition → Compliance costs*

Increasingly intense and frequent extreme weather events in the late 2020s triggered public pressure on elected officials to take dramatic action. The swift introduction of highly proscriptive and punitive legislation increased retailers' compliance and legal costs – particularly with regards to emissions reductions and the health and safety of workers exposed to extreme weather.

### *Societal Expectations → Shareholder Expectations → Legal impact (D&Os)*

Rapidly shifting social sentiment in early 2030s resulted in shareholders and broader stakeholders taking legal action against the directors and officers of retail businesses seen as slow in rising to the challenges posed by climate change.



# Outcomes and indicators

## Key outcomes at 2050

- The world has warmed by 1.7°C since pre-industrial times. As a result, the physical impacts of climate change are significant and continue to grow. Extensive, invasive, and punitive but late government intervention, in combination with some deployment of carbon removal solutions, means the world is on-track to limit total warming this century to less than 2°C. This may be sufficient to avoid critical tipping points in the Earth system.
- The direct and indirect impacts of increasingly unpredictable and extreme weather, alongside other acute and chronic manifestations of climate change, have already destroyed significant economic value and continue to inject uncertainty into the global economy. The physical impacts of climate change are having a greater effect on the economy than they would have if governments had invested in adaptation sooner. Economic tailwinds from the global transition to a climate-smart, nature-positive economy have been diffuse and limited due to its disorderly and jarring nature.
- Delayed then swift decarbonisation put retailers in the public and political spotlight, with consumer choices becoming a deeply political activity. Many retail brands responded by providing environmentally and socially sustainable goods/services while enabling exponential growth in the shared and second-hand economies. Slow-moving Kiwi retailers were bought out or pushed out by larger, greener and more advanced global business that began their transition earlier. While faster-moving Kiwi retailers were able to keep up with the global competition (incorporating low-carbon technology into the redesign, reformulation, or replacement of unsustainable products and doing the same with their business models to ensure enduring relevance), delayed and then rushed decisions/investments were fundamentally more risky.
- Total product and brand transparency is now the norm. To survive in this market, major retailers have entered into long-term, strategic partnerships with suppliers and (co)invested in technology solutions that enable innovative, low-carbon material, packaging and logistics solutions.
- Retailers belatedly supported their employees and communities through a 'Just Transition' in the 2030s and 2040s, re-building some trust and loyalty. This has enabled leading brands to attract and retain some of the top talent they require to continue succeeding in a complex, non-linear and extremely fast-moving world.

## Key indicators

1. International and domestic policy settings fail to halve greenhouse gas emissions by 2030 but succeed in reaching net zero emissions by 2050.
2. New Zealand fails to meet its first two emissions budgets, instead relying heavily on international offsets.
3. The transition of the global economy to a low-emissions, environmentally sustainable, and socially just pathway triggers a period of pronounced market volatility which peaks in the mid-2030s. Afterwards, markets stabilise and begin to benefit from a 'green wave' of growth.
4. By 2035, the overwhelming majority of consumers are committed to sustainable lifestyles as evidenced by a widespread shift to eco-based purchasing patterns.
5. By 2035, many low-emissions, nature-positive sourcing, design and manufacturing, distribution, point of sale and/or sale, and waste solutions are widely available and affordable to New Zealand retailers.
6. By 2035, New Zealand retailers have been able to recruit, train, and retain the necessary talent to build customer trust, earn market loyalty, and ensure enduring relevance.



# Short term

Economic pressure sees consumers prioritise 'cost over climate', choosing material and carbon intensive products with little demand for transparency. Sustainability remains a nice-to-have or a middle-class luxury.

A lack of policy direction, low infrastructure investment, and faltering global climate finance means the enabling ecosystem isn't there to make radical change. Despite national emissions targets, even well-intentioned retailers struggle to find the room to evolve, delaying investments in downstream circularity, low-carbon product or process innovation, or the data and technology needed to create a low-emissions supply chain. Shareholders and investors, grown weary of ESG, demand a 'return to returns' to boost economic growth. It feels like all parties are waiting for the other to make the first move.

Levels of government distrust, reducing social cohesion, and polarisation around climate action<sup>59</sup> are action blockers. Marginal groups and younger voices call desperately for change, and begin to blacklist high emitters. Retailers find staff relations across ethnic, geographic, and political lines fracturing, declining productivity. Although most employees remain focussed on salary, top sustainability professionals and younger climate-conscious talent are difficult to acquire.

Advances in technology (as in other scenarios) see rising use of IoT, AI, and alternative materials and products. However, taking government's lead, these are initially geared at physical climate risk reduction and resilience-building across, estate, logistics and supply chain. Emissions reductions are typically by-products of efficiency gains. Adaptation-linked products rise in prominence, and chronic changes in seasonal weather predictability see retailers invest in weather-related data analytics or weather-responsive advertising to drive sales and reduce reputationally and financially costly obsolescence.

## SHORT-TERM (2023-2030)







# Short term

## SHORT-TERM (2023-2030)

### Political factors

- Continued geopolitical tensions, underwhelming flows of Green finance, and a focus on post-COVID-19 and Ukraine War economic recovery mean that, despite Cyclone Gabrielle and other events in 2023, the 2020s are characterized by continued indecision over the scale and speed of climate action, with the debate around transitioning legacy industries highly polarized.
- Most climate-related plans during this period remain 'plans to make plans', with policy settings in central and local government inconsistently aligned with limiting warming to no more than 1.5 degrees by 2030<sup>60</sup>.
- Government focusses investment in adaptation measures in Aotearoa to counter the extreme weather.
- Retailers struggle to plan with the changeable political and financial support, lack of direction, and short-termism.<sup>61</sup> Retailers focus on 'compliance' with climate-related regulations, in lieu of more proactive policy.

### Environmental factors

- The physical impacts of climate change are materially similar to impacts for the same time period under a Net Zero 2050 scenario.
- The unsustainable production of fast and slow moving consumer goods continues to exact a heavy toll on the environment. However, this is slowly changing. Major retail brands, responding to rising consumer sentiment, are pushing for changes in how fast and slow moving consumer goods are sourced, produced, distributed, and managed at end-of-life.
- Lack of coordinated intervention mean that biodiversity and ecosystem integrity continue to decline both internationally and domestically, raising production prices and creating supply issues.<sup>62</sup>

### Social factors

- Most consumers prioritise cost-of-living pressures<sup>63</sup> whilst maintaining highly material and carbon lifestyles.
- Only niche, affluent, or activist segments prioritise 'premium' sustainable products.
- Social expectations around climate action is mainly focussed on adaptation in response severe weather events.
- Whilst companies face rising scrutiny on their increasingly transparent environmental impacts, this does not translate to material reputational, legal or financial outcomes. There is strong negative reaction in New Zealand to topics like greenwashing, waste, and implications of modern slavery.
- Climate change becomes increasingly politicised for a period, with growing frustration at the physical impacts of climate change driving noticeable discord amongst increasingly polarised social (and employee) groups.
- Social inequality rises. The awareness of te ao Māori values grows, but it is not the dominant cultural narrative.
- Most employees remain driven by traditional metrics such as salary, benefits, (climate-related) workplace safety and wellbeing for frontline workers. Sustainability professionals move to more progressive locations and companies.<sup>64</sup>

### Technological factors

- New Zealand and retailers move slowly in adopting climate-related technology. A lack of an enabling ecosystem around policy, infrastructure, education and green finance means that renewable energy options develop slowly and are expensive. Transport remains locked into fossil fuels.
- Growth in new technology such as automation, AI, intelligent packaging<sup>65</sup> and IoT continues, but New Zealand remains behind larger markets, and retailers' investments in these technologies, and supply chain partnerships and data, are mainly focussed around mitigating physical climate risks.
- Retailers' adoption of low-carbon products, smart packaging<sup>66</sup> and new materials is more sporadic, and mainly driven by short-term cost improvements focussed on automation.
- Customers' demand for omni-channel, virtual and personalised shopping continues to rise in this scenario.
- New Zealand's nature-based carbon capture solutions are debated and delayed. Its carbon credit market struggles with domestic politics, and lack of international alignment for exporters and importers.



# Short term

## SHORT-TERM (2023-2030)

### Legal factors

- There is a slow growth in the development of XRB climate legislation, and limited examples of public or private legal action against companies for (failing on) their emissions or reporting targets. Retailers experience growing pressure and more frequent litigation around greenwashing claims.<sup>67</sup>
- D&Os experience limited exposure to climate-related litigation. The concept of, and legislation around, fiduciary care remains focussed on protection of short-term shareholder financial value.

### Economic factors

- Consumer spending power is squeezed by high inflation.
- Fossil-fuelled growth is used as a short-term solution to post-COVID-19 and Ukraine War geo-economic instability.<sup>68</sup>
- The finance sector does release climate-related products, but struggles to fully mobilise in a myopic political environment. Insurance retreat and premiums both rise.<sup>69</sup>
- Shareholders value short-term profitability, and often vote against the business model transformation that retailers might need to survive in a decarbonised world.
- Carbon prices remain too low to trigger meaningful change.
- Within a tight global labour market, the retail sector is slow to attract the sustainability specialists needed to assist with the transition to a low carbon economy.
- IMO agreements on shipping emissions reduction fall short of 1.5°C aligned targets of a 45% cut by 2030.







# Medium term

A new generation entering into positions of real influence, and a string of catastrophic climate-linked events mean the speed at which overwhelming political and social sentiment shifts towards a hard, fast and deep decarbonisation of the economy takes most retailers by surprise. Government enacts Covid-esque central 'crisis' command, and passes fast, intense and punitive legislation across the retail value chain, from carbon emissions to waste reduction and requirements for climate-related health & safety adaptation interventions.

Alarmed by the lack of government consultation, retailers find ambitious targets and mandates on emissions, product and ingredient regulations, and targets around waste and circularity being pushed upon them by a panicked government. Finance and insurance retreat faster than expected from certain sectors and locations.

Retailers scramble to mobilise transition plans, with fast decisions on asset divestment, product portfolio changes, and decarbonisation technology meaning the costs are higher, and many retailers make different choices. By the middle of the decade, policy, climate finance and market effects are forming norms around certain options.

Lack of early planning means natural resources, precious metals and foreign energy are increasingly expensive worldwide, but particularly in New Zealand, putting pressure on a decarbonising economy where sudden and uncoordinated economic transformation has significantly eroded most households' spending power.

Global retailers who have previously invested in low-carbon business models and operations benefit from improved sales volumes, lower carbon taxes, and improved marginal costs driven by greater circularity. Many high-performing, sustainable international organisations seize market share from incumbent Kiwi players.

Consumer expectations around sustainability and technology rapidly rise to meet those in the Net Zero 2050 scenario. Government's use of hard-line, blunt policy instruments has meant retailers struggle to balance mitigation with adaption, and provide the same planned Just Transition as in other scenarios. Certain consumer segments strongly resist the 'authoritarian' change, and disengage with 'woke' brands, affecting addressable markets for some brands.

Many employees struggle to reskill or retrain, and feel marginalised from decision making. Redundancies are high, and the lowest socio-economic cohorts suffer the most. The collective psychological pressure and stress of rapid change reduces productivity, wellbeing and social cohesion across the economy, seeing a decline in GDP.

However, by mid-decade, New Zealand is well on its way to an electrified, low-carbon and modern economy. The social impacts of a rapid transition on consumers and employees remain, but there is stronger consensus on the direction of travel.

## MEDIUM-TERM (2031 – 2040)







# Medium term

MEDIUM-TERM (2031 – 2040)

## Political factors

- Growing international alarm at the physical impacts of climate change, and a new generation entering into power, sees Government's pace of change become frantic, with heavy-handed, reactive and uncoordinated policies, plans and programmes.
- Tokenistic public and business consultation leads to poorly planned policy interventions. Retailers find themselves regularly un-consulted as regulation on emissions, packaging and land use are done 'to' them, not 'with' them.
- A lack of planning sees a reduced focus on the Just Transition elements of policy, resulting in higher financial and welfare costs for people, especially those on lower incomes. Retailers struggle to support all employees as roles and skills rapidly shift. This leads to a period of decline in social and institutional trust<sup>70</sup> as costs and tensions rise. There are pockets of highly politicised resistance against Government's actions. Initially, this social discontent makes it more difficult for government to establish the multi-sectoral frameworks and partnerships required for effective climate action. However, by mid-decade, political and social consensus on the need and direction of travel reduces instability.
- Feeling the pressure to align with international trading partners' progress, this singular focus on emissions reduction sees other areas deprioritised, with regular rhetoric of making sacrifices for the 'greater good'.
- The 2030s see a reemphasis on geopolitical collective action demanded by global citizens and governments, with the eventual ushering in of a decade of greater stability, with high-influence groups such as the US, China and the EU working together.

## Environmental factors

- Physical and chronic climate impacts are locked in from previous decades' emissions. Increasingly unpredictable and severe weather are more common by 2035, including flooding, cyclones and droughts. Adaption measures in the 2020s lessens the impact on domestic logistics. Chronic changes in seasonal predictability are similar to the Net Zero 2050 scenario.
- Lack of intervention or geopolitical collaboration in the 2020s around biodiversity and nature sees greater ecosystem impairment, with some biomes and species lost forever, yields reduced, and commodity prices inflated. There is more conflict in certain geographic regions over vital resources such as water, and the rapid transition to net zero sees precious metals and minerals become scarce, expensive commodities.
- However, belated action on biodiversity and nature in the early 2030s begins to pay dividends towards the end of the decade, with early signs of recovery in some regions.
- Rising global temperatures and lack of preventative measures mean that climate-linked diseases expand beyond the tropics. However, there are few examples of New Zealand being materially or directly impacted.

## Social factors

- Social concern over climate impacts, a younger generation entering society, and an increasingly diverse Aotearoa see a rapid social shift towards decarbonisation.
- Consumers eagerly adopt (and expect) low-carbon technologies, products and packaging that fit seamlessly into their increasingly digital lives. Reliability becomes a key product and brand feature within the context of climate-related supply disruption. Sustainability sentiments coupled with transition-related economic strain sees overall consumption of non-essentials reduced, and a pivot towards health-focussed wellbeing.
- By the mid-2030s, a mix of tech-enabled radical product transparency, and people's feelings of collective investment in a common cause mean there is even more judgement of poorly performing companies – greenwashing is not socially acceptable, and retailers' social licence to operate is increasingly tied to playing their part.
- Retailers' visibility and the speed of change means some brands become 'blacklisted' by certain consumer cohorts as 'not playing their part' in this society-wide endeavour.



# Medium term

MEDIUM-TERM (2031 – 2040)

## Social factors continued

- Employees feel rapidly onsetting and strong pressure by society to align their work with climate-positive retailers. The sustainability talent needed to manage such a rapid transition is in short supply, and favours leading companies.
- The speed of transition puts pressure on Kiwi's physical, mental and financial health. Retailers experience rising calls from employees for a Just Transition across physical and financial domains, and customers criticise price increases at a time of collective 'sacrifice'. The speed and cost of government-enforced transition means there are competing voices and variation on what retailers could and should do, driving reputational risks and raising operational costs.
- Consumers' expectations around technology such as alternative products, omni-channel delivery and personalisation now need to be dovetailed with climate outcomes.
- New Zealand consumers open-up to a swathe of new technology based alternative products, and the 2030s see a rapid increase in demand for truly accurate product-level emissions data.
- There is tipping point in renewable energy price and supply - it becomes easier for fleets to charge than refill, and legacy fuels become seemingly operationally unprofitable almost overnight.
- The government invests heavily in New Zealand's nature-based offset market. However, this speed means mistakes are made, and trade-offs with negative nature or social impacts are persistent.

## Technological factors

- Rapid decarbonisation in the early 2030s sees (local) government and individual companies rushing to invest in disparate decarbonisation technology. This leads to more variation on the market, with some retailers losing out on misplaced investment 'bets', and lagging companies becoming locked in to the 'winners' design choices.
- The advances in AI, automation, smart packaging, and IoT that were employed in the 2020s for supply chain risk management are pivoted towards achieving climate outcomes.

## Legal factors

- A rapid shift to decarbonisation in the early 2030s sees the Government and FMA increasing the number of mandatory climate-related disclosures and other legislation, especially for listed companies. There is a sharp rise in the government and public both taking direct action against retail Boards for compliance failures, or for failure to reduce emissions at the required rate.
- By the mid 2030s, climate mitigation and transition action become central to the concept of fiduciary duty of care – not just to shareholders but to the wider public. D&Os face increasing exposure to liabilities for failing to uphold transition plans. This leads to increasing attraction issues for top D&O talent.
- Carbon prices rise rapidly to the highest levels under any scenario, strongly dictating profitability.
- Shareholders respond to wider socio-economic and political trends, as well as the erosion of value in their current business models, and put pressure on management to reduce company emissions and transform.
- Globally, from 2031-2034, transition-associated fiscal spending raises inflation and interest rates, impacting consumers wallets. Labour shortages create high wage demands, especially for skilled sustainability professionals.
- The combination of legacy degradation of global natural resources and rapid transition inflate the price of basic commodities for retailers, and severely spikes the price of transition-related materials like precious metals.

## Economic factors

- A macroeconomic awakening to the long-term costs of climate change, and benefits of mitigation across intergenerational timeframes, sees a rapid pivot of economic policy towards meaningful decarbonisation in the early 2030s. The financial services sector employees finance and access to capital as a driver for change, with poorly performing retailers finding overnight their access to funding and general insurance quickly restricted.
- Australia, and by virtue New Zealand, both find themselves initially stuck between aligning economically with US or China, as both compete to supply transition-related technology.
- However, from 2035, the economic uplift associated with economic decarbonisation such as job creation, efficiency gains and better health outcomes sees the outlook for global and domestic GDP begin to improve.



# Long term

Longer term, the retail industry ends up in a similar position as under the Net Zero 2050 scenario across most drivers. However, the delayed, faster, and less-planned transition had implications for the sector, people and the economy.

The difficulty balancing mitigation with a socially Just Transition sees many retail employees and customers scarred from a period of social and economic turbulence. Higher levels of redundancies in certain lines of work or geographies hang over communities.

The reputational consequences of failing to support communities or consumers through transition has seen some retailers out-competed in the market, or bought-out by international brands.

Aotearoa retailers' slow start to adapting to a low-carbon, climate-resilient and, eventually, net positive business models has seen large, early-moving international players erode material market share from traditional Kiwi businesses.

The slow attraction and adoption of technology (and related finance) in the late 2020s has seen foreign players dominate many of the latest logistics, supply chain and product-level offerings. From distribution drones, to popular Metaverse marketing channels and digital clothing<sup>71</sup>, and supplier relations with the world's leading smart packaging and e-textile<sup>72</sup> manufacturers, the cutting-edge of the market is heavily influenced by Chinese, American and, increasingly, Indian companies.

A rapid transition saw New Zealand companies forced to align with Australia's purchasing power for low-carbon technology (such as electric fleets) and renewables, who themselves pivoted to importing from China. This establishes China further as an influence over New Zealand's import and export market and economy.

Natural resources begin to recover globally, tempering price rises. However, some production locations have been permanently shifted. New Zealand's burgeoning energy security is less mature than in the Net Zero 2050, and the economic benefits of transition are only just beginning to flow into the pockets of consumers.

## LONG-TERM (2041 – 2050)







# Long term

LONG-TERM (2041 – 2050)

## Political factors

- Despite the higher financial and social costs of a delayed transition, New Zealand emerges in 2050 with a more sustainable and resilient economy and society. The general consensus is that 'the ends justified the means'.
- Internationally, New Zealand's response to the climate change is recognised by major trade partners, ensuring access to critical low-carbon trading blocs. However, its early lack of vision means that, by 2050, New Zealand's society and economy are still less prepared for the future than many of its OECD peers.

## Environmental factors

- Transition efforts mean that global average temperatures stabilise around 1.6°C higher than in pre-industrial times. Tipping points in the Earth climate system have been avoided.
- El Niño conditions are now common – redefining average temperatures and New Zealand's rainfall patterns, as well as flood, drought, and fire risks.
- New Zealand's investments in adaptation and nature-based solutions in the 2030s mean that by the mid 2040s, Aotearoa New Zealand's nature is protected, well managed, and begins to flourish. Temperature and precipitation changes shift growing ranges for crops, opening up new opportunities.

- Globally, shifting thermal ranges mean that some biomes and species have been lost forever, and many natural resources have shifted in where they are viably grown or produced. Whilst there is a notable increase in climate-related zoonotic diseases around the tropics, these tend to only have upstream impacts on Kiwi retailers' supply chains.

## Social factors

- By 2050, New Zealand society is in a similar place to the Net Zero 2050 scenario. Consumption is less material, lower impact, and geared towards healthier lifestyles and the sharing economy. Society, consumers, and employees expect retailers to embed circularity, sustainability and digital as standard in their operations, packaging and products. Innovative technologies, AI and connected IoT assets blur the lines between physical and virtual consumption.
- However, there are collective social scars from the rapid transition. Inequality is higher in this future, and consumers and employees remember which brands most actively supported their employees through a difficult period.

- The delayed transition means the global economy who won't fully reap the benefits of transition until later than 2050, although New Zealanders enjoy increasing benefits of lower priced energy, and long-term food security.
- Demographic changes are similar to under the Net Zero 2050 scenario. In the long term, climate-driven migration to New Zealand is marginally higher than under Net Zero 2050.

## Technological factors

- By 2050, New Zealand is in a materially similar position technologically to the Net Zero 2050 scenario, but a few years behind. The country is working towards 100% electrification, and the variation in low-carbon technology choices in the 2030s has been ironed out of the system with clear, economy-wide consensus. Technology supports health-focused lifestyles, and is geared towards zero-carbon, circular and traceable activities, whilst also bolstering climate-resilience.
- As in other scenarios, the irrepressible rise of data availability, AI and IoT sees supply chains increasingly automated and adept at handling the rising physical disruption of climate change. Retail employs a lighter human resource element across its value chain.

- Consumers expect automation, personalization and new tech-enabled sales models like the sharing economy or Metaverse. However, New Zealand remains materially behind some other markets, and international tech-advanced retailers and logistics companies have taken advantage to meet Kiwi consumers' expectations.

## Legal factors

- Materially the same as the Net Zero 2050 scenario. By 2050, climate and sustainability expectations are central tenants of social and legal systems. There are high penalties for climate poor performance or governance, and even worse for greenwashing or misleading consumers. Retailers find there is little room for failure. Greater international alignment on Directors' and Officers' responsibilities, as well as concepts of fiduciary duty, mean New Zealand remains an attractive, competitive location to for top talent.



# Long term

LONG-TERM (2041 – 2050)

## Economic factors

- A delayed and less planned transition combined with the physical impacts of climate change mean decarbonisation is an order of magnitude more expensive and challenging than in the Net Zero 2050 scenario, with New Zealand's GDP notably lower.
- However, by the 2040s, global and domestic GDP growth is recovering as major economies emerge in a climate-resilient, low-carbon state, and more equal form. Aotearoa begins to see the benefits of decarbonisation in areas such as efficiency, health outcomes, and natural resource availability, with the full economic benefits associated with delayed transition pushed out further than 2050
- Finance and insurance is aligned to sustainable outcomes as standard.
- Carbon prices are very high, and the most expensive out of any scenario or time horizon.
- The on-shoring of (renewable) energy production, investment in supply chain resilience, and New Zealand's comparatively climate-sheltered location attract capital and in-migration, pointing towards a more prosperous long-term state for Aotearoa and consumers.





# Physical parameters

**Table 4:** Delayed Transition socio-economic parameters

VARIABLE	LOCATION	2005	2030	2040	2050
<b>Mean Annual Temperature Change</b> <i>(Average annual temperature vs pre-industrial baseline)</i>	New Zealand	0.87°C	1.38°C	1.51°C	1.61°C
	North Island	0.87°C (above pre-industrial levels)	1.40°C	1.53°C	1.63°C
	South Island		1.37°C	1.49°C	1.58°C
<b>Number of Days Exceeding 25.0°C Annually</b> <i>(% increase in days vs 2005 baseline)</i>	North Island	17.5 days/yr	41.0%	52.3%	61.3%
	South Island	9.2 days/yr	31.9%	40.7%	47.7%
<b>Number of Frost Days Annually</b> <i>(% decrease in days per year vs 2005 baseline)</i>	North Island	9.0 days/yr	-40.2%	-48.2%	-53.8%
	South Island	58.1 days/yr	-16.5%	-20.2%	-23.0%
<b>Mean Sea Level Rise</b> <i>(Increase in centimetres vs pre-industrial baseline)</i>	North Island	19.95cm	32.8cm	38.5cm	44.6cm
	South Island	17.4cm	30.1cm	35.9cm	41.9cm
<b>Extreme Precipitation Events Lasting 3hrs</b> <i>The Average Recurrence Interval (ARI) of a 3 hour extreme precipitation event (based on the rainfall volume in a 2005 '1 in 100 year' event).</i>	North Island	1 in 100 years	1 in 70 years	1 in 65 years	1 in 62 years
	South Island	1 in 100 years	1 in 70 years	1 in 65 years	1 in 62 years
<b>Extreme Precipitation Events Lasting 24hrs</b> <i>The Average Recurrence Interval (ARI) of a 24 hour extreme precipitation event (based on the rainfall volume in a 2005 '1 in 100 year' event).</i>	North Island	1 in 100 years	1 in 72 years	1 in 67 years	1 in 64 years
	South Island	1 in 100 years	1 in 70 years	1 in 66 years	1 in 62 years
<b>Extreme Wind Speed Events</b> <i>The Average Recurrence Interval (ARI) of an extreme wind speed event (based on the max wind speed in a 2005 '1 in 100 year' event).</i>	North Island	1 in 100 years	1 in 63 years	1 in 68 years	1 in 64 years
	South Island	1 in 100 years	1 in 51 years	1 in 57 years	1 in 54 years
<b>Drought (Annual Potential Evapotranspiration Deficit)</b> <i>(% increase in annual average deficit in millimetres vs 2005 baseline)</i>	North Island	144.94 mm	4.98%	6.20%	7.20%
	South Island	108.4 mm	2.80%	3.53%	4.06%

See Appendix E for further information to support reading of select parameters.

Source: CLIMsystems, 2023



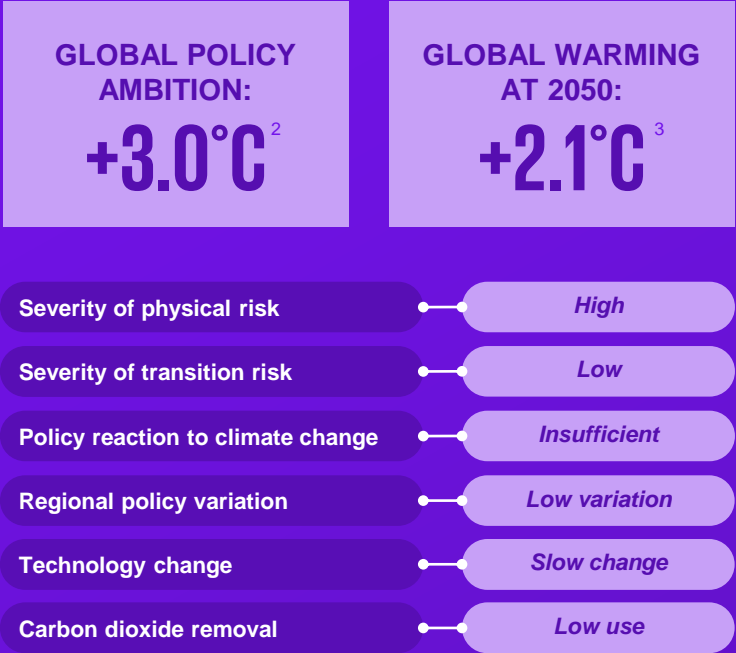


# Socio-economic parameters

**Table 5:** Delayed Transition socio-economic parameters

VARIABLE			BASELINE	2030	2040	2050
	<b>New Zealand Economic Damage due to Extreme Weather</b> <sup>49</sup>	Annual expected damage from river floods (% at median line compared to the reference year 2015)	2.2% (2015)	31.1	30.9	30.9
		Annual expected damage from tropical cyclones (% at median line compared to the reference year 2015)	-2.3% (2015)	-15.7	-22.6	-22.6
		1-in-100-year expected damage from tropical cyclones (% at median line compared to the reference year 2015)	-1.8% (2015)	-20.2	-25.8	-25.8
	<b>Global GDP Per Capita</b> <sup>50</sup> <i>(measured in 2005 international US dollars, adjusted for inflation and cross-country price differences)</i>		8,791 (2005)	19,332	26,606	34,148
	<b>New Zealand GDP</b> <sup>51</sup> <i>(% difference, 2009 prices; local currency vs baseline)</i>		-	-0.73	-2.57	-1.45
	<b>New Zealand Inflation Rate</b> <sup>52</sup> <i>(abs. difference % vs baseline )</i>		-	-0.13	0.17	-0.11
	<b>New Zealand Long Term Interest Rate</b> <sup>53</sup> <i>(abs. difference % vs baseline)</i>		-	0.07	0.78	0.54
	<b>New Zealand Energy Price</b>	Electricity <sup>54</sup> (\$/MWh)	68.1 (2020)	74.7	88.2	88.3
		Oil <sup>55</sup> (% difference, US\$ per barrel vs baseline)	-	14.46	441.11	839.28
	<b>New Zealand Carbon Price</b> <sup>56</sup> (NZD\$ 2022, per tonne of CO2-equivalent)		-	104	291	369
	<b>Global Population</b> <sup>57</sup> <i>(million)</i>		6869.324 (2010)	7999.914	8322.06	8459.401
	<b>New Zealand Population</b> <sup>58</sup> <i>(million)</i>		4.368 (2010)	5.308	5.700	6.044

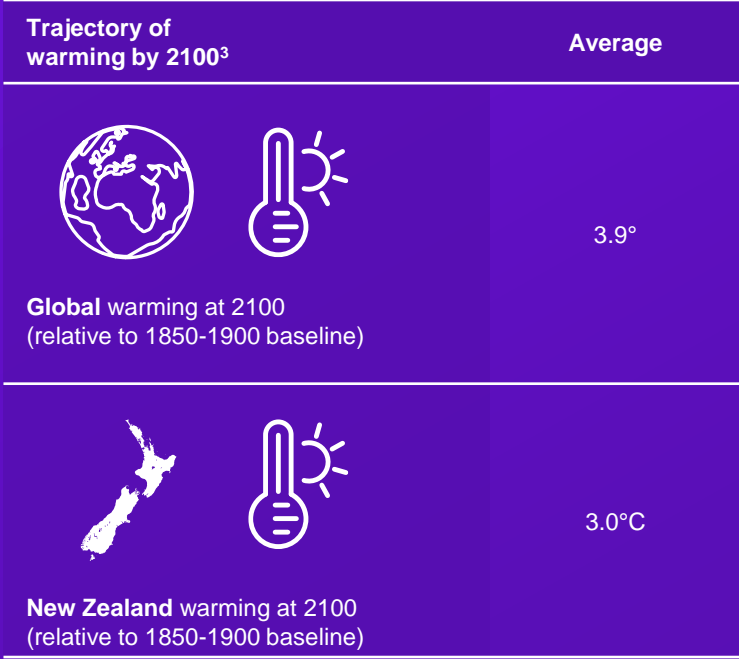
Hot house scenario– Current Policies



This is a divided world that refuses to cooperate and confront the non-negotiable realities of planetary boundaries. Instead, countries focus on their short-term domestic best interests, resulting in persistent and worsening inequality and environmental degradation. International and domestic policy settings result in well over 3.0°C warming by end of century.

The physical impacts of climate change are substantial by mid-century. However, from 2050 onwards, their scope, scale, and ferocity accelerate. We have almost certainly surpassed a tipping point in the earth’s climate system, beyond which greenhouse gas emissions lead to a shutdown of large ocean circulation systems and massive permafrost melting.

Under this scenario, the world is most likely to have warmed by roughly 3.6°C (potential range of 2.8°C to 4.6°C) at end of century, with global average sea levels having risen by 46 to 74 centimetres - assuming ice sheets in Greenland and Antarctica remain stable.



## Our World

The prolonged war in Ukraine brought the post-Cold War era to a close, giving rise to a world characterised by resurgent nationalism and driven by short-term economic competitiveness and security goals. Conflicts have spread and geopolitical tensions grown, preventing effective global action on climate change. Most governments are preoccupied with achieving energy and food security goals at the expense of broader-based development. Countries' capacity to adapt to the physical impacts of climate change is relatively low as a result of worsening inequality, widespread environmental degradation, lack of cooperation, and slow technology development.

- **Consumption:** Continues along current trends, remaining material-intensive. A growing percentage of the population aims to align consumption with planetary boundaries, but most people's choices are driven by consideration of cost and/or the social status they associate with particular goods, services, and/or brands.
- **Society:** Inequalities persist or worsen over time.
- **Education and health:** Population growth is low in industrialised and high in developing countries. Public investment in education and health declines.
- **Economy/trade:** Economic growth is based on material-intensive production and consumption patterns. The physical impacts of climate change are affecting the economy through multiple pathways, including lost labour productivity, lost productive land, damaged capital, increased incidence of disease and mortality, lost tourism, and reduced agricultural yields. By 2050, the physical impacts of climate change have cost the world 11-14% of global GDP, with the degradation of nature generating additional economic headwinds.
- **Land use and nature:** Addressing environmental concerns is a low priority, leading to strong environmental degradation in some regions.
- **Technology:** The absence of strict climate policies means that energy supply is dominated by the economics of energy resource availability and energy conversion technologies. The development and uptake of technologies is relatively slow.



## Our Home

New Zealand lags behind its OECD peers in mitigating climate change and – like many others – sees no need to play a meaningful role in global efforts. Instead, New Zealand links to weak global emissions markets and uses selective accounting for emissions from land-use and land-use change. Agriculture does not pay a price for emissions and is focused on maximising production. In recognition of significant climatic changes, New Zealand focuses on strategic adaptation to ensure continued economic viability and retain competitive advantages.

- **Policy:** Government's approach to curbing emissions continues to rely on a demonstrably ineffective Emissions Trading Scheme. Adaptation is primarily motivated by economic considerations and driven by powerful special interests. These dynamics are epitomised by successive iterations of Natural and Built Environments, Strategic Planning, and Climate Change Adaptation Acts which focused on preserving the value of businesses and well-off communities. Few policies have sought to protect vulnerable populations, contributing to the loss of social cohesion.
- **Trade:** Strong regional migration based on maximizing labour supply, which results in strong regional competition to attract business. There is limited demand for clean, green products.
- **Behaviour:** People and businesses continue to embrace high emitting activities and practices while tending to resist the adoption of low-emissions technologies except where there is a compelling economic or commercial rationale.
- **Natural resources:** New Zealand exploits its natural resources to maximise economic returns in the short to medium-term and retain competitive advantages. Freshwater resources are provided with limited protection. High discount rates are a major driver for government expenditure, and environmental conservation is a low government priority.





# Sector narrative

Consumer sentiment, technology development, and policy settings continue on current trajectories. Remaining domestic and regional retailers are making incremental improvements to the sustainability of their goods and services. However, these improvements are driven by – and limited to – short-term commercial considerations. Retail businesses continue prioritising profits while successfully externalising environmental and social costs.

## The Retail Sector in 2050

**Key characteristics:** New Zealand's retail sector has made incremental improvements to its environmental and social sustainability. The choices that retailers make are mostly driven by short-term economic calculations. Despite financial constraints driving significant growth in New Zealand's shared economy, individual ownership is still the predominant model – exacting a heavy toll on the environment and household finances. Most hard goods are designed to fail and be replaced. Many soft goods are designed to appeal only in the short-term and be replaced on an annual or seasonal basis. Hard and soft goods are manufactured to facilitate end-of-life recycling where mandated by governments concerned about secure access to manufacturing inputs. Consumers can access detailed information about products' environmental and social footprint – but most don't. Instead, price, social status, and point of origin are primary considerations. There is limited demand and few premiums for clean, green products. Persistent mental models, buttressed by clever corporate marketing campaigns, and the increasing cost of living have prevented transformational change.

**Key trends:** Retailers' operating environment is increasingly shaped by the rising cost of inputs (driven by a combination of natural resource scarcity, inflation, and trade barriers) and distribution logistics, increasingly frequent, severe, and protracted supply chain disruptions, and the growing gap between 'haves' and 'have-nots.'

The proportion of the population that chooses to align consumption with planetary boundaries is growing steadily – but incrementally. All retail value chains are becoming less material and energy intensive as a result of economic imperatives and enabled by pervasive data and efficiency-oriented technologies.

**Structural forces:** Data is omni-present throughout retail value chains, from sourcing, to point of sale, to end-of-life. This enables customers to easily identify goods and services meeting their priority concerns – whether cost, endorsement by specific social influencers, origin, or degree of sustainability. New Zealand's environmental legislature and recycling infrastructure continue to lag behind OECD peers. Materials and energy are increasingly expensive worldwide, but particularly in New Zealand - driving up the cost of goods and services at the same time that economic headwinds mount and erode most households' spending power. The country's degraded soils, limited investment in irrigation, and increasingly extreme and chaotic weather are placing significant strain on domestic food production and affordability. As the volume of New Zealand's agricultural exports has declined and global supply chains become brittle, the complexity and cost of importing retail goods has risen – posing particularly significant challenges to the importers of fast moving consumer goods. New Zealand's short political cycle prevents an effective government response to the global polycrisis.<sup>73</sup>

**Mental models:** The majority of New Zealand's population still participate in perpetuating a 'consumer culture' in which people feel the need to buy more and more things in order to craft identity and advance their social position. Corporate pledges to value the wellbeing of individuals, communities, and nature over profit and unsustainable consumption are more often performance than practice. Amidst all the evidence of accelerating environmental and societal decay, the majority of Kiwis close their eyes and tell themselves, 'She'll be right'. Corporate success remains defined in singularly financial terms.

## Interaction between drivers

### ***Politicisation of Climate Change → Consumer & Employee Preferences → Domestic Action***

The politicisation of climate change leaves Kiwi voters, consumers, and employees divided. Their 'mixed messages' result in the paralysis of politicians and retail brands afraid to be seen as moving 'left' or 'right.' As a result, climate action fails to build meaningful momentum.

### ***Nature → Economic Competition → Political Stability → Trade barriers + Macroeconomic Conditions***

The continuing degradation of nature and exhaustion of once plentiful natural resources is enflaming competition/protectionism and exacerbating geopolitical tensions. Trade barriers are going up around political blocks, hampering trade and increasing the cost of goods. 'Circularity' is valued as a means of maintaining access to primary materials.

### ***Physical Impacts of Climate Change → Macroeconomic Conditions → Household Finances → Consumer Preferences***

The physical impacts of climate change have given rise to significant and growing macroeconomic headwinds which are experienced unevenly across New Zealand's diverse communities. More and more households are under chronic financial pressure, resulting in lower levels of consumption focused on purchasing lower-cost necessities.



# Outcomes and indicators

## Key outcomes at 2050

- Critical tipping points in the Earth system have been passed, ensuring that the compounding and cascading impacts of climate change will dramatically accelerate. These impacts will be irreversible on centennial to millennial time scales.
- Countries spent decades building critical energy and transport infrastructure that is not designed to withstand the increasingly extreme realities of climate change. The infrastructure systems underpinning New Zealand's retail sector value chain are now buckling under extreme heat, wildfires, and floods; and the investments that were made – both within New Zealand and abroad – are not up to the challenge.
- The physical impacts of climate change have already destroyed significant economic value and are injecting growing uncertainty into the global economy through a wide range of direct and indirect transmission channels. These economic headwinds are exacerbated by the continuing degradation of nature and international competition for resources.
- Economic headwinds and growing social inequality are driving polarisation of the retail market, with most brands drifting towards high-cost luxury goods and services or low-cost essentials.
- Increasingly unpredictable weather patterns are impacting the demand profile of many retail goods and services – challenging lead times, increasing holding costs, and increasing the risk of obsolete inventory.
- All retailers are contending with increasingly disrupted and costly supply chains, but New Zealand is disproportionately affected due to its geographic location and small market size.
- Relative to their European peers, Kiwi politicians and retail brands were slow to address the intertwining challenges posed by climate change and the destruction of nature. As a result, many national and regional retailers have been bought out or displaced by international (especially European) retail groups that were early movers in reducing energy/material intensity and building supply chain resilience.
- Still-independent national and regional retailers have incorporated low-input sourcing, design and manufacturing, distribution, point of sale, and waste solutions – but not as well as global brands.

## Key indicators

1. International and domestic policy settings fail to halve greenhouse gas emissions by 2030 or reach net zero emissions by 2050.
2. New Zealand consistently fails to meet its emissions budgets, instead relying on international offsets.
3. The Government of New Zealand increasingly focuses on adaptation to the physical impacts of climate change rather than action to reduce emissions, as evidenced by successive Budgets.
4. While an increasing number of consumers are concerned about sustainability, purchase patterns and consumer surveys indicate that most remain wed to material and energy-intensive lifestyles.
5. By 2050, New Zealand retailers have been able to recruit, train, and retain the necessary talent to manage upstream and downstream risks, build customer trust, earn market loyalty, and ensure enduring relevance.



# Short term

## SHORT-TERM (2023 – 2030)

Even well-intentioned retailers struggle to find the financial or political room to transform, instead restricted to incremental decarbonisation. Consumer preference remains largely uninfluenced by sustainability, and government policy and private finance is directed at adapting Aotearoa to a climate-insecure future.

Continued short-term and simplistic policymaking and low levels of government trust<sup>74</sup> see political and social climate discourse increasingly polarised. Retailers struggle with divided voices within customer, employee and local authority groups. Brands who try and move faster become tarnished as 'woke', and the worst emitters are targets for activism by younger consumers who feel their voices are not being heard.

A fossil-fuelled, business-as-usual, one-dimensional drive to recover GDP worsens inequalities, exacerbating existing social inequalities, the outcomes of which increasingly impact retailers' customer-facing operations, with increases in shoplifting and violence in-stores. A backlash against ESG finance sees many shareholders seeking to re-focus on short-term profitability.

Retailers' compliance with reporting standards is mainly compliance focussed, with D&Os unconcerned by climate-related legal risks, as most companies are 'in the same boat', so precedent remains low. Pollution and modern slavery allegations remain high reputational risks.

Technological progress supports the development of lower-cost innovative products and packaging. Supply chain advances in data, IoT and automation are mainly geared towards ensuring climate-resilient supply. Domestic operations remain locked into fossil-fuelled transport.







# Short term

SHORT-TERM (2023 – 2030)

## Political factors

- Materially similar to the same period in the Delayed Transition scenario. However, even under current pledges, the world is set to reach 2.6 degrees of warming.<sup>75</sup> Geopolitical stability steadily worsens during the 2020s, with post-Ukraine geoeconomic conflict between China and the US. There is a lack of collaboration and support, with more affluent nations retreating into protectionism.<sup>76</sup>
- Countries begin to visibly fail against their 2030 Nationally Determined Contributions (NDC) targets, with attentions turning to short-term economic stabilisation, and nationalistic agendas. Fossil-fuelled growth and natural resource exploitation are easy short-term options. Longer term renewables projects are implemented. However, despite rhetoric, these are aimed at domestic energy security rather than climate.
- Localised climate-impact related conflicts begin to plague retailers' foreign manufacturing and supply chains.
- Rising inequality drives social and institutional distrust<sup>77</sup>, fuelling a more polarised<sup>78</sup> and politicised approach to climate change and politics. Legacy issues with democratic institutions and Kiwis' perceptions that the political system is non-responsive to their needs<sup>79</sup> drives greater bipartisan populism, short-term thinking, and simplistic, low-consultation policy making.
- Climate change becomes ideologically weaponised in Aotearoa, and an increasingly polarising topic that aligns with partisan politics. This inhibits long-term political planning, and puts in place many geographically localised legislative, social and political barriers to emissions reduction. Retailers increasingly struggle with not just divided consumers, but also employees.

## Environmental factors

- In the short-medium term, the acute and chronic weather impacts of climate change are materially similar to the Net Zero 2050 and Delayed Transition Scenarios. New Zealand and many Southern Hemisphere countries experience more severe, and less predictable, weather systems.<sup>80</sup>

## Social factors

- Consumer and employee habits, and social expectations of retailers are materially similar to the same period in the Delayed Transition scenario.
- There is rising social awareness of corporate climate impacts.<sup>81</sup> However, whilst climate protests against high-emitting brands increase, they tend to be from dwindling activist groups, are only locally disruptive, and are overwhelmed by the priority messaging of economic growth. Rising corporate transparency does make retailers vulnerable to topics such as excess waste, pollution, or modern slavery allegations, which remain key issues for Kiwis.
- Growing economic and social inequalities, declining perceived wellbeing<sup>82</sup> and sinking economic optimism<sup>83</sup>, and a faltering adoption of widespread te ao Māori sees worsening social cohesion.
- The economic costs of growing geopolitical tensions trickle down to society later in the decade. In response, consumers and employees becoming increasingly nationalistic and pro-New Zealand.

## Technological factors

- Materially similar to same period under Delayed Transition. However, declining levels of geopolitical collaboration in the 2020's see further barriers to importing (climate-related) technology into New Zealand.
- New Zealand's carbon-offsetting programmes are beleaguered by even further politicised disagreements and competing industry influences.



# Short term

SHORT-TERM (2023 – 2030)

## Legal factors

- Materially similar to the same time period as under the Delayed Transition scenario. D&Os remain sheltered from shareholder activism, and public legal action against retailers remains sporadic.<sup>84</sup>
- The government remains uninclined to penalise companies based on climate performance for fear of hampering the New Zealand economy's competitive edge in relation to more liberal global markets.
- There are public examples of greenwashing 'scandals' exposed by continuing activist groups in society.<sup>85</sup> However, these are met with relative neutrality as people understand businesses' attentions are focussed on Aotearoa New Zealand's economic recovery in the 2020's.

## Economic factors

- Economic impacts and context are materially similar to the same time period under a Delayed Transition scenario.
- Geoeconomic conflict between the US and China rises in the Pacific, with China asserting itself as the dominant ASPAC regional power.
- India's booming economy<sup>86</sup> becomes a material influence as a producer and consumer-nation, influencing product and commodity flows, and altering supply chain price dynamics.
- Lack of global collaboration or agreement in the IMO sees shipping decarbonise slowly, with a focus on operational cost minimalization in the short term.







# Medium term

MEDIUM-TERM (2031 – 2040)

Despite the arrival of a new generation – old habits die hard. Partisan politics continue to inhibit meaningful climate-policy development or decarbonisation. Retail consumption remains mostly high volume, materially intensive, and geared towards individual ownership, consumption and status. Digital consumption and channels continue to rise in popularity.

Whilst greenwashing is not accepted; price, reliability, and point of origin are primary considerations. Carbon reduction in products, packaging and processes is typically a co-benefit of new, efficient technology and increasingly digital transactions. A faltering carbon market means lowering product emissions intensity doesn't materially impact retailers' margins.

Resurgent nationalism sees increasing producer country trade barriers. 'NZ-made' rises in popularity, and some consumer goods multinationals, hampered by legislation, pull back from the New Zealand market, reducing retailers' product selection.

Worsening chronic and acute climate impacts see retailers invest in adaptation across their manufacturing, logistics, and marketing strategies.

Most now employ advanced supply chain technologies to counter the rising prices, failed crop yields, and instability of supply of ingredients and materials that have been driven by accelerating natural resource decline, earlier-than-expected levels of climate-driven geopolitical conflict, and zoonotic disease in many foreign sub-tropical manufacturing countries.

The requirement to maintain high volume, low-margin sales sees retailers invest in weather-forecasting technology, and weather-driven marketing to counter decreasing predictability in seasonal-demand. These new market-dynamics see richer and more technologically advanced global retailers rapidly erode Kiwi brands' market share.

In a tight labour market, employees increasingly demand support and protection against climate-related impacts. Declining profitability sees management struggling to find the resources.

Despite increasing climate impacts, Aotearoa New Zealand's GDP grows as it drives agriculture, timber, and tourism revenue. However, there is an increasing market split between the 'haves' and 'have-nots', and rising levels of polarisation and activism from an angry younger generation who are fearful of the future. Declining psychological wellbeing and social divides hamper productivity across the domestic value chain.

Front line staff find themselves dealing with multiple stressors. Increased cost pressures see management raise expectations and lower wages; expectations to be first-responders to extreme weather events whose impacts have been exacerbated by slower climate action; and a fracturing social cohesion across New Zealand sees retail staff increasingly targeted by psychologically stressed and socially disconnected customers who are frustrated by delayed, reduced availability, and expensive stock.

Towards the middle of the century, a combination of mounting climate impacts and decreasing geopolitical collaboration see the government begin to make material progress towards securing Aotearoa New Zealand's domestic energy and resource security, with strategic renewable energy and circular resource systems Government legislative priorities, with direct implications for retailers.

By 2040, product 'on-shelf' availability and price are increasingly dictated by access to pressurised natural resources. Crop failure and drought are major stressors also to producer country communities. This visible human impact means some environmental issues are now ethical ones in consumers' eyes – for example rapidly accelerating climate-driven water shortages<sup>87</sup> make water-intensive products far less viable.







# Medium term

MEDIUM-TERM (2031 – 2040)

## Political factors

- The political tipping point for concerted emissions reduction has been missed. Countries increasingly struggle with the social and financial costs of physical climate change impacts. Geopolitics becomes shaped by negotiations and power struggles over natural resources, with fresh water a growing cause for concern. Affluent nations lock-in energy security through mass, now more expensive, roll outs of renewables.
- Less global collaboration, and rising geoeconomic warfare between major plays such as India, China and the US means New Zealand finds itself struggling to negotiate with emerging trading blocs to achieve preferential trade access, increasing friction and costs for retailers importing capital, goods and materials, and labour.
- Growing concern for the future, and lack of perceived agency see voters turning to more populist, partisan politics, slowing the decarbonisation agenda.
- Domestic political focus turn further away from mitigation and doubles down on bolstering Aotearoa New Zealand's adaptation to climate change. The government introduces expensive adaptation requirements for retailers and increases taxes to fund infrastructure projects.

- Government looks to exploit remaining and new natural resources, including the Exclusive Economic Zone (EEZ) around Aotearoa New Zealand's coastline for precious metals and minerals. This increasing exploitation of nature drives further social discord amongst a growing Māori population and beyond.
- Decarbonisation of the transport sector begins to accelerate with a view to long-term energy security. However, progress is slow, and rising international oil prices pose an operational risk for retailers' fleets.
- Inequalities across and within countries including New Zealand begin to accelerate.
- New Zealand continues the trend of the 2020s in declining reported life satisfaction<sup>88</sup> from a population increasingly divided along economic, cultural, and wellbeing lines.

## Environmental factors

- Temperature rises and associated acute and chronic impacts of climate are materially similar to other scenarios.
- However, lack of a globally coordinated intervention in nature-related issues in the 2020s means the degradation of nature, ecosystems and natural assets accelerates, materially increasing commodity prices.

- Similarly, less co-ordinated adaptation planning means the physical impacts of climate are worse both in New Zealand, and more so in many countries that retailers import from, driving increasing supply chain disruption.
- Failure to provide adaptation climate-finance to developing producer nations sees communities and regions comparatively more impacted by drought, flooding and heat stress - impacting manufacturing and logistics costs.<sup>89</sup>
- New Zealand begins to see a precipitous decline in agricultural efficiency as legacy methods see soil quality<sup>90</sup> and crop health decline at the same time as droughts and heavy rainfall become more frequent.
- Economic pressure sees New Zealand reduce its NBS offsetting in favour of timber production.
- By 2040, the expansion of tropical ranges induces a swathe of novel infectious diseases.<sup>91</sup> Lack of global co-ordination means there are examples of climate-induced global pandemics that cause global social disruption, similar to Covid 19. New Zealand's agricultural sector struggles with new disease types and pests.
- Aotearoa New Zealand's historic terrestrial and aquatic ecosystems are under significant stress. New species of flora and fauna, including insects and pests, wreak havoc with ecosystems.<sup>92</sup>

## Social factors

- New Zealanders' focus is mainly on adaptation, protecting national interests, and keeping up with a still-growing fossil-fuelled global economy.
- An information-rich society punishes retailers who greenwash, pollute or employ social malpractice in their supply chains. However, retailers find revenues and product mixes are not materially correlated to emissions intensity.
- Consumption remains highly linked to identity, material and typically carbon intensive, with a shift towards adaptation-focussed products. Rising commodity prices and supply chain disruption mean that traditional decision drivers like price and quality remain key, with growing emphasis also placed on supply reliability, product transparency, waste reduction, and locally sourced goods.
- Consumers readily adopt new technologies such as synthetic products, smart packaging and digital delivery channels, with carbon-reduction a secondary co-benefit.
- Employee attraction and retention remains predominately linked to salary and career progression. As climate-impacts worsen, workplace safety and adaptation is a key driver for talent. Adaptation-focussed sustainability professionals are in high demand.



# Medium term

MEDIUM-TERM (2031 – 2040)

## Social factors continued

- Social cohesion continues to decline as inequalities are entrenched, polarisation around climate inaction rises, and growing multiculturalism strains social relations in urban centres.<sup>93</sup> Te ao Māori thinking struggles to take a hold as technology interconnects New Zealand to a globalised online culture. A new generation drive renewed calls for mitigation, however it is too late. Young people and minority groups are increasingly concerned, angry and disillusioned about the climate-related impacts on nature, people and future prosperity.<sup>94</sup> Retailers struggle to engage these groups, and face rising antagonism in stores and online.
- Internationally, climate impacts and lack of adaptation mean climate change is impacting worker physical and mental health and productivity across retailers' supply chains.<sup>95, 96</sup>
- Growing online presence means retailers feel little obligation to play 'community building' in increasingly populated urban centres.

## Technological factors

- Aotearoa does belatedly invest in system-wide renewable energy, driven by desire for energy security in a geopolitically destabilised world that is struggling with climate impacts.
- Developed nations move fast towards a digital future. Consumers and supply chains employ automation, IoT, smart packaging and AI as standard.<sup>97</sup> There is an unprecedented volume of decision-useful data. Decarbonisation is an unintended outcome of new, better technology. However, retailers' primary motivations are to manage the increasingly high physical climate risks they face abroad, in transit, and in Aotearoa.
- Supply chain data continues to improve, but is mainly aimed at mitigating physical climate risk, and not on product emissions intensity.<sup>98</sup>
- New Zealand's carbon offset industry remains active, however struggles to align with other international markets, with carbon prices slow to rise across the decade.

## Legal factors

- Retailers do experience increasing legal and reputational risks around waste management and pollution as Aotearoa citizens look to protect their local environment despite declining global standards.<sup>99</sup> Increasingly, new legislation around employee adaptation measures (typically linked to health and safety standards) poses risks to retailers.
- A frustrated younger generation look to take corporates to court for missing emissions targets. Some cases are successful, but many lack precedent, and the ubiquity of target-failure across the economy means there is little appetite for collective self-sabotage.<sup>100</sup>

## Economic factors

- Decarbonisation is limited. To meet rising population, debt, pension, and production requirements, emissions-intensive GDP growth becomes the norm globally. However, geoeconomic issues that plague the delayed transition scenario continue to worsen into the 2030's.
- Retailers experience rising fuel costs in the late 2030's as oil supply chains are regularly impaired by a concoction of social, political, and climate instability.

- Trapped in a vicious cycle; temperature-linked acute and chronic climate impacts drive resource scarcity and disrupt economies, leading to greater conflict, less collaboration, and less adaptation. Natural resource scarcity is a driver of localised regional conflict across producer countries, with trading blocs forming and affecting market access. Countries begin to retreat into resource autarkies, with trade barriers and increasing protectionism increasing import and export costs.
- Reduction in labour flow impairs retailers talent attraction, with adaptation-focused sustainability professionals hard to come by.<sup>101</sup>
- Medium-term growth in Aotearoa New Zealand's agriculture, timber and tourism sectors raises incomes and consumer spending power.
- Shareholder primacy, financial profits and political desire for short-term economic growth remain barriers to transformative climate action at the ecosystem or entity level in New Zealand.
- Shipping costs and predictability begin to become impacted by port and ocean-based climate disruption.



# Long term

LONG-TERM (2041 – 2050)

The physical impacts of climate change are fuelling geopolitical tensions and conflict. The depletion of natural resources – especially fresh water – is driving multiple humanitarian crises and mass migration away from the equator and drier parts of the world.

The physical impacts of climate change are less severe in New Zealand than in most other parts of the world. Even so, extreme weather events and shifting weather patterns have eroded significant value in local retail value chains.

A series of climate-related pandemics have rippled outwards from the equator, causing periods of severe operational difficulty for retailers. Lack of international collaboration alongside failing crop yields, increasing requirement for manufacturer private security, and producer countries diverting resources for national interests sees Aotearoa experiencing high and unpredictable commodity prices.

Lack of adaptation investment in producer countries sees ports increasingly impacted. Sea level rise, subsidence, and urbanisation see over 140 million people in port-cities at risk of coastal flooding, with Asia the worst hit region.<sup>102</sup> Greater wind speeds, wave swell, and storm intensity are hampering ocean freight in the Pacific<sup>103</sup>, disproportionately affecting New Zealand's remote, primarily ocean-based supply chains.

The steady decline in non-regenerative agricultural outputs, and continued loss of 192 million tons of fertile soil a year,<sup>104</sup> have seen a chronic decline in Aotearoa New Zealand's agricultural exports, which have had knock-on effects for 'return-trip' shipping schedule reliability and capacity for import-based retailers. Fractured supply chains, increasing protectionism and politically aligned trading blocs see New Zealand's fossil-fuel powered transport system become increasingly expensive.

These factors combine to see a chronic slowdown in GDP growth, on top of widespread social discontent which reaches tipping points. Retail staff find themselves facing increasing public disorder and unrest, with shoplifting, semi-regular panic buying and abuse now regular parts of working life amidst regular supply shortages and rising prices. Mental health, wellbeing and productivity are all impacted. Māori groups are increasingly disenfranchised, and many Iwi are angry at the degradation of natural treasures in Aotearoa, with the damaging exploitation of New Zealand's Exclusive Economic Zone ocean-economy the final straw.

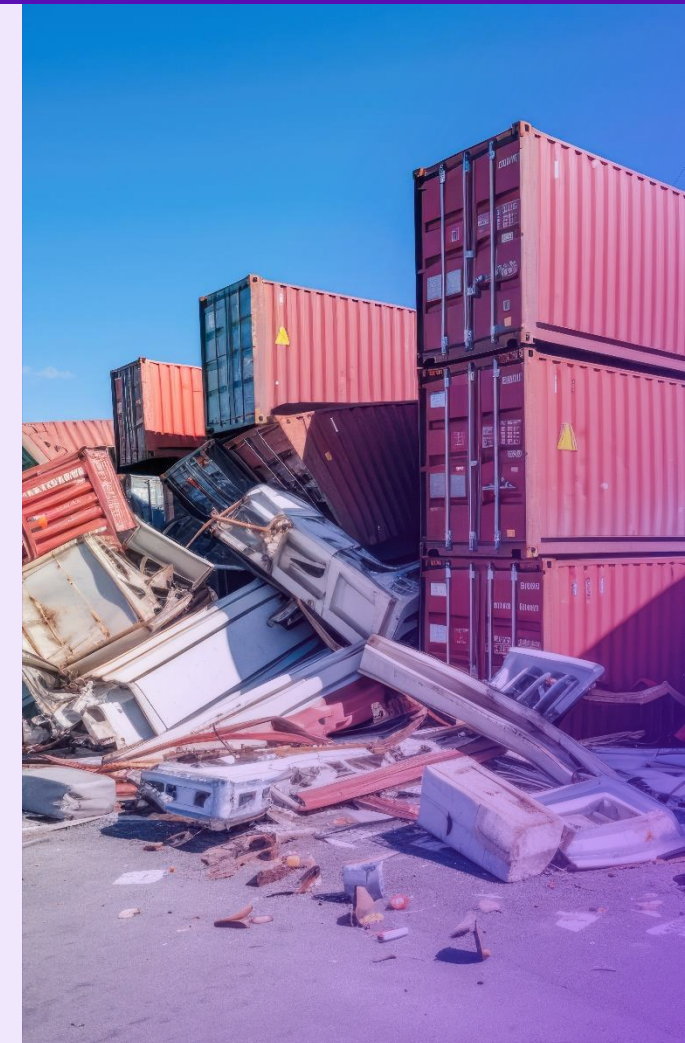
Companies face rising legal action from aggressive activists, with the looming 2050 emissions failures a legal timebomb.

The government rushes through circularity-based legislation in an attempt to protect strategic national resources, and a belated drive for genuine transport-based decarbonisation is now a geoeconomic necessity.

Within this backdrop, retailers find an increasingly bifurcated and divided market that few can bridge. Retail's societal role straddles a widening divide between catering to individualism and identity expression, and providing core, reliable and affordable necessities. Luxury, expensive and digitally augmented products occupy one end of the product spectrum, with increasingly expensive and supply-insecure commodities at the other.

Supply chains are often localised, and some food retailers are forced to rationalise their product ranges, and shift towards local and seasonal goods.

A shrinking market sees consolidation, with larger, resilient companies monopolising sectors.







# Long term

LONG-TERM (2041 – 2050)

## Political factors

- Affluent nations have established resource autarkies where possible. Dwindling natural resources and rising global populations see ever increasing geoeconomic, political and actual conflict, raising material and goods prices. Defined trading blocs aligned to geopolitical structures define market access for New Zealand's retailers, who are increasingly tied to Australia's decisions.
- Driven by continued short political cycles and an increasingly insular outlook, domestic political narratives are dominated by nationalism and protectionism. Kiwis look to 'protect what they have'.
- Global consumer goods companies face market-access barriers across geopolitical lines, and have to carve up their divisions, potentially excluding Australia (and by virtue often also New Zealand).
- Government feels pressure for being reliant on other nations for key resources like metals and fossil fuels for transport. There is an increased government-led drive for circularity and keeping resource 'on the motu', which heavily involves retailers. There is a overdue movement to engage in regenerative production practices locally to preserve biodiversity and ecosystem (e.g. soil) health.

- Large social inequalities across class, ethnic and geographic groups, reduced social and institutional trust, and a growing fear of climate-futures has unravelled social cohesion. There is widespread disconnect between groups, and regular political, verbal, and sometimes physical conflict across and communities, sometimes within retail stores. Retailers and brands struggle to cater and remain relevant or acceptable to multiple groups.

## Environmental factors

- By 2050, global average temperatures stabilise around 2.0°C higher than in pre-industrial times. This has seen Earth System tipping points reached. Glacial and permafrost melting has locked in future sea level rises and temperatures, with a high probability of large ocean system circulations slowing down.<sup>105</sup>
- 2°C of warming substantially increases the risk of sea-level related flooding in South East Asia producer countries.<sup>106</sup> El Niño conditions are now common – redefining average temperatures and New Zealand's rainfall patterns, as well as flood, drought, and fire risks. Extreme weather is now more frequent.

- Temperature rises and lack of intervention see widespread severe degradation of ecosystems and biodiversity. Natural resources and the crucial economic services they provide, from fresh water, to pollinators, and forests, are placed under extreme pressure.<sup>107</sup> Reduced supply drives up prices, and triggers regional conflict for precious resources.
- Industrialised, high-technology countries turn to alternative means of hyper-efficient, localised production. This leaves developing nations, who received limited climate finance, struggling to meet the food or energy needs.
- Natural resource degradation has first and second-order implications for commodity prices. For example, fresh water is a vital yet threatened resource. Drought impacts not just crop yields, but impairs local community health and exacerbates regional conflict. Water wars are commonplace and impact along the supply chain.
- Long-term soil<sup>108</sup> and ecosystem degradation sees New Zealand's increasingly unproductive agricultural sector lose efficiency, raise prices, and struggle to stay globally relevant in a modernised, 'laboratory-based' industry (e.g. vertical farming).

## Social factors

- Kiwis collectively expect private business and retailers to play an active role in protecting their lifestyles and contribute to ensuring Aotearoa New Zealand's economy is a strong, growing, and relatively climate-sheltered destination for individuals, business and capital.
- Reduction in pollution, and retaining precious resources on Aotearoa, are the main sustainability expectations of retailers. People remain 'carbon-conscious', and even a slower global transition away from fossil fuels makes heavily emitting activities or products increasingly expensive and unpopular.
- Wealth is not shared equally and prolonged, deep, social inequality - exacerbated by climate impacts - has deteriorated historic social cohesion past tipping points. Aotearoa struggles to marry its bicultural underpinnings with an increasingly multicultural reality.<sup>109</sup> Civic relations and discourse begin to break down across political, geographic, class, and cultural groups. A noticeable rise in welfare issues, crime and health problems all directly impact retail stores and staff.
- An unequal society and mounting geoeconomic price pressures sees consumption split between high-end, personalised, tech-enabled luxury (physical and digital) products, and core, cost-focussed necessities.



# Long term

LONG-TERM (2041 – 2050)

## Social factors continued

- Tech-enabled, hyper-efficient production methods (like vertical farming) have enabled some staples to be produced at far lower marginal rates. However, it is mainly the advanced economies that have access to these methods. New Zealand's slow investment in new technology means it is still reliant on traditional manufacturing and logistics, so exposed to price fluctuations.
- Regenerative sustainable products are a smaller segment. Reliability of supply, and levels of resource circularity (and value re-capture) are key elements for customers.
- Employee expectations throughout the value chain remain centred around personal income and climate adaptation-related health & safety protection against rising physical risks.
- Demographic changes are similar to other scenarios in the short and medium term. In the long term, New Zealand experiences higher climate-linked migration. This includes Pacific climate refugees seeking asylum, but also high net-wealth individuals looking to escape more climate-impacted and insecure regions.

## Technological factors

- New Zealand brings online more sources of renewable energy to bolster its ageing hydropower capacity. However, most non-urban transport system remains primarily locked into legacy fossil fuel infrastructure.
- Automation, AI and IoT have driven hyper-connectivity globally, but mainly within supply chains that are fractured along geopolitical lines.
- Lower carbon, efficient alternative products are now commonplace on the market. New options such as synthetic proteins are now cost-effective, efficient and mass-produced. A material proportion of retail sales now take place in entirely digital channels, although core necessities remain a key market. Larger, more advanced international companies have eroded traditional Kiwi brands' market share.
- The government heavily promotes a circular economy, as natural resource constraints – driven by poor initial global management of commons - mean retaining expensive precious commodities on Aotearoa is now a strategic priority. Legislation around product and packaging design and recycling capabilities are strict for retailers.

- Carbon capture technology grows along with slow decarbonisation efforts, but remains relatively underfunded. Aotearoa has established nature-based offsets and land are often repurposed to other industry.

## Legal factors

- Companies face increasing legal risks in the late 2040s as the physical impacts of climate change, and the dawning reality that many companies will miss the Net Zero 2050 target, lead to higher public and government action.

## Economic factors

- Decarbonisation is limited, as global GDP growth to meet rising population, debt, and production requirements drives continued use of fossil fuels. However, global and New Zealand GDP is materially lower, and inflation higher, in this scenario than in others. Consumer spending power is steadily eroded through the century as climate change impairs the global economy.
- Reduction in labour flow impairs retailers talent attraction, with adaptation-focused sustainability professionals hard to come by.

- Geoeconomic issues that plague the delayed transition scenario continue to worsen into the 2030s. Trapped in a vicious cycle; acute and chronic changes drive resource scarcity and disrupt economies, leading to great conflict, less collaboration, and less adaptation. Natural resource scarcity is a driver of regional conflict, with trading blocs forming and affecting market access. Countries begin to retreat into resource autarkies, with trade barriers and increasing protectionism reducing import and export abilities.
- Shareholder primacy, financial profits and political desire for short-term economic growth remain barriers to transformative climate action at the ecosystem or entity level in New Zealand.
- Aotearoa New Zealand's agricultural sector, having failed to invest in regenerative farming practices, adaptation or diversification to low-carbon and resilient food production is materially impaired by droughts, diseases and soil erosion. A reduced volume of agricultural exports have knock-on effects for the 'return-trip' shipping schedule reliability, impacting retailers' supply chain predictability.
- Shipping to New Zealand is materially less reliable, and more expensive, in the longer-term due to acute climate disruption, and rising fossil fuel prices (of which the system remains predominantly locked into).



# Physical parameters

**Table 6:** Current Policies physical parameters

VARIABLE	LOCATION	2005	2030	2040	2050
<b>Mean Annual Temperature Change</b> <i>(Average annual temperature vs pre-industrial baseline)</i>	New Zealand	0.87°C <i>(above pre-industrial levels)</i>	1.38°C	1.63°C	1.90°C
	North Island		1.40°C	1.66°C	1.93°C
	South Island		1.37°C	1.61°C	1.87°C
<b>Number of Days Exceeding 25.0°C Annually</b> <i>(% increase in days vs 2005 baseline)</i>	North Island	17.5 days/yr	41.0%	64.1%	91.0%
	South Island	9.2 days/yr	31.9%	50.0%	71.0%
<b>Number of Frost Days Annually</b> <i>(% decrease in days per year vs 2005 baseline)</i>	North Island	9.0 days/yr	-40.2%	-55.4%	-67.9%
	South Island	58.1 days/yr	-16.5%	-23.8%	-31.2%
<b>Mean Sea Level Rise</b> <i>(Increase in centimetres vs pre-industrial baseline)</i>	North Island	19.95cm	32.9cm	40.1cm	48.2cm
	South Island	17.4cm	30.3cm	37.4cm	45.4cm
<b>Extreme Precipitation Events Lasting 3hrs</b> <i>The Average Recurrence Interval (ARI) of a 3 hour extreme precipitation event (based on the rainfall volume in a 2005 '1 in 100 year' event).</i>	North Island	1 in 100 years	1 in 70 years	1 in 61 years	1 in 53 years
	South Island	1 in 100 years	1 in 70 years	1 in 61 years	1 in 53 years
<b>Extreme Precipitation Events Lasting 24hrs</b> <i>The Average Recurrence Interval (ARI) of a 24 hour extreme precipitation event (based on the rainfall volume in a 2005 '1 in 100 year' event).</i>	North Island	1 in 100 years	1 in 72 years	1 in 63 years	1 in 56 years
	South Island	1 in 100 years	1 in 70 years	1 in 61 years	1 in 54 years
<b>Extreme Wind Speed Events</b> <i>The Average Recurrence Interval (ARI) of an extreme wind speed event (based on the max wind speed in a 2005 '1 in 100 year' event).</i>	North Island	1 in 100 years	1 in 62 years	1 in 53 years	1 in 48 years
	South Island	1 in 100 years	1 in 52 years	1 in 52 years	1 in 41 years
<b>Drought (Annual Potential Evapotranspiration Deficit)</b> <i>(% increase in annual average deficit in millimetres vs 2005 baseline)</i>	North Island	144.94 mm	4.98%	7.49%	10.27%
	South Island	108.4 mm	2.80%	4.22%	5.70%

See Appendix E for further information to support reading of select parameters.

Source: CLIMsystems, 2023





# Socio-economic parameters

**Table 7:** Current Policies socio-economic parameters

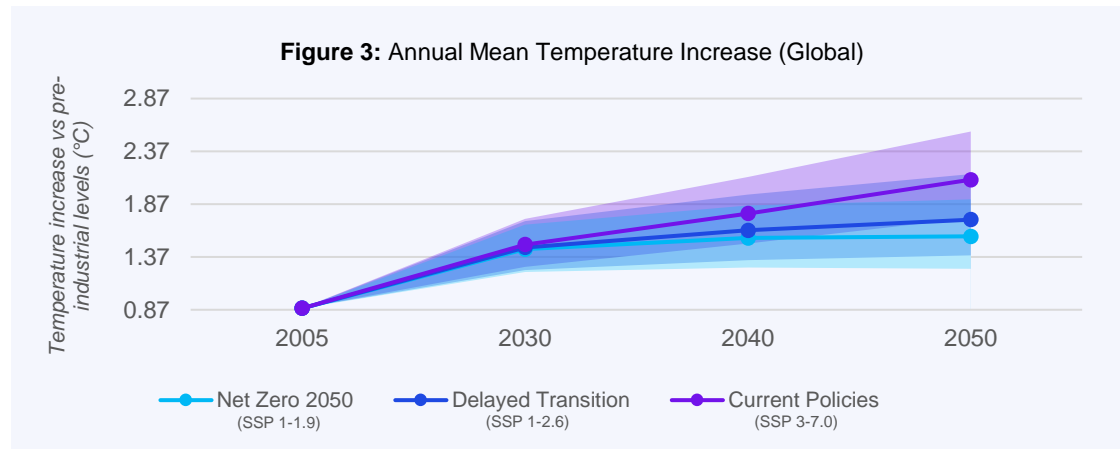
VARIABLE			BASELINE	2030	2040	2050
	<b>New Zealand Economic Damage due to Extreme Weather</b> <sup>49</sup>	Annual expected damage from river floods (% at median line compared to the reference year 2015)	2.2% (2015)	31.1	31.1	17.3
		Annual expected damage from tropical cyclones (% at median line compared to the reference year 2015)	-2.3% (2015)	-15.7	-22.6	-35.6
		1-in-100-year expected damage from tropical cyclones (% at median line compared to the reference year 2015)	-1.8% (2015)	-20.2	-25.8	-33.2
	<b>Global GDP Per Capita</b> <sup>50</sup> <i>(measured in 2005 international US dollars, adjusted for inflation and cross-country price differences)</i>		8,791 (2005)	15,295	16,567	17,224
	<b>New Zealand GDP</b> <sup>51</sup> <i>(% difference, 2009 prices; local currency vs baseline)</i>		-	-0.73	-1.70	-2.74
	<b>New Zealand Inflation Rate</b> <sup>52</sup> <i>(abs. difference % vs baseline )</i>		-	0.04	0.10	0.17
	<b>New Zealand Long Term Interest Rate</b> <sup>53</sup> <i>(abs. difference % vs baseline)</i>		-	0	0	0
	<b>New Zealand Energy Price</b>	Electricity <sup>54</sup> (\$/MWh)	68.1 (2020)	70.4	74	83.5
		Oil <sup>55</sup> (% difference, US\$ per barrel vs baseline)	-	0	0	0
	<b>New Zealand Carbon Price</b> <sup>56</sup> (NZD\$ 2022, per tonne of CO2-equivalent)		-	104	145	186
	<b>Global Population</b> <sup>57</sup> <i>(million)</i>		6869.324 (2010)	8503.464	9247.508	9949.085
	<b>New Zealand Population</b> <sup>58</sup> <i>(million)</i>		4.368 (2010)	4.957	5.036	5.015

## Section 3

# Comparative visualisation

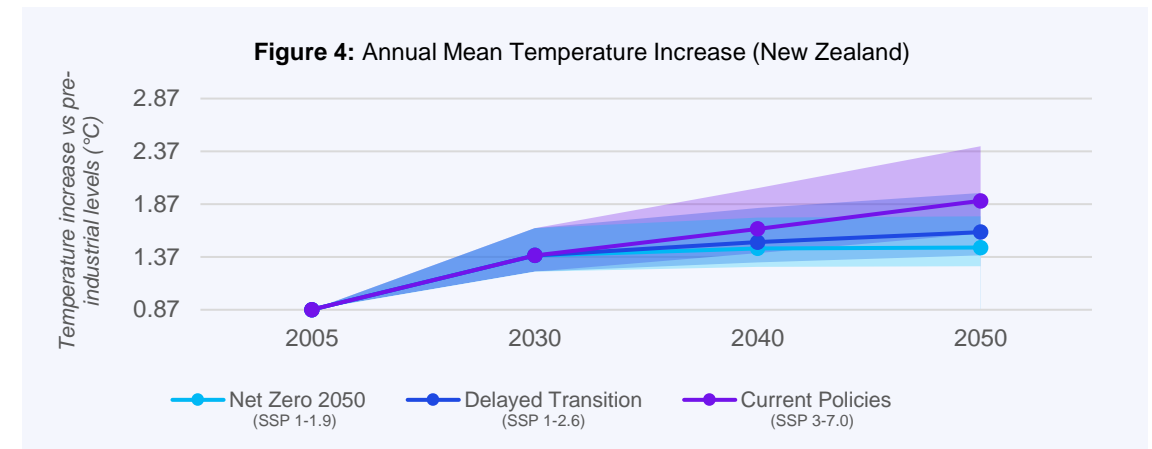


# Key physical parameters



Source: Fyfe et al., 2021 & IPCC, 2021b

**Figure 3** illustrates the IPCC's 'best estimates' for global mean annual temperature increase across three scenarios, noting that the underlying models do not consider individual tipping points or cascading knock-on effects between tipping points. These models are, therefore, inherently conservative. As of 2022, anthropogenic emissions of greenhouse gases have already resulted in global warming of at least 1.16°C relative to the 1880-1920 average.<sup>1</sup> In-line with IPCC SSP1-1.9, a Net Zero 2050 scenario, ambitious emissions reductions succeed in limited further warming to 1.44°C above baseline in 2030, 1.55°C in 2040, and 1.57°C in 2050. During the second half of this century, this trend is reversed through the large scale deployment of nature- and technology-based emissions removal solutions, resulting in just 1.4°C of global warming by 2100. In-line with IPCC SSP1-2.6, a Delayed Transition scenario, the world warms by 1.46°C above baseline in 2030, 1.62°C in 2040, and 1.72°C in 2050. During the second half of this century, this trend is reversed through moderate emissions removals, resulting in 1.8°C of global warming by 2100. In-line with SSP3-7.0, the Current Policies scenario sees global average temperatures increase by 1.49°C above baseline by 2030, 1.78°C by 2040, and 2.10°C by 2050. The rate of warming dramatically increases thereafter, leading to a range of 2.8°C to 4.6°C warming by 2100 with IPCC's best estimate pointing towards 3.6°C.<sup>2</sup> Under this scenario, we have almost certainly surpassed a tipping point in the earth's climate system, beyond which greenhouse gas emissions could lead to a shutdown of large ocean circulation systems and massive permafrost melting.



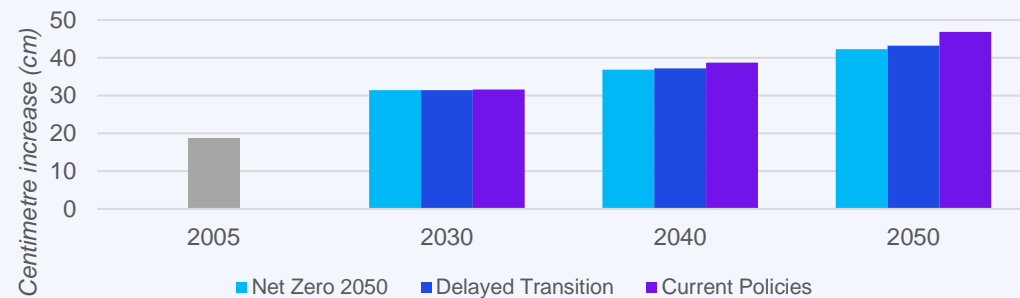
Source: CLIMsystems, 2023

**Figure 4** illustrates best estimates (solid lines) and ranges (5th and 95th percentiles) of mean annual temperature increases in New Zealand across three scenarios against pre-industrial levels (1850–1900 baseline). The seas surrounding New Zealand are absorbing vast amounts of heat. As a result, the country is currently warming at a slower rate than the global average. As of 2020, New Zealand has already warmed by 1.1°C above 1850-1900 baseline (IPCC, 2021b). Across all plausible scenarios, this trend continues. Downscaled Coupled Model Intercomparison Project 6 (CMIP6) data provides the most recent insights into future warming across the motu. Under our Net Zero 2050 scenario, warming is estimated to be 1.38°C above baseline in 2030 (using 50th percentile), 1.45°C in 2040, and 1.46°C by 2050. Under our Delayed Transition scenario, New Zealand warms by 1.38°C above baseline in 2030, 1.51°C in 2040, and 1.61°C in 2050. During the second half of this century, this trend is reversed through moderate emissions removals, resulting in 1.6°C of global warming by 2100. Under our Current Policies scenario, New Zealand's average temperature increases by 1.4°C above baseline by 2030, 1.63°C by 2040, and 1.9°C by 2050. The rate of warming dramatically increases thereafter, leading to a best estimate of 3.0°C by 2100.



# Key physical parameters

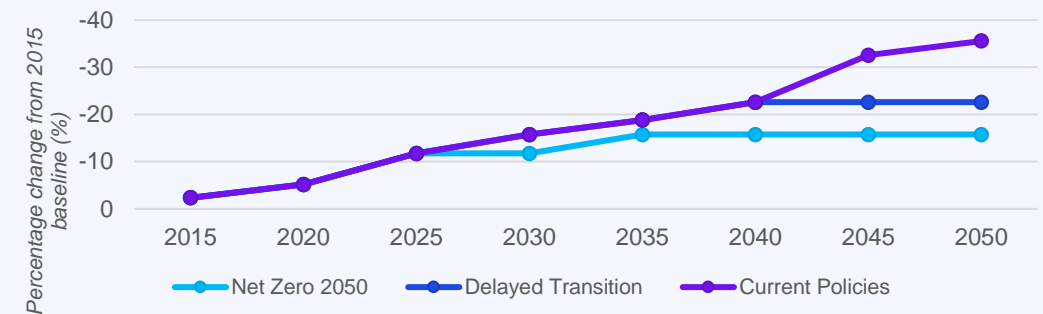
**Figure 5: Mean Sea Level Rise (New Zealand)**



Source: CLIMsystems, 2023

**Figure 5** illustrates relative sea level rise (SLR) in New Zealand under three scenarios. ‘Relative’ SLR is a combination of rising sea levels and local land subsidence, tectonic effects, and the relaxation of the Earth’s crust. As a result, the impacts of SLR vary significantly across Aotearoa.<sup>3</sup> Global average sea level rise (SLR) was more than twice as fast (4.62mm a year) in the most recent decade (2013-22) than 1993-2024, the first decade of satellite measurements, when the rate was 2.77mm a year. Even if the world stopped emitting greenhouse gases immediately, sea levels would continue to rise. Even in the best-case scenario, it’s too late to hold back the ocean because the systems causing sea level rise (e.g. the thermal expansion of the ocean and the melting of glaciers and ice sheets) have a centuries-long time lag. Under all scenarios, by 2030 average SLR across New Zealand is +12.8cm vs 2005 levels, and +31.4cm vs a 1901 baseline. Even by 2050 (a relatively short timeframe in the context of SLR) a Current Policies Scenario sees SLR of +28.2cm vs 2005 levels, +46.8cm vs 1901 levels, and 4.6cm more SLR than a Net Zero 2050 scenario (with tipping points likely compounding the speed of SLR towards the end of the century under this scenario).

**Figure 6: Relative Change in Annual Expected Damage from Tropical Cyclones (New Zealand)**



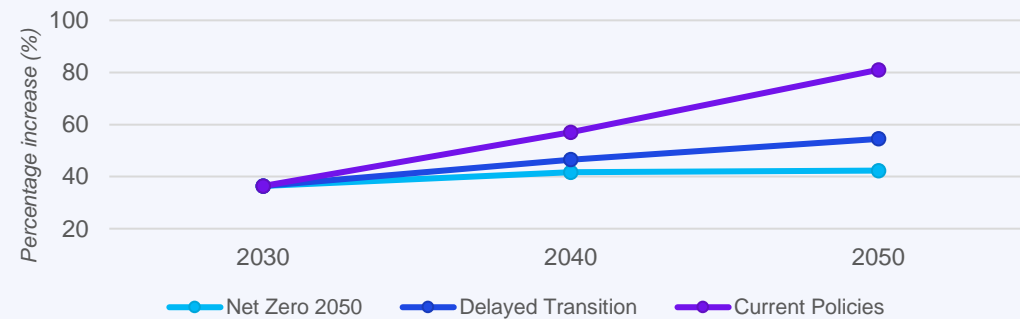
Source: CLIMADA, 2021

**Figure 6** illustrates the growing economic cost of tropical cyclones in New Zealand. Higher (negative) percentages indicate greater damage. Under a Net Zero 2050 scenario, the annual cost is estimated to be 11.7% greater in 2030 than in 2015 – reaching 15.7% in 2035. Under a Delayed Transition Scenario, annual costs continue to grow until 2040, when they are 22.6% higher than in 2015. Under a Current Policy scenario, annual damage from cyclones may be 35.6% higher in 2050 than 2015.

Percentages are subject to methodological limitations detailed by CLIMADA<sup>4</sup>, and as such should be considered indicative of the scale and speed of change.

# Key physical parameters

**Figure 7: Average Annual Number of Days Exceeding 25°C (New Zealand)**

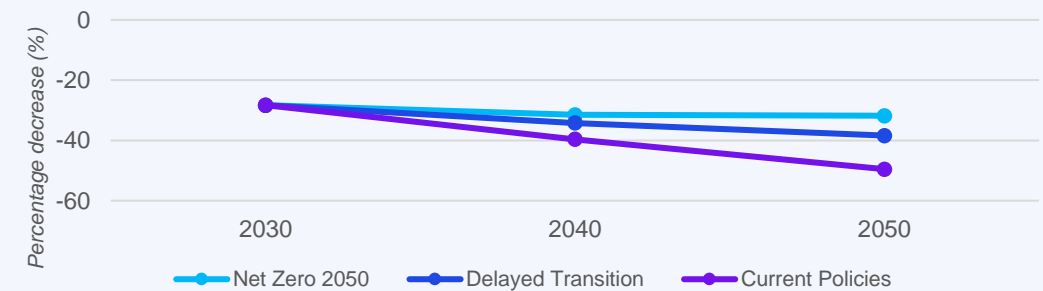


Source: CLIMsystems, 2023

**Figure 7** illustrates the increase in average number of days per year warmer than 25°C. Under all scenarios, the number of days above 25°C are forecast to increase, with the North island experiencing materially more 25°C+ days than the South island.

Under a Current Policies Scenario, the average number of 25°C+ days in the North Island increases 91% by 2050 (from 2005 levels), with Northland is expected to have 48 days above 25°C, Auckland 42 days, and the Waikato 41 days. Under this same scenario and time period, the number of 25°C+ in the South Island is expected to increase from 9 to 16 days per year.

**Figure 8: Mean Number of Frost Days (New Zealand)**



Source: CLIMsystems, 2023

**Figure 8** illustrates the decrease in number of frost days that New Zealand could expect under three scenarios. Frost days decrease as temperatures rise. Under a Net Zero scenario, there is a 45.0% reduction in average frost days for the North Island by 2050, and a reduction of 18.7% in the South Island. In contrast, under a Current Policies scenario, the average number of frost days decreases by 68% across the North Island and 31% across the South Island.

Under a Current Policies scenario, the average number of frost days in 2050 versus baseline declines by 29% in Canterbury, 27% in Otago, and 65% Hawkes Bay, 32% in Marlborough and 62% Manawatū-Whanganui.

# Key physical parameters

**Figures 9 and 10** illustrate the Annual Exceedance Probability (AEP) of 'Extreme Precipitation Events'. A qualifying event is based on the average rainfall volume for what was a '1 in 100 year event' in 2005\* (i.e. the chance per year under different scenarios and time horizons that this rain volume is exceeded in the future).

Under A Net Zero scenario, the chance of a 3 hour rainfall qualifying event per year increases from 1% in 2005, to 1.44% in 2030, and up to 1.5% by 2050.

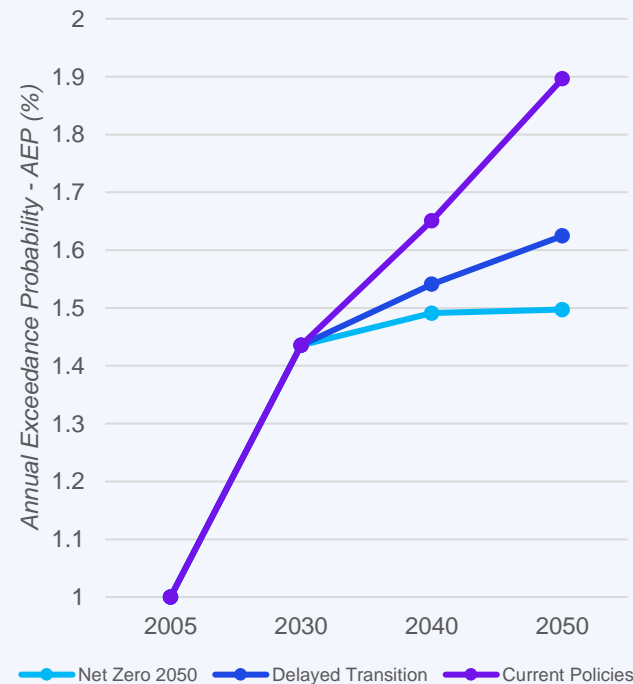
Under a Delayed Transition, the AEP of a qualifying 3 hour event increases from 1% per year in 2005, to 1.44% per year by 2030 (comparable to the Net Zero 2050 scenario). However, by 2040 the AEP increases to 1.54% per year in 2040, and rises to 1.62% per year by 2050.

Under a Current Policies Scenario, the 3 hour AEP is the same as the other scenarios at 2030, however rapidly rises to an AEP of 1.65% per year by 2040, and 1.9% per year by 2050 (almost twice as likely).

For 24 hour qualifying events, the pattern is similar to 3 hour events. Under a Net Zero 2050 scenario, the AEP increases from 1% per year in 2005, to 1.47% in 2050. Under a Current Policies scenario, the AEP for a 24 hour qualifying event increases from 1% in 2005, to 1.83% per year in 2050.

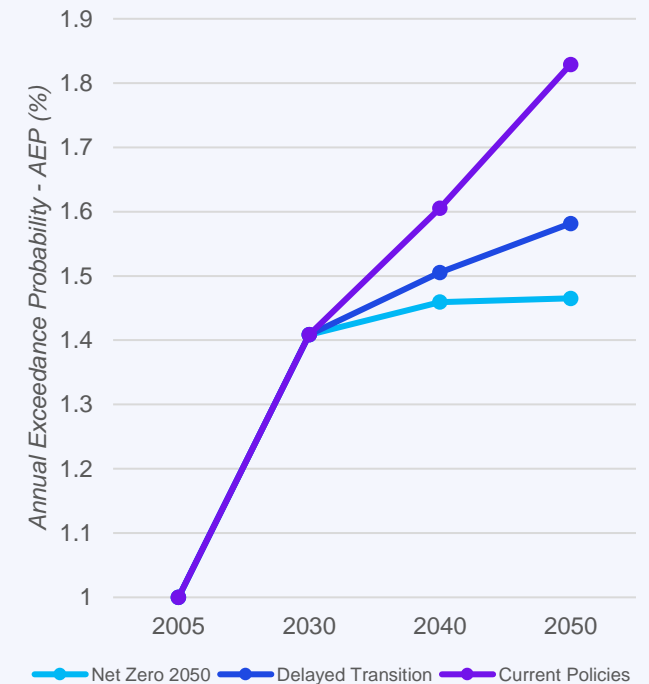
\*For 3 hour rainfall, a '1 in 100 year' event in 2005 was rainfall volume of 74mm of rain in 3 hours in the North Island, and 66mm in the South Island. For 24 hour events, the volume was 213mm of rain in the North Island, and 240mm in the South Island. The AEP figures shows an average of the likelihood per year under different scenarios of rainfall exceeding these volumes in 3 or 24 hour periods during a 1 year period.<sup>5</sup> For context, the Auckland Anniversary weekend floods saw 245mm of rainfall in 24 hours, and 160mm in 6 hours, exceeding NIWA's '1-in-250 year' (0.4% chance per year) 24 hour storm event predictions.<sup>6</sup>

**Figure 9: Increase in likelihood of Extreme Precipitation Events – 3hr duration (New Zealand)**



Source: CLIMsystems, 2023

**Figure 10: Increase in likelihood of Extreme Precipitation Events – 24hr duration (New Zealand)**



Source: CLIMsystems, 2023



# Key physical parameters

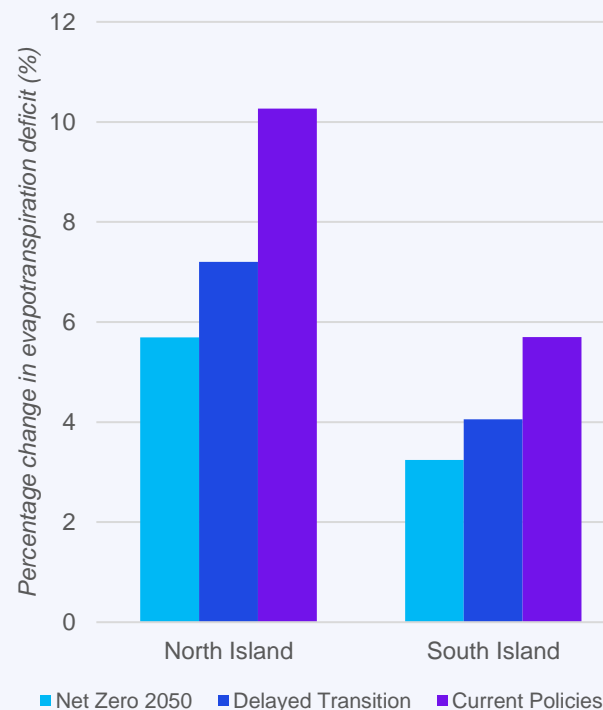
**Figures 11 and 12** illustrate monthly Potential Evapotranspiration Deficit (PED), which is a commonly recognised drought proxy, for the North and South Islands.<sup>7</sup>

Rising temperatures see a steady increase in PED across all plausible scenarios. Under a Net Zero 2050 scenario, the average level of PED across the North Island increases 5.7% by 2050 and 10.3% under Current Policies. The South island has a lower average absolute PED and lower % increases than the North Island across all three scenarios. Even under Current Policies, PED increases by only 5.7%.

Under a Current Policies scenario, the Bay of Plenty (12.2%), Gisborne (12.5%) and Hawke's Bay (13.5%) have the highest percent increases in PED of any regions. Under the same scenario, Auckland (300mm), Northland (222mm) and Nelson (212mm) have the highest absolute levels of PED.

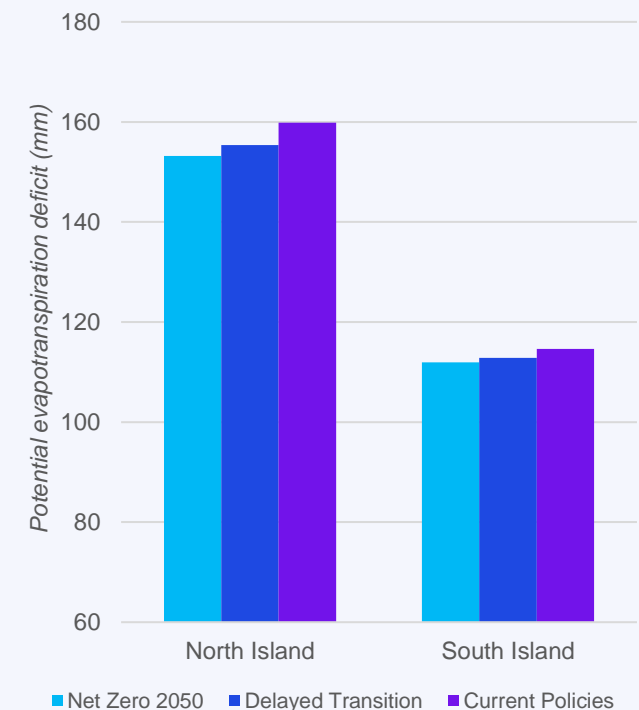
The South Island's West Coast region has very low levels of PED, with only 9mm per month even under a Current Policies scenario by 2050. A small increase in PED under this scenario from 4.6mm to 9.4mm provides a comparatively high (9.4%) change, which marginally skews other South Island figures (non-area weighted average of 5.6% PED increase). However, area geographical area weightings nullify any meaningful effects.

**Figure 11: Drought % Change - North vs South by 2050 (New Zealand)**



Source: CLIMsystems, 2023

**Figure 12: Annual Mean Drought by 2050 (New Zealand)**



Source: CLIMsystems, 2023

# Key socio-economic parameters

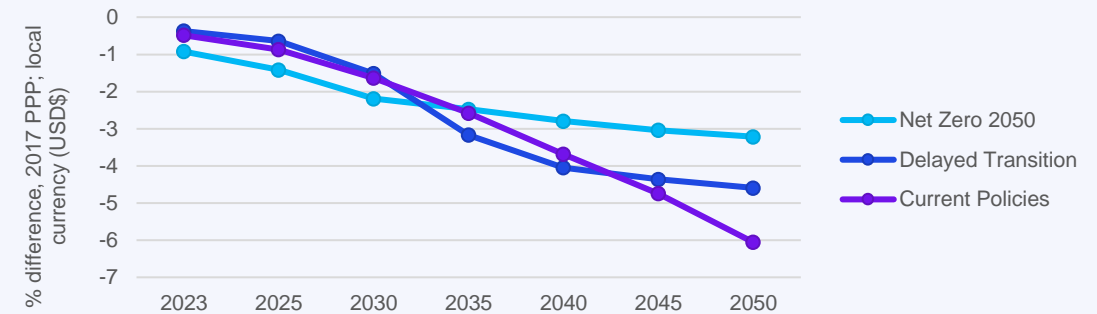
**Figures 13 and 14** illustrate relative changes in global and New Zealand Gross Domestic Product (GDP) under three scenarios. Both data sets are derived from the NiGEM NGFS v1.22 REMIND-MAgPIE 3.0-4.4 IAM and reflect NGFS assumptions about reduction in economic output vs a world where the physical and transition-related impacts of climate change do not occur.

Under all scenarios, the physical and transition-related impacts of climate change are assumed to negatively impact global GDP. However, the impact is significantly less under a Net Zero 2050 scenario than under a Current Policies scenario for the 2023-2050 period. Under a Net Zero 2050 scenario, New Zealand's GDP is negatively impacted in the short-term as Aotearoa invests in future-fit infrastructure and the market undergoes a period of 'creative destruction.' From the 2030s onward, economic activity associated with the transition drives GDP growth. Meanwhile, the speed and limited coordination of economic transformation under a Delayed Transition scenario results in significant damage to GDP by 2035 but creates conditions and momentum for recovery post-2050. Under a Current Policies scenario, declining natural resources, rising energy prices and worsening health and social outcomes systematically and steadily undermine GDP for the foreseeable future.

As such, the scenarios represent three forms of economic disruption bearing down on New Zealand retailers: the first is proactive and coordinated, the second reactive and uncoordinated, and the third passive and utterly unpredictable. Under the first two scenarios, we bring climate change under control through the deliberate transformation of our societies and economies. Under the third scenario, runaway climate change transforms our economies in ways we can neither foresee or control.

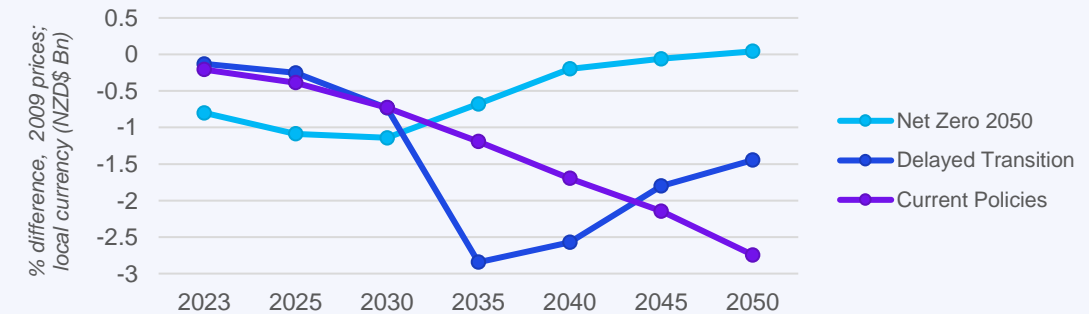
The NiGEM NGFS v1.22 REMIND-MAgPIE 3.0-4.4 IAM does not account for economic tail risks such as global recessions, the collapse of financial markets, sovereign debt crises or currency crises triggered by geopolitical conflict (due to heightened resource scarcity), mass migration due to climate events and climatic shifts, state fragility due to loss of revenues associated with transition (petrostates) or physical climate impacts (agricultural nations), supply/demand mismatches during the transition (especially in critical minerals and energy), failure of a major fossil fuel firm (due to the transition) or a major insurer (due to physical impacts) leading to widespread financial contagion, extent of supply chain exposure to physical hazards, climate tipping points resulting in greater severity of climate impacts than forecast, or cascading/compounding interaction between these risks. Therefore, this model may dramatically underestimate financial impacts. For the avoidance of doubt, *the physical and transition-related impacts of climate change on GDP could be far worse than suggested in figures 14 and 15.* It is also possible that early, ambitious investment in the transition to a low-emissions, climate-resilience future could generate greater economic tailwinds than captured in the model.

**Figure 13: GDP (Global)**



Source: NGFS, 2022a

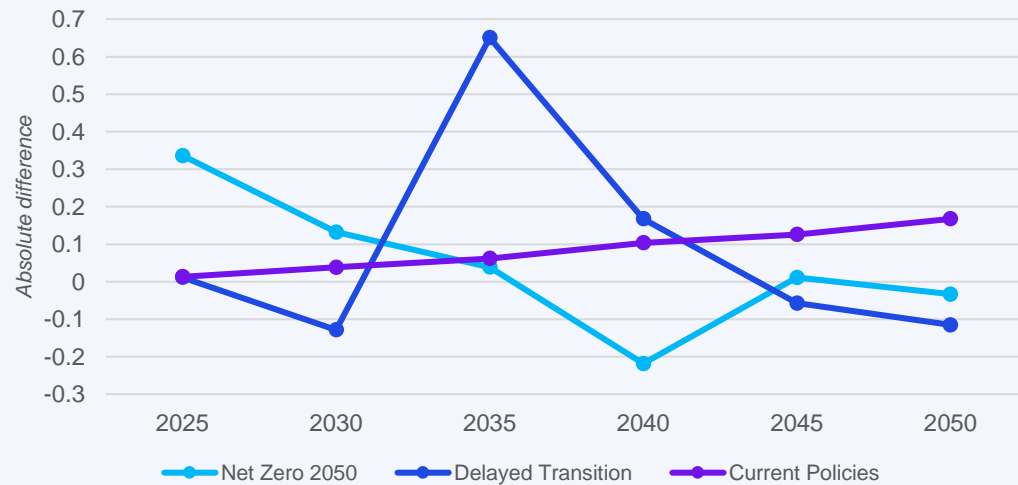
**Figure 14: GDP (New Zealand)**



Source: NGFS, 2022a

# Key socio-economic parameters

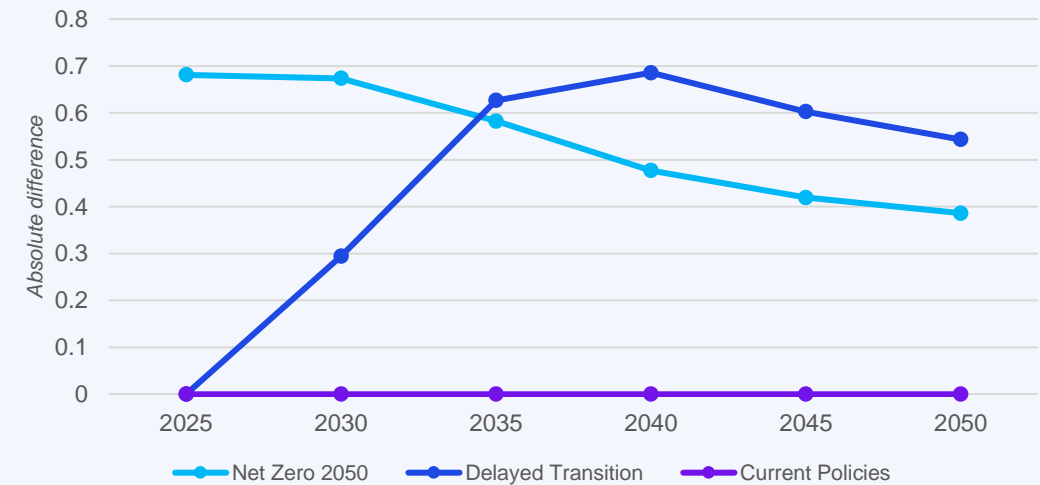
**Figure 15: Inflation Rate (New Zealand)**



Source: NGFS, 2022a

**Figures 15 and 16** suggest the patterns of absolute change in New Zealand's inflation and long-term interest rates that might be anticipated under Net Zero 2050, Delayed Transition, and Current Policy scenarios. Both data sets are derived from NiGEM NGFS v1.22 REMIND-MAGPIE 3.0-4.4 IAM and, therefore, reflect inherently conservative assumptions about potential changes in inflation and long-term interest rates versus a world where the physical and transition-related impacts of climate change do not occur.

**Figure 16: Long-term Real Interest Rate (New Zealand)**

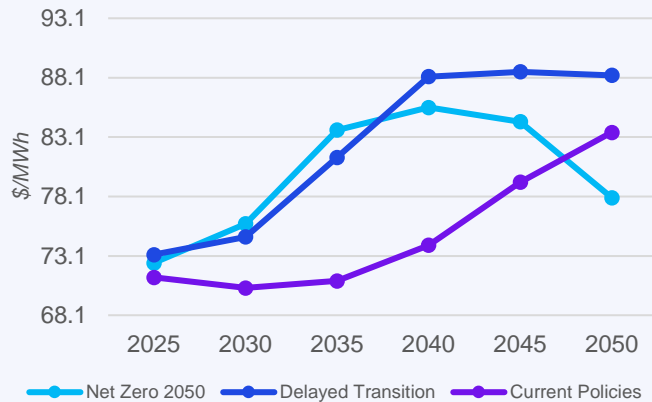


Source: NGFS, 2022a

Accordingly, actual changes in inflation and long-term interest rates may be far more pronounced, enduring, and damaging. As with GDP, the rapid ramp up of investment under a the Net Zero 2050 scenario sees inflation rise to medium-high levels before stabilising. Under a Delayed Transition scenario, inflation peaks later and much higher due to less planned and more costly efforts. Under a Current Policies scenario, inflation steadily rises as a result of the physical impacts of climate change and slow investment in decarbonisation.

# Key socio-economic parameters

**Figure 17: Energy Price (New Zealand)**

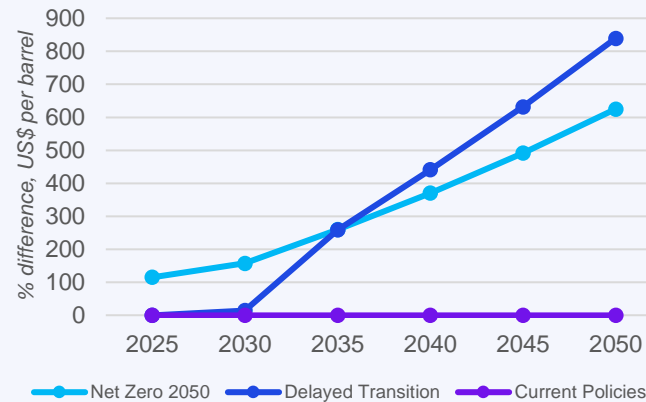


Source: CCC, 2021a

**Figure 17** suggests changes in the levelized cost of electricity (LCOE)\* in New Zealand under different climate scenarios. Under all scenarios, electricity prices increase through 2040, driven by the cost of investment in renewables and decarbonisation. Early investment in cheaper, renewable energy sees electricity prices start to fall from 2040 under the Net Zero 2050 scenario, whereas in a Delayed Transition they plateau at 2040 at \$88/MWh. Under a Current Policies scenario, the price of electricity continues to rise past mid-century.

\*The levelized cost of electricity (LCOE) is a way to measure the full costs of producing electricity from a particular source over the lifetime of that source.

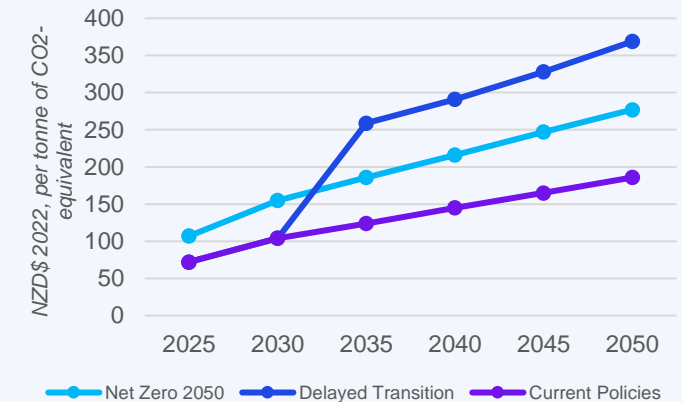
**Figure 18: Oil Price (New Zealand)**



Source: NGFS, 2022a

**Figure 18** suggests the difference in oil prices for New Zealand vs a theoretical baseline with no climate-related physical or transition-related impacts. This is an inherently conservative approach, and actual changes in oil prices may be far greater. Accepting NGFS assumptions, oil prices rise sharply in both Net Zero 2050 and Delayed Transition scenarios due to decarbonisation and the shift away from fossil fuels. Under a Net Zero 2050 scenario, the price rises from 2023 onwards, reaching 174% of 2015 prices by 2030, and 625% by 2050. Under a Delayed Transition scenario, prices do not begin rising until 2030 but reach 839% of 2015 prices by 2050. No data is available for a Current Policies scenario.

**Figure 19: Carbon Price (New Zealand)**



Source: New Zealand Treasury, 2022a

**Figure 19** indicates the New Zealand Treasury's October 2022 recommended shadow prices for emissions under three different pricing pathways. Whilst the CCC and Treasury cannot predict carbon price pathways, these figures suggest what may happen should New Zealand commit to faster or slower decarbonisation.



## Section 4

# Technical appendices



**A.**

**Glossary**



**B.**

**Process**



**C.**

**Approach**



**D.**

**NGFS framework**



**E.**

**Physical  
parameters**



**F.**

**Limitations  
& mitigation**



**G.**

**End notes**



**H.**

**References**



# Appendix A: Glossary

TERM	DEFINITION
<b>Adaptation</b>	<p>The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.</p> <ul style="list-style-type: none"><li>• ‘Hard’ adaptation measures are typically capital-intensive, large, complex, inflexible investments in technology and infrastructure.</li><li>• ‘Soft’ adaptation measures include nature-based solutions that emphasise community control.</li></ul>
<b>AEP</b>	<p>Annual exceedance probability (AEP) is a statistical term that represents the likelihood of a certain event, such as flooding, occurring in a given year. It is expressed as a percentage, and it is calculated based on historical data of the frequency and severity of the event. For example, if a certain area has experienced flooding of a certain magnitude, say 10 feet, 5 times in the past 100 years, then the AEP of a 10-foot flood in that area would be 5%. This means that there is a 5% chance of experiencing a 10-foot flood in that area in any given year. A ‘1 in 100’ year event has a 1% chance of occurring. However, that does not mean that, especially within a changing climate, that event cannot occur more than once per year.</p>
<b>ARI</b>	<p>An Annual Recurrence Interval (ARI) is a statistical measure used in weather forecasting and analysis to estimate the likelihood of a particular weather event occurring. It is calculated by dividing the length of a historical record by the number of times a particular event has occurred within that record. For example, if a particular city has experienced 10 major floods in the past 100 years, the ARI for a major flood in that city would be 1 in every 10 years. This means that, on average, a major flood occurs in that city once every 10 years. Because ARIs are based on historic data, and due to changing climate, events can occur more frequently than their ARI (e.g. a 1 in 100 year event can occur more than once in that period). See (Australian Government, n.d.) for an explanation of ARI, and why 1-in-100 year events can occur so often.</p>

TERM	DEFINITION
<b>Cash flows</b>	<p>An entity’s actual cash flows as reflected in its statement of cash flows or potential cash flows under different climate-related scenarios.</p>
<b>Climate change</b>	<p>Climate change refers to a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing, such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use.</p>
<b>Climate-related scenario</b>	<p>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. Note that climate-related scenarios are not intended to be probabilistic or predictive, or to identify the ‘most likely’ outcomes of climate change.</p>
<b>Climate-related risks</b>	<p>Climate-related risks refers to the potential negative impacts of climate change on an organisation. Physical risks emanating from climate change can be event-driven (‘acute’) such as increased severity of extreme weather events (e.g. cyclones, droughts, floods, and fires). They can also relate to longer-term shifts (‘chronic’) in precipitation and temperature and increased variability in weather patterns (e.g. sea level rise). Climate-related risks can also be associated with the transition to a lower-carbon global economy, the most common of which relate to policy and legal actions, technology changes, market responses, reputational considerations, and access to capital.</p>
<b>Critical uncertainties</b>	<p>The driving forces that are most influential and most uncertain. These will define the range of scenarios required to explore the potential futures</p>
<b>Driving forces</b>	<p>Broad scale, external factors that may affect the outcomes of the focal question(s), also known as ‘drivers’</p>

TERM	DEFINITION
<b>Impacts</b>	The effects of climate-related risks and opportunities materialising on an entity, which will in turn depend on the impacts of climate change on the broader socio-economic and ecological systems the entity operates within. These impacts are driven by the specific climate-related risks and opportunities to which an entity is exposed, and its strategic and risk management decisions on seizing those opportunities and managing those risks.
<b>Just Transition</b>	The term "Just Transition" refers to a framework for managing the shift towards a low-carbon economy in a way that is fair and equitable for workers and communities impacted by the transition. The International Labour Organization defines it as "greening the economy in a way that is as fair and inclusive as possible to everyone concerned, creating decent work opportunities and leaving no one behind" (ILO, n.d.).
<b>Mitigation</b>	A human intervention to reduce the sources or enhance the sinks of greenhouse gases (GHGs).
<b>PED</b>	Potential Evapotranspiration Deficit (PED) is It is the difference between how much water could potentially be lost from the soil through evapotranspiration (evaporation and transpiration) and how much is actually available. PED measures the amount of water that is needed to meet the water demand of plants in a particular area. A higher PED may mean plants are not getting the water needed for growth.
<b>Resilience</b>	The characteristics of an entity's strategy that allows it to adapt to climate-related changes materially affecting it, while maintaining operations and profitability and safeguarding people, assets, and overall reputation. Strategy resilience has two main pillars: vulnerability and preparedness. Vulnerability incorporates the elements of strategic planning and adaptive capacity. Strategic planning is primarily a forward-looking exercise. Assessment of adaptive capacity involves both present and forward-looking aspects.
<b>Scenario analysis</b>	The characteristics of an entity's strategy that allows it to adapt to climate-related changes materially affecting it, while maintaining operations and profitability and safeguarding people, assets, and overall reputation. Strategy resilience has two main pillars: vulnerability and preparedness. Vulnerability incorporates the elements of strategic planning and adaptive capacity. Strategic planning is primarily a forward-looking exercise. Assessment of adaptive capacity involves both present and forward-looking aspects.

TERM	DEFINITION
<b>Scenario category</b>	NGFS-sourced scenarios 'Orderly', 'Disorderly' and 'Hot House World' are termed the 'scenario category' in this report. Under each scenario category, validated selections have been made of representative scenarios from NGFS, 2020.
<b>Scenario 'framework architecture'</b>	The combinations of SSPs, RCPs, NGFS representative scenarios, modified SPANZ selections and CCC reference scenarios that comprise each scenario.
<b>Scenario narrative</b>	A plausible propagation of natural, macroeconomic, socio-economic and political factors occurring during each time frame of each scenario.
<b>Sharing economy</b>	Within the context of this report, the sharing economy involves short-term transactions to share the use of idle assets and services or to facilitate collaboration. The sharing economy often involves some type of online platform that connects buyers and sellers. In a sharing economy, idle assets such as parked cars, spare bedrooms, tools, or clothing can be rented out when not in use. In this way, physical assets are shared as services.
<b>Tipping points</b>	'Positive tipping points' refer to the moment at which low-carbon technologies become more affordable, attractive and/or accessible than high-carbon alternatives. 'Negative tipping points' refer to a situation where a small change in the Earth's climate system triggers a larger and more permanent change.
<b>Value chain</b>	The upstream and downstream life cycle of a product, process, or service, including material sourcing, production, consumption, and disposal/recycling. Upstream activities include operations that relate to the initial stages of producing a good or service (e.g., material sourcing, material processing, supplier activities). Downstream activities include operations that relate to processing the materials into a finished product and delivering it to the end user (e.g., transportation, distribution, and consumption).



# Appendix B: Process

## Phase 1

The sector-level scenarios in this Report were developed through the five-step process summarised in Figure 1. Steps 1 through 4 were conducted between March and July 2023. Outputs from each workshop were used as inputs for the following session. Training (Step 5) was provided to ‘key persons responsible’ in participating businesses.

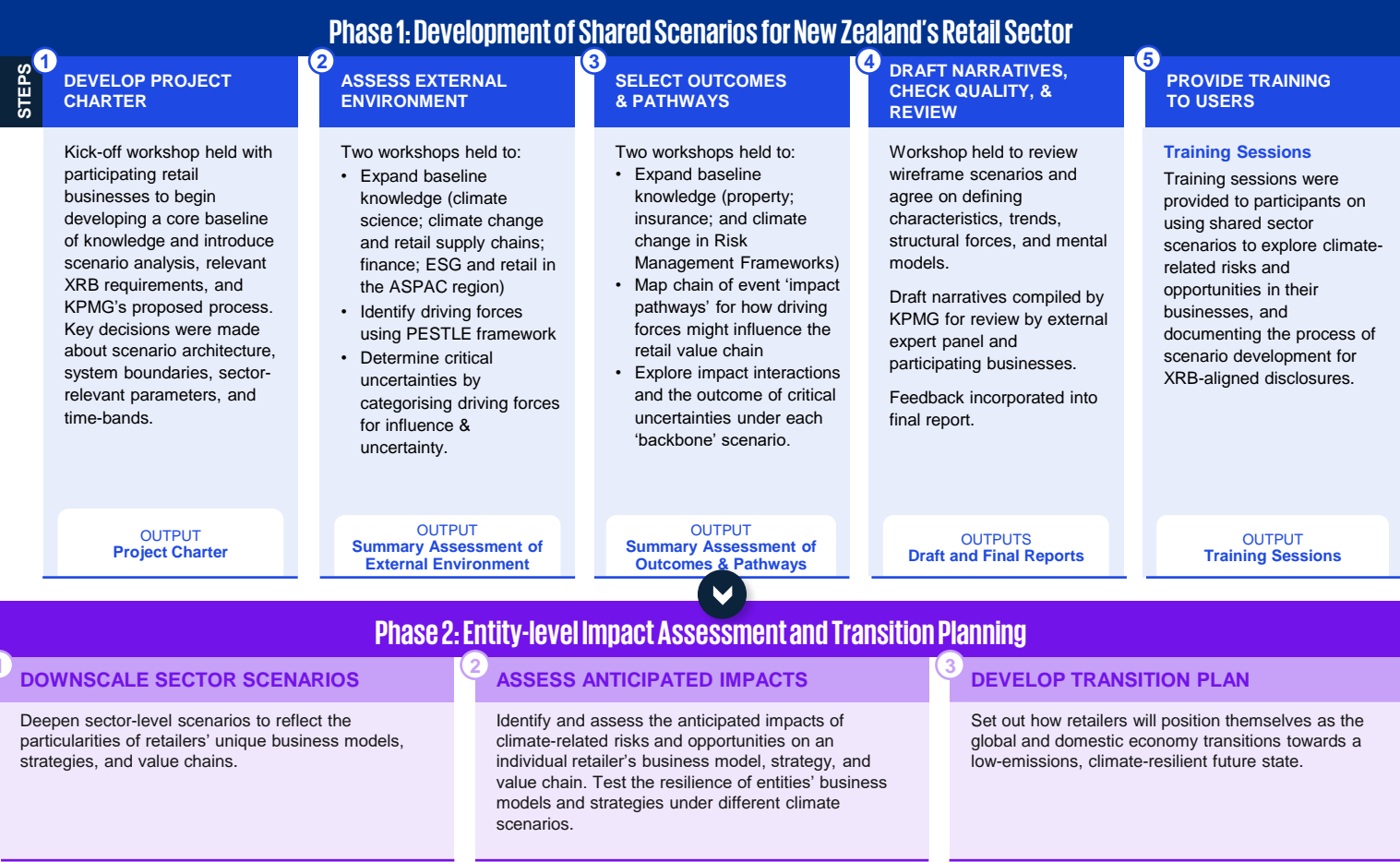
## Phase 2

Sector-level scenarios provide retail business with a solid starting point for exploring the potential impacts of climate change. However, in order to build future-fit businesses and meet NZ CS disclosure requirements, individual retailers will need to:

- *‘Downscale’ Sector-level Scenarios* to reflect the particularities of their unique business models, strategies, and value chains.
- *Assess Anticipated Impacts* of climate-related risks and opportunities on their business models, strategies and value chains.
- *Develop Transition Plans* setting out how their businesses will position themselves as the global and domestic economy transitions towards a low-emissions, climate-resilient future state, specifically including how retailers’ business models and strategies might change.

Steps 6 through 8 include commercially sensitive data and discussions. They are, therefore, undertaken on an individual entity rather than collective sectoral basis.

Figure 20: Summary of Phase 1 and 2 processes



# Appendix C: Approach

## Governance

The ‘Retail Sector Shared Scenarios Project’ was led by representatives from participating business. All material decisions about scenario design and content were made by agreement between participants with technical advice provided by KPMG New Zealand.

## External experts and specialists

Key outputs (e.g. summary assessments of external conditions, outcomes, and pathways) were reviewed by an international panel of retail sector experts. In addition, specialists joined the Materiality & Drivers and Outcomes & Pathways Workshops to share their insights into the potential impacts of climate change on New Zealand’s retail sector. Specialists covered topics including:

- Climate & earth system science
- The impacts of climate change on supply chains & operations
- The future of insurance
- The future of commercial property, green buildings, and green building standards
- ESG and the future of retail in the Asia Pacific Region
- Climate change in enterprise risk management frameworks.

## Scenario design

Framework architecture (defining assumptions), parameters (quantifiable variables), boundaries (what was in and what was out of scope), and granularity (level of detail) were determined by participants during the Project’s Kick-off Workshop.

The ‘framework architecture’ of retailers’ Net Zero 2050, Delayed Transition, and Current Policies scenario set has been presented in the Executive Summary (page 10) and consists of an internally coherent set of socio-economic assumptions, decarbonisation pathways, and climate change projections. Following XRB guidance, this architecture combines distinctive and diverse higher-level, publicly available scenarios and projections to provide broad guide rails.

Table 8: Integration with higher-level, publicly available scenarios and projections

	Retail sector scenario	Net Zero 2050 	Delayed Transition 	Current Policies 
Publicly available scenarios	Network for Greening the Financial System (NGFS) scenarios	Net Zero 2050 scenario, Orderly category	Delayed Transition scenario, Disorderly category	Current Policies scenario, Hot House World category
	Intergovernmental Panel on Climate Change (IPCC) scenarios	Shared socio-economic Pathway (SSP) SSP1-1.9	SSP1-2.6	SSP3-7.0
	New Zealand Climate Change Commission (CCC) scenarios	Tailwinds	Headwinds	Current Policy Reference

The retail sector scenarios in this report have also been influenced by the ‘100% Smart’, ‘Kicking, Screaming’, and ‘Homo Economicus’ Shared-climate Policy Assumptions for New Zealand (SPANZ), though the dated nature of the SPANZ framework limits the potential for tighter alignment.<sup>1</sup>

## Parameters

'Parameters' refer to the detailed (often, but not always, quantitative) physical climate or socio-economic variables that help define and distinguish scenarios. These data points are critical to analysing and eventually quantifying related risks and opportunities.

**Table 9:** Scenario Parameters

Parameters	
Physical	<ul style="list-style-type: none"> <li>Mean Annual Temperature Change</li> <li>Maximum Temperature Days &gt;25.0°C</li> <li>Frost Days</li> <li>Mean Sea Level Rise</li> <li>Extreme Precipitation Events Lasting 3hrs</li> <li>Extreme Precipitation Events Lasting 24hrs</li> <li>Extreme Wind Speed Events</li> <li>Drought (Annual Potential Evapotranspiration Deficit)</li> </ul>
Socio-economic	<ul style="list-style-type: none"> <li>Annual Expected Damage from River Floods</li> <li>Annual Expected Damage from Cyclones</li> <li>1-in-100-year Expected Damage from Tropical Cyclones</li> <li>Global GDP per Capita</li> <li>NZ GDP</li> <li>NZ Inflation Rate</li> <li>NZ Long Term Interest Rate</li> <li>Electricity Price</li> <li>Oil Price</li> <li>Carbon Price</li> <li>Global Population</li> <li>NZ Population</li> </ul>

## Granularity

Whilst country-level figures are acceptable (and/or all that is currently available) for many socio-economic parameters, quantitative data about the physical impacts of climate change was provided at the regional-level in order to assist retailers in assessing implications for their operational and market footprints.

## Boundaries

The scope of the scenarios in this report are limited to:

- New Zealand (including near-shore coastal shipping)
- Fast and slow moving consumer goods
- Manufacturing, Distribution, Retail, and Corporate value chain elements

## Time horizons

Participants agree three time horizons which are relevant to retail's strategic planning horizons and capital deployment plans, wherein:

- 'Short-term' refers to the 2023-2030 period
- 'Medium-term' refers to the 2031-2040 period
- 'Long-term' refers to the 2041-2050 period

## Choice of high-end outcome

Two >3.0°C SSP-RCP pairs were considered to help define retailers' high-end Hot House World: SSP3-7.0 and SSP5-8.5. SSP3-7.0 was selected because it accounts for milestone international agreements and mounting progress towards mitigation goals.

In contrast, SSP5-8.5 is a so-called 'baseline' scenario that does not include any specific emissions reduction target, assumes limited international cooperation on climate change, and assumes that policies to address climate change are not a priority amongst governments. Under this scenario, greenhouse gas emissions continue to increase, leading to a radiative forcing of 8.5 W/m<sup>2</sup> by 2100.<sup>2</sup> This scenario's failure to account for progress at the international level (e.g. the 2019 Paris Agreement), national level (e.g. Nationally Determined Contributions and associated legislation, including New Zealand's 2019 Zero Carbon Amendment to the Climate Change Response Act), coordinated efforts by the private sector (e.g. the Sustainable Apparel and We Mean Business coalitions), or 'positive tipping points' in public access to/demand for electric cars or the plunge in coal-powered electricity in the US over the past decade) limits the relevance of SSP5-8.5 to real world decision-makers in the retail sector.<sup>3</sup>

## Focal questions

The focal questions guiding Steps 2 and 3 were, 'How could climate change plausibly affect New Zealand's retail sector?' and 'What are the critical uncertainties our sector needs to prepare for?' The assessment of external climate-related forces re-shaping value in the retail sector (Step 2) followed the 'PESTLE' analytical framework. The acronym 'PESTLE' stands for Political, Economic, Sociocultural, Technological, Legal, and Environmental factors.

## Climate-Related Driving Forces

The XRB defines climate-related driving forces (drivers) as "broad scale, external factors that may affect the outcomes of the focal question(s)".<sup>4</sup> During Step 2, participants identified the following climate-related drivers relevant for Aotearoa New Zealand's retail sector that were used to create pathways and narratives in Steps 3 and 4:

### Political Drivers

- International Ambition
- Domestic Ambition
- Domestic Legislation/Regulation
- Trade Barriers
- Politicisation of Climate Action
- Geopolitical Instability

### Environmental Drivers

- Physical Impacts of Climate Change – Domestic
- Physical Impacts of Climate Change – International
- Nature and Natural Resources
- Disease

### Social Drivers

- Changing Consumer Attitudes
- Changing Employee Attitudes
- Changing Demographics
- Changing Societal Expectations of 'Corporate Sustainability'
- Changing Societal Expectations of 'Worker Welfare'

### Technological Drivers

- Products, Packaging & Sales Technology
- Energy & CO2 Removal Technology

### Legal Drivers

- D&O Liabilities
- Exposure to Legal Action by Public
- Exposure to Legal Action by Government
- Compliance

### Economic Drivers

- Macro-economic Conditions
- Consumer Financial Strain
- Labour Market
- Finance Costs / Costs of Capital
- Cost & Availability of Insurance
- Shareholder / Investor Expectations

# Appendix D: NGFS framework and models

The NGFS scenario framework and economic models are far from perfect. For example, defining assumptions about fossil fuel investment levels and the roll-out of carbon capture and storage (CCS) technologies may be fundamentally out of alignment with science-based pathways to a 1.5°C world. Meanwhile, the current generation of NGFS Integrated Assessment Models fails to account for tail risks, second-order effects, potential non-linearities in climate-related risks (e.g. tipping points), and other potentially large sources of risk (e.g. an abrupt correction in asset prices when transition shocks result in the fire sale of assets in exposed sectors). Despite such significant shortcomings, the scenarios in this report are rooted in the NGFS framework and macroeconomic models because they:

- Are widely used by key partners in the retail sector value chain
- Provide relatively wide variable coverage, geography-specific granularity and a dataset that allows comparison across different climate models
- Represent the most comprehensive global macroeconomic, land and energy models currently available
- Are regularly updated and improved.

For further information on the benefits and limitations of using NGFS IAMs, see NGFS Technical Documentation and FAQs (Richters, et al., 2022; NGFS, n.d.b).

## Choice of Integrated Assessment Model

The NGFS has used three Integrated Assessment Models (IAMs) to explore future macroeconomic conditions. All NGFS macroeconomic data included in this report has been extracted from the REMIND-MAgPIE 3.0-4.4 IAM (and NiGEM REMIND-MAgPIE 3.0-4.4) (Hilaire & Bertram, 2020).

- MAgPIE (Model of Agricultural Production and its Impacts on the Environment) is a global, multi-regional economic land-use optimisation model designed for scenario analysis up to the year 2100. It focuses on the fulfilment of agricultural demand for ten world regions at minimum global costs under consideration of biophysical and socioeconomic constraints.
- REMIND (Regional Model of Investment and Development) is a global multiregional model incorporating the economy, the climate system and a detailed representation of the energy sector. REMIND enables analyses of technology options and policy proposals for climate change mitigation. The latest version includes a detailed representation of the transport sector with an explicit separation into freight and passenger transport for short-to-medium and long distances respectively.
- REMIND-MAgPIE is a 'comprehensive' IAM framework that simulates, in a forward-looking fashion, the dynamics within and between energy, land-use, water, air pollution and health, economy and climate systems up to 2100. It is the only NGFS IAM that generates New Zealand (regional) tailored data.

## NiGEM overlay

The Scenarios also utilise the NGFS NiGEM v1.22 overlay for REMIND-MAgPIE. NiGEM (National Institute Global Econometric Model) is the leading global macroeconomic model, relied upon by policymakers and private sector organisations around the world for economic forecasting, scenario building and stress testing.

It consists of individual country models for major economies which are linked together through trade in goods and services and integrated capital markets.

A key feature of the model is its flexibility which allows users to define the scenario space, including policy regimes, expectation formation by consumers, firms, wage setters or financial markets, and other assumptions and judgements. The IAM's reference scenario GDP pathway is a counterfactual long-term asymptotic GDP pathway that would emerge in the absence of either physical or transition shocks. NiGEM replicates the long-term, reference GDP pathways produced by the three IAMs, as well as the associated population and primary energy consumption pathways.

NiGEM overlays physical and transition 'shocks' under each temperature and policy profile. NiGEM transition scenario inputs are based on change in energy consumption type and emissions, 'useful energy' (the actual level of energy service (e.g. passenger-km, tonne-km) which can be satisfied by various technologies with different energy efficiency and carbon intensity), and carbon tax revenue. Transition shocks are focused on; Prices (carbon pricing raising prices of energy, and reduction in fossil fuel usage deflating prices; Taxation (carbon pricing an additional tax cost and revenue, and increasing costs of production); and Demand (decline in volume of demand for fossil fuels).

Simplified representations of acute physical risks (i.e., risks driven by the occurrence of extreme climatic events as a macroeconomic shock) have been included in the NiGEM model. The purpose of this is to complement the existing estimate of chronic physical risk estimates in the IAMs and capture the highly disruptive economic impacts of extreme events. It should be noted that 'regions' (such as New Zealand) in NiGEM consist of several countries, all with a differing frequency and severity of acute climate effects, so a weighted average approach to GDP impacts of historic damage is used.



# Appendix E: Physical parameters, CLIMsystems overview & disclaimer

## Introduction

Projections for the physical impacts of climate change in New Zealand were provided by CLIMsystems Limited drawing upon Coupled Model Inter-comparison Project phase 6 (CMIP6) and other data deemed appropriate by CLIMsystems. CMIP6 data has been developed under a new framework of socio-economic and emissions pathways, with some General Circulation Models (GCMs) accounting for climate processes and Earth system elements unavailable to earlier generations. As a result, projections for the physical impacts of climate change in this report should offer greater confidence than scenarios that rely on more commonly available CMIP5 projections.

## CLIMsystems Overview

CLIMsystems Limited are a professional climate modelling and risk assessment team. The parameters used in this report are based on CMIP6 and (Coupled Model Intercomparison Project) data (and other CMIP iterations where relevant) for the range of CMIP6 Shared Socioeconomic Pathways (SSPs): SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5. CLIMsystem data strictly follows IPCC guidelines in data modelling and application, and accessed and modelled using peer-reviewed methods. All algorithms and data sets used in modelling are thoroughly documented and traceable. CLIMsystems select and apply the best available dataset to carry out the site-specific study, including the data sources from national and international agencies for baseline study and the CMIP6 GCM ensemble approach for climate change projections. As such, this data represents the leading practice for reliable climate data for New Zealand climate scenario analysis.

## CLIMsystems Disclaimer

This report has been prepared exclusively for KPMG and the participants of the Retail Sector Climate Scenarios project, specifically The Warehouse Group Limited, Restaurant Brands New Zealand Limited, Woolworths New Zealand Limited, Smartpay Limited, KMD Brands Limited, Michael Hill New Zealand Limited, Briscoe Group Limited, and Hallenstein Glasson Holdings Limited (Recipients) and may not be relied upon by any other person without CLIMsystems' express written permission.

The conclusions presented in this report represent CLIMsystems' professional judgment based on data made available during this assignment. The conclusions are true and correct to the best of CLIMsystems' knowledge as at the date of the assessment.

This report is based on conditions encountered at the nominated site of climate data at the time of the report, and CLIMsystems disclaim responsibility for any changes that may have subsequently occurred.

CLIMsystems did not independently verify either written or oral information provided during this investigation. While CLIMsystems have no reason to doubt the accuracy of the information provided, the report is complete and accurate only to the extent that the information provided was itself complete and accurate. CLIMsystems take great care to ensure the climate change information in this assessment and products are as correct and accurate as possible. The climate change information provided is subject to the uncertainties of scientific and technical research; it may not be accurate, current, or complete; it may be subject to change without notice and is not a substitute for independent professional advice.

Users should obtain any appropriate professional advice relevant to their particular circumstances. CLIMsystems do not guarantee the information provided and accept no legal liability whatsoever arising from or connected to the use of any material contained therein.

As the climate change projections used are approximate by nature, it is possible that the climate change and ensuing consequences that occur may not be an exact fit to those assumed in this exercise. Climate change assessment, by its nature, is a dynamic and ongoing process. Therefore, it is recommended that the Recipient routinely incorporate the latest climate change impact knowledge into all future planning. It is recognised that there may be other impacts from climate change that could not be fully assessed in this process due to the limitations of the exercise. CLIMsystems recommend that the Recipients use their skill and care concerning their use of the climate change information, and those users carefully evaluate the accuracy, currency, completeness, and relevance of the material for their purposes. Any use of the data is solely at the Recipient's own risk. No party can rely upon the results of the assessments and plans.

To the extent permitted by law, CLIMsystems make no representation or warranty (expressed or implied) as to merchantability or performance of the data; about the fitness of the data for the permitted use; or that the data does not infringe the intellectual property rights or any other right of any person. This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

# Appendix F: Limitations and mitigation measures

## Inherent limitations

Climate change scenarios have inherent limitations, including:

- *Uncertainty:* Scenarios are based on assumptions about the future, and the future is intrinsically uncertain. Moreover, the speed at which climate-related impacts are evolving is unprecedented and little reliance can be placed on historical experience to assess their magnitude, timing, or how different climate-related forces might interact. This gives rise to a higher level of uncertainty.
- *Simplification:* Even the most complex scenarios are highly simplified representations of profoundly complex systems. They cannot capture all the nuances and interdependencies of the real world, and they may overlook important forces that can have a significant impact on the future.
- *Bias:* Scenarios are influenced by the assumptions and biases of the people that develop them. Different participants may develop different scenarios based on their own perspectives and assumptions.
- *Over-reliance:* Scenarios are useful tools for exploring different futures, but they should not be over-relied upon. They are just one of many tools that can help inform decision-making, and they should be used in conjunction with other methods and sources of information.

## SSP-RCP limitations

The UN Intergovernmental Panel on Climate Change (IPCC) Shared socio-economic Pathways (SSPs) and Representative Concentration Pathways (RCPs) contributing to the scenarios in this report are widely used but do have methodological limitations. The most significant of these limitations include:

- *Uncertainty:* SSP-RCP pairs are based on a range of uncertain factors, such as future greenhouse gas emissions and the effectiveness of climate policies.
- *Simplified assumptions:* SSPs and RCPs are based on simplified assumptions about the future, such as demographic trends, economic growth, and technological development. These assumptions may not accurately reflect the complexities of real-world social, economic, and technological systems.
- *Lack of integration:* SSP-RCP pairs do not fully integrate political, economic, social, technological, and environmental factors.
- *Inflexibility:* SSP-RCP pairs are static and do not consider physical or socio-economic feedback loops or tipping points.

This last point is particularly important.

## Tipping points and the precautionary principle

Tipping points in the Earth system can have a significant impact on the reliability of SSP-RCP scenarios. These scenarios are based on assumptions about the future, including greenhouse gas emissions, land use, and other factors that influence climate change. However, tipping points can cause sudden and unexpected changes to the Earth system, which can invalidate these assumptions.

For example, if a tipping point is reached in the Arctic, where melting permafrost releases large amounts of methane, it could significantly increase greenhouse gas emissions beyond what is predicted in the SSP-RCP scenarios. This could lead to more severe and rapid climate change impacts than what is anticipated in the scenarios.

Similarly, tipping points in the ocean, such as the collapse of the Atlantic Meridional Overturning Circulation (AMOC), could also have significant impacts on climate change. This could cause a rapid cooling of the North Atlantic, which is not accounted for in the SSP-RCP scenarios. This could have significant impacts on the reliability of the scenarios, as they may not accurately predict the future impacts of climate change if these tipping points are reached.

Overall, tipping points in the Earth system highlight the limitations of the SSP-RCP scenarios and the need for continued research and monitoring to better understand and account for these potential impacts.

## Physical parameters

Projections for the physical impacts of climate change in New Zealand were provided by CLIMsystems Limited drawing upon Coupled Model Inter-comparison Project phase 6 (CMIP6) and other data deemed appropriate by CLIMsystems. CMIP6 data has been developed under a new framework of socio-economic and emissions pathways, with some General Circulation Models (GCMs) accounting for climate processes and Earth system elements unavailable to earlier generations. As a result, projections for the physical impacts of climate change in this report should offer greater confidence than scenarios that rely on more commonly available CMIP5 projections.

## Socio-economic parameters

The Socio-economic projections in this report have been drawn from:

- The Integrated Assessment Model (IAM) Regionalized Model of Investments and Development-Model of Agricultural Production and its Impact on the Environment (REMIND-MAGPIE) 3.0-4.4 accessed via NGFS Scenario Explorer<sup>5</sup>
- The Climate Mapping and Damage Assessment (CLIMADA) model accessed via the Climate Analytics Climate Impact Explorer<sup>6</sup>
- The International Institute for Applied Systems Analysis (IIASA) Shared socio-economic Pathways (SSP) Database<sup>7</sup>
- The New Zealand Climate Change Commission's 'Ināia tonu nei: a low emissions future for Aotearoa' datasets<sup>8</sup>
- The New Zealand Treasury's Recommended Shadow Emission Values.<sup>9</sup>

REMIND-MAGPIE combines the MAGPIE model of the global economy with the REMIND model of regional energy systems to (a.) explore the relationships between climate change, greenhouse gas emissions, and socio-economic factors and (b.) assess the impacts of climate change mitigation policies. Meanwhile, the CLIMADA model simulates the potential impacts of climate change on a range of sectors using climate projections, socio-economic data, and environmental data.

The REMIND-MAGPIE and CLIMADA models have undergone extensive peer review and are widely used. However, like all models, they are subject to limitations and uncertainties, particularly with regards to capturing the full complexity of the systems they seek to model. Ongoing efforts to improve the accuracy and usefulness of these models through better data sources and modelling techniques are important for enhancing their value to decision-makers in retail and other sectors.

Of note, all NGFS models are currently based on the use of IPCC SSP2, in combination with the previous generation of IPCC RCPs, both of which have been superseded by the latest generation of IPCC SSPs used elsewhere in this report. For more information about the state of NGFS IAMs, the rationale for specific socio-economic models used in this report, and their inherent limitations see Appendix D.

## Combining higher-level, publicly available scenarios

The sector-specific scenarios in this report blend NGFS, IPCC, and CCC 'backbone' (i.e. high-level, sector-agnostic) scenarios, allowing for greater granularity and breadth of decision-relevant insights. However, this approach comes at a cost, especially:

- **Friction:** NGFS, IPCC, and CCC scenarios were not designed to be integrated. They have been developed using different methodologies, assumptions, and models, which makes it difficult to blend them in 'frictionless' narratives. Apparent inconsistencies and/or contradictions can undermine credibility in the eyes of end-users.<sup>10</sup>
- **Complexity:** Blending multiple scenarios increases the complexity of analysis, which can make interpretation and communication more difficult.

Overall, blending well-recognised backbone scenarios can be useful for exploring the potential impacts of climate change and making well-informed decisions.

## Mitigation measures

In order to help address known risks and limitations, the Project has:

- Developed challenging scenarios that capture a wide range of possible outcomes
- Incorporated feedback loops and non-linearities in socio-economic and Earth systems
- Employed a collaborative process leveraging a range of professional disciplines, experiences, and perspectives across the retail sector value chain
- Sought to expose implicit assumptions and potential biases through an external review panel of international experts in the retail sector.

## A final word of caution

Climate *science* may be moving more slowly than climate *change*, and the projections in this report may significantly underestimate the extent and/or timing of physical impacts. As such, users should apply the precautionary principle when making material decisions in the face of deep and dynamic uncertainty.

# Appendix G: End notes

## Section 1: Executive Summary

1. IPCC, 2023a.
2. MBIE, 2023
3. Parliamentary Counsel Office, 2021
4. TCFD, 2017
5. XRB, 2022
6. XRB, 2022
7. In a paper published 17 April 2023 in the journal Earth System Science Data, an international group of researchers estimated that, between 1971 and 2020, around 380 zettajoules - that is, 380,000,000,000,000,000,000 joules - of energy has been trapped by global warming. This has been estimated as equivalent to around 25 billion times the energy released during the detonation of "Little Boy," the atomic bomb dropped on Hiroshima, Japan, on Aug. 6, 1945. See: von Schuckmann, et al., 2023 and King & Sherwood, 2023.
8. The World Meteorological Organisation's 'State of the Global Climate 2022' report, published in 2023, states that the global mean temperature for 2022, which combines near-surface temperature measurements over land and ocean, was 1.15 (1.02–1.28)°C above the 1850–1900 pre-industrial average. A recent change in La Niña conditions is associated with the temporary reduction in global mean temperatures, making 2021/22 cooler than 2019/20. See: WMO, 2023.
9. United Nations, n.d.b
10. XRB, 2022

11. UNEP, 2022
12. XRB, 2022, pp. 12
13. XRB, 2022, pp. 14
14. IPCC, 2021a
15. IPCC, 2018

## Section 2: The Scenarios

1. TCFD, 2016
2. NGFS, 2022b
3. The global and New Zealand temperature figures on the scenario overview slides are retrieved from different sources. These sources have some discrepancies in their projections due to model type, date of calculation and the inherent uncertainty of climate outcome projections. The below figures provide average projections of surface temperature warming above pre-industrial (1850-1900 baseline) levels for each scenario from different sources. For the 'Global warming at 2050' and 'Global warming at 2100', we used IPCC AR6 figures. These figures are typically higher than NGFS. However, IPCC AR6 is not only the authoritative source on global warming projections but, given the uncertainty around surface temperature rise and that all of these projections are provided as ranges, we wanted to employ the precautionary principle. For 2100 New Zealand average surface temperature projections, we used NGFS Climate Impact Explorer due to data availability. Note, this may provide a lower temperature compared to localised AR6 projections, which were not received from

CLIMsystems Limited.

'Global warming at 2050' figures:

- NGFS-IIASA Scenario Explorer\* (NGFS, 2022a)
  - Net Zero 2050: 1.554°C
  - Delayed Transition 1.746°C
  - Current Policies: 2.039°C
- IPCC AR6 (Fyfe, et al., 2021)
  - Net Zero 2050: 1.565°C
  - Delayed Transition 1.723°C
  - Current Policies: 2.100°C
- NGFS Climate Impact Explorer (Climate Analytics, n.d.)
  - Net Zero 2050: N/A
  - Delayed Transition N/A
  - Current Policies: N/A

'Global warming at 2100' \*\*\* figures:

- 'NGFS-IIASA Scenario Explorer\* (NGFS, 2022a)
  - Net Zero 2050: 1.379°C
  - Delayed Transition 1.613°C
  - Current Policies: 3.196°C
- IPCC AR6\*\* (Fyfe, et al., 2021)
  - Net Zero 2050: 1.384°C
  - Delayed Transition 1.723°C
  - Current Policies: 3.908°C
- NGFS Climate Impact Explorer (Climate Analytics, n.d.)
  - Net Zero 2050: N/A
  - Delayed Transition N/A
  - Current Policies: N/A

'New Zealand warming at 2100'\*\*\* figures:

- NGFS-IIASA Scenario Explorer\* (NGFS, 2022a)
  - Net Zero 2050: N/A
  - Delayed Transition N/A
  - Current Policies: N/A
- IPCC AR6 (Fyfe, et al., 2021)
  - Net Zero 2050: N/A
  - Delayed Transition N/A
  - Current Policies: N/A
- NGFS Climate Impact Explorer (Climate Analytics, n.d.)
  - Net Zero 2050: 1.3°C
  - Delayed Transition 1.6°C
  - Current Policies: 3.0°C

\*All figures retrieved using selection of REMIND-MAGPIE 3.0-4.4 model.

\*\*2100 figures for IPCC AR6 data taken at the 2099 point. 2100 data not available in dataset. This year-specific selection also explains any differences to the 'best estimate' figures in the IPCC's 'Summary for Policymakers' (IPCC, 2021b) which takes the average over that time band.

\*\*\*Note – CLIMsystems CMIP6 temperature data for New Zealand only retrieved up to 2050 by CLIMsystems Ltd.

4. IPCC, 2023a
5. Deloitte, 2022
6. Informed by the '100% Smart,' 'Kicking, Screaming,' and 'Homo Economicus' Shared-climate Policy Assumptions for New Zealand (SPANZ) See: Frame & Reisinger, 2016



7. Within this report, 'Active' packaging refers to packaging that has been designed to actively interact with the product inside the packaging, such as by releasing or absorbing certain substances to maintain product freshness or extend shelf life. 'Intelligent' packaging, on the other hand, refers to packaging that incorporates technology such as sensors, RFID tags, or QR codes to provide information about the product or monitor its condition. 'Smart' packaging is a broader term that encompasses both active and intelligent packaging, and refers to packaging that has been designed to provide additional value beyond basic protection and containment of the product. This can include features such as interactive packaging, augmented reality, or personalized packaging experiences. See: BPAK, 2022 or Kuswandi & Jumina, 2020, and AIPIA, n.d.
8. University of Oxford, 2022
9. New Zealand is using a system of 'emissions budgets' to meet its 2050 target. The Government published the first three emissions budgets (2022–2025, 2026–2030, 2031–2035) in May 2022. The emissions reduction plan setting out policies and strategies for meeting emissions budgets was published on 16 May 2022. Progress is monitored by the Climate Change Commission, as outlined in the Climate Change Response Act (2002). The budget for between 2026 and 2030 averages at 61 megatonnes per year, 18.1% below average annual emissions from 2017 to 2021. The third budget - between 2031 and 2035 - averages out at 48 megatonnes per year, 35.5% below average annual emissions from 2017 to 2021. See: MfE, 2022.
10. UNFCCC, n.d.
11. Nielson, 2020
12. The Guardian, 2023
13. Within the context of this Report, a sharing economy is characterised by short-term transactions to share the use of idle assets and services or to facilitate collaboration. The sharing economy often involves some type of online platform that connects buyers and sellers. In a sharing economy, idle assets such as parked cars, spare bedrooms, tools, or clothing can be rented out when not in use. The sharing economy is rapidly growing and evolving but faces significant challenges in the form of regulatory uncertainty and concerns about abuses. Sharing economies allow individuals and groups to make money from underused assets. The sharing economy has evolved over the past few years and now serves as an all-encompassing term that refers to a host of on-line peer-to-peer and business-to-business economic transactions. Examples include: companies that provide shared open work spaces for freelancers, entrepreneurs, and work-from-home employees; companies that allow for individuals to lend money to other individuals at rates cheaper than those offered through traditional credit lending entities; and sites that allow for individuals to sell or rent their clothes. Freelancing Platforms: Sites that offer to match freelance workers across a wide spectrum ranging from traditional freelance work to services traditionally reserved to handymen. Spurred primarily with the growth of Uber and Airbnb, the value of the sharing economy is forecast to reach \$335 billion by 2025. See: Investopedia, 2020.
14. Just Food, 2023
15. C E Delft, 2023
16. United Nations, n.d.a
17. MFAT, 2023
18. MFAT, 2023
19. MfE, 2023a
20. MfE, 2023b
21. Habibullah, et al., 2022
22. Kantar, 2023
23. New Zealand has become an increasingly diverse country, with 200+ ethnicities and 190+ languages spoken. By 2038, the European/Pakeha share of the population is projected to decrease, whilst Māori will increase to 18%, Asian to 22% and Pasifika to 10%. See: SportNZ, 2018
24. SportNZ, 2018
25. University of Auckland, 2019
26. In a March 2023 survey of 24,000 people across 24 countries, nearly half of self-identified higher income respondents reported considering switching jobs to work for a more sustainable company, compared to only 13% of lower income counterparts (Deloitte, 2023). See, also: KPMG, 2023
27. RNZ, 2022
28. WEF, 2018
29. The Guardian, 2023
30. WEF, 2022
31. Eskander, et al., 2020
32. Preston, 2020
33. Eskander, et al., 2020
34. Parliamentary Counsel Office, 2021
35. ANZ, 2023
36. McKinsey, 2022a
37. BNP Paribas, 2022
38. C E Delft, 2023
39. Science Direct, n.d.
40. Local Government Association, 2022
41. Local Government Association, 2022
42. BPAK, 2022
43. United Nations Sustainable Development, 2021
44. BPAK, 2022
45. Deloitte, 2023
46. Local Government Association, 2022
47. United Nations Sustainable Development, 2021
48. University of Auckland, 2023
49. CLIMADA, 2021
50. Riahi, et al., 2017
51. NGFS, 2022a
52. NGFS, 2022a
53. NGFS, 2022a
54. CCC, 2021a
55. NGFS, 2022a
56. New Zealand Treasury, 2022a
57. SSP Public Database, 2018
58. SSP Public Database, 2018
59. University of Auckland, 2023
60. MfE, 2023b
61. MfE, 2023b
62. University of Auckland, 2023
63. Habibullah, et al., 2022
64. Kantar, 2023
65. KPMG, 2023
66. BPAK, 2022

67. Australian Institute of Company Directors, 2022
68. McKinsey, 2022b
69. ICNZ, 2023
70. University of Auckland, 2023
71. Elle, 2019
72. Science Direct, n.d.
73. The World Economic Forum (WEF) defines polycrisis as “a cluster of related global risks with compounding effects, such that the overall impact exceeds the sum of each part”. See: WEF, 2023.
74. University of Auckland, 2023
75. Carbon Brief, 2023
76. WEF, 2023
77. University of Auckland, 2023
78. Finkel, et al., 2020
79. New Zealand Parliament, 2022
80. Minter Ellison Rudd Watts, 2023
81. WWF, 2021
82. New Zealand Treasury, 2022b
83. BERL, 2022
84. LSE, 2022
85. Lawyers for Climate Action NZ, 2022
86. WEF, 2020
87. Wada, et al., 2016
88. University of Auckland, 2023
89. Ministry of Transport, 2022
90. StatsNZ, 2018
91. Tonnang, et al., 2022
92. Habibullah, et al., 2022
93. Kantar, 2023
94. KPMG, 2023
95. Al Jazeera, 2023
96. WHO, 2022
97. NZIOTA, 2022
98. Opimas, 2019
99. Courts of New Zealand, 2022
100. Eskander, et al., 2020
101. StatsNZ, 2023
102. Hanson, et al., 2011
103. Semedo, et al., 2011
104. StatsNZ, 2018
105. Science Daily, 2023
106. IPCC, 2018
107. Kubiszewski, et al., 2017
108. StatsNZ, 2018
109. University of Auckland, 2023

### Section 3: Comparative Visualisation

1. WMO, 2023
2. IPCC, 2021b
3. NIWA, n.d.
4. Climate Analytics, 2022
5. Australian Government, n.d.
6. NZIC, 2023
7. NIWA, 2023

### Section 4: Technical Appendices

1. Frame & Reisinger, 2016
2. 'W/m2' stands for watts per square meter. It is a unit of measurement used to express the amount of power or energy transferred per unit area. In the context of climate change, 'W/m2' is often used to express the radiative forcing of greenhouse gases, which is the difference between the amount of energy that the Earth receives from the sun and the amount of energy that the Earth radiates back to space. An increase in greenhouse gas concentrations leads to an increase in radiative forcing, which can cause global temperatures to rise.
3. For further insights into the limitations of RCP 8.5, see for example (Hausfather & Peters, 2020) or (Riahi et al., 2011). For further insights into positive tipping points, see for example (Systemiq et al., 2023) and (Stern, 2022).
4. XRB, 2023
5. NGFS, 2022a
6. Climate Analytics, n.d.
7. SSP Public Database, 2018
8. CCC, n.d.
9. New Zealand Treasury, 2022a
10. The XRB recognises that higher-level, publicly available scenarios have not been designed to be integrated and will not neatly align. Nor, according to the XRB, do they need to “where the aim at sectoral level is simply a broad-brush framing of plausible future outcomes in a few key factors of interest.

Waiting for all providers of higher-level scenarios, pathways and projections to align on methods, inputs and assumptions would require sectors to wait many years, or draw on a much narrower range of inputs” (XRB, 2023, pp. 42-43).

# Appendix H: References

- AIPIA, n.d.. The Smart Packaging Association. [Online] Available at: <https://www.aipia.info/> [Accessed July 2023].
- Al Jazeera, 2023. *India's heat putting economy, development goals at risk: Study*. [Online] Available at: <https://www.aljazeera.com/news/2023/4/20/indias-heat-putting-economy-development-goals-at-risk-study> [Accessed July 2023].
- ANZ, 2023. *Roy Morgan Consumer Confidence*. [Online] Available at: <https://www.anz.co.nz/about-us/economic-markets-research/consumer-confidence/> [Accessed July 2023].
- Australian Government, n.d.. *Why do 100 year events happen so often?*. [Online] Available at: <http://www.bom.gov.au/water/designRainfalls/rainfallEvents/why100years.shtml> [Accessed July 2023].
- Australian Institute of Company Directors, 2022. *Beware the risk of greenwashing*. [Online] Available at: <https://www.aicd.com.au/risk-management/framework/climate/beware-the-risk-of-greenwashing.html> [Accessed July 2023].
- BERL, 2022. *Lack of consumer confidence signals tough times ahead*. [Online] Available at: <https://www.berl.co.nz/economic-insights/lack-consumer-confidence-signals-tough-times-ahead> [Accessed July 2023].
- BNP Paribas, 2022. *Decade of growth in green finance underlines opportunity to scale up action*. [Online] Available at: <https://cib.bnpparibas/decade-of-growth-in-green-finance-underlines-opportunity-to-scale-up-action/> [Accessed July 2023].
- BPAK, 2022. *Connected: The Internet of Packaging*. [Online] Available at: <https://bpak.com/connected-the-internet-of-packaging/> [Accessed July 2023].
- C E Delft, 2023. *Shipping GHG emissions 2030: Analysis of the maximum technical abatement potential*. [Online] Available at: [https://safety4sea.com/wp-content/uploads/2023/06/CE-shipping-ghg-emissions-2030-2023\\_06.pdf](https://safety4sea.com/wp-content/uploads/2023/06/CE-shipping-ghg-emissions-2030-2023_06.pdf) [Accessed July 2023].
- Carbon Brief, 2023. *Guest post: What 'credible' climate pledges mean for future global warming*. [Online] Available at: <https://www.carbonbrief.org/guest-post-what-credible-climate-pledges-mean-for-future-global-warming/> [Accessed July 2023].
- CCC, 2021a. *Data and Modelling: 2021 Draft Advice Scenarios Dataset*. [Online] Available at: <https://www.climatecommission.govt.nz/public/lnai-a-tonu-nei-a-low-emissions-future-for-Aotearoa/Modelling-files/Scenarios-dataset-2021-final-advice.xlsx> [Accessed July 2023].
- CCC, n.d.. *Modelling and data*. [Online] Available at: <https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/lnai-a-tonu-nei-a-low-emissions-future-for-aotearoa/modelling/> [Accessed July 2023].
- CLIMADA, 2021. *CLIMADA-project/climada\_python: v2.1.1*. [Online] Available at: <https://climate-impact-explorer.climateanalytics.org/> [Accessed July 2023].
- Climate Analytics, n.d. *Climate Impact Explorer*. [Online] Available at: <https://climate-impact-explorer.climateanalytics.org/> [Accessed July 2023].
- Climate Analytics, 2022. *Methodology*. [Online] Available at: <https://climate-impact-explorer.climateanalytics.org/methodology/#two3-climada> [Accessed July 2023].
- CLIMsystems, 2023. *Downscaled Coupled Model Intercomparison Project 6 (CMIP6) data for the range of CMIP6 Shared socio-economic Pathways (SSPs): SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0, SSP5-8.5*. Provided May 2023, from: CLIMsystems Ltd.
- Courts of New Zealand, 2022. *Michael John Smith v Fonterra Co-Operative Group Limited SC149/2021*. [Online] Available at: <https://www.courtsofnz.govt.nz/cases/michael-john-smith-v-fonterra-co-operative-group-limited-genesis-energy-limited-dairy-holdings-limited-new-zealand-steel-limited-z-energy-limited-new-zealand-refining-company-limited-and-bt-mining-limited> [Accessed July 2023].
- Deloitte, 2022. *The Turning Point: A Global Summary*. [Online] Available at: <https://www.deloitte.com/global/en/issues/climate/global-turning-point.html> [Accessed July 2023].
- Deloitte, 2023. *Aotearoa New Zealand's Turning Point*. [Online] Available at: <https://www2.deloitte.com/content/dam/Deloitte/nz/Documents/about-deloitte/nz-turning-point-report.pdf> [Accessed July 2023].
- Elle, 2019. *Virtual fashion: the digitally generated clothes appearing on your IG influencer feeds*. [Online] Available at: <https://www.elle.com/uk/fashion/a28166986/digital-fashion-dressing-virtually/> [Accessed July 2023].
- Eskander, S. M., Fankhauser, S. & Setzer, J., 2020. Global Lessons from Climate Change Legislation and Litigation. *Environment and Energy Policy and the Economy*, Volume 2, pp. 45-82.

- Finkel, E. J., Bail, C. A., Cikara, M. & Ditto, P. H., 2020. Political sectarianism in America: A poisonous cocktail of othering, aversion, and moralization poses a threat to democracy. *Science*, 370(6516), pp. 533-536.
- Frame, B. & Reisinger, A., 2016. *Climate Changes, Impacts and Implications for New Zealand to 2100, Synthesis Report: RA5, Exploring Options for New Zealand under Different Global Climates*. [Online] Available at: <https://niwa.co.nz/sites/niwa.co.nz/files/RA5-Synthesis-report.pdf> [Accessed July 2023].
- Fyfe, J., Fox-Kemper, B., Kopp, R. & Garner, G., 2021. *Summary for Policymakers of the Working Group I Contribution to the IPCC Sixth Assessment Report - data for Figure SPM.8 (v20210809)*. NERC EDS Centre for Environmental Data Analysis. [Online] Available at: <https://catalogue.ceda.ac.uk/uuid/98af2184e13e4b91893ab72f301790db> [Accessed July 2023].
- Habibullah, M. S., Din, B. H., Tan, S.-H. & Zahid, H., 2022. Impact of climate change on biodiversity loss: global evidence. *Environmental Science and Pollution Research*, 29(9), pp. 1073-1086.
- Hanson, S., Nicholls, R., Ranger, N. & Hallegatte, S., 2011. A global ranking of port cities with high exposure to climate extremes. *Climatic Change*, Volume 104, pp. 89-111.
- Hausfather, Z. & Peters, G., 2020. Emissions – the ‘business as usual’ story is misleading. *Nature*, Volume 577, pp.618-620.
- Hilaire, J. & Bertram, C., 2020. *The REMIND-MAGPIE model and scenarios for transition risk analysis. A report prepared by PIK for the UNEP-FI Banking Pilot project (Phase 2)*, Potsdam: Potsdam-Institut für Klimafolgenforschung.
- ICNZ, 2023. *2022 Confirmed as Record Year for Climate Claims*. [Online] Available at: <https://www.icnz.org.nz/industry/media-releases/2022-confirmed-as-record-year-for-climate-claims/> [Accessed July 2023].
- ILO, n.d.. Frequently Asked Questions on just transition. [Online] Available at: [https://www.ilo.org/global/topics/green-jobs/WCMS\\_824102/lang--en/index.htm](https://www.ilo.org/global/topics/green-jobs/WCMS_824102/lang--en/index.htm) [Accessed July 2023].
- Investopedia, 2020. *Sharing Economy: Model Defined, Criticisms, and How It's Evolving*. [Online] Available at: <https://www.investopedia.com/terms/s/sharing-economy.asp#The%20Sharing%20Economy%20Is%20Evolving> [Accessed July 2023].
- IPCC, 2018. *Special Report: Global Warming of 1.5°C - Impacts of 1.5°C of Global Warming on Natural and Human Systems*. [Online] Available at: <https://www.ipcc.ch/sr15/chapter/chapter-3/> [Accessed July 2023].
- IPCC, 2021a. *Climate change widespread, rapid, and intensifying*. [Online] Available at: <https://www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/> [Accessed July 2023].
- IPCC, 2021b. *Summary for Policy Makers*. [Online] Available at: [https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC\\_AR6\\_WGI\\_SPM.pdf](https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf) [Accessed July 2023].
- IPCC, 2023a. *AR6 Synthesis Report: Climate Change 2023*. [Online] Available at: <https://www.ipcc.ch/report/sixth-assessment-report-cycle/> [Accessed July 2023].
- Just Food, 2023. *Nestlé to walk away from ‘carbon neutral’ claims*. [Online] Available at: <https://www.just-food.com/news/nestle-to-walk-away-from-carbon-neutral-claims/> [Accessed July 2023].
- Kantar, 2023. *Better Futures Report 2023*. [Online] Available at: <https://www.kantarnewzealand.com/latest-thinking/better-futures/> [Accessed July 2023].
- King, A. & Sherwood, S., 2023. *Two trillion tonnes of greenhouse gases, 25 billion nukes of heat: are we pushing Earth out of the Goldilocks zone?*. [Online] Available at: <https://theconversation.com/two-trillion-tonnes-of-greenhouse-gases-25-billion-nukes-of-heat-are-we-pushing-earth-out-of-the-goldilocks-zone-202619> [Accessed July 2023].
- KPMG, 2023. *Climate quitting - younger workers voting with their feet on employer's ESG commitments*. [Online] Available at: <https://kpmg.com/uk/en/home/media/press-releases/2023/01/climate-quitting-younger-workers-voting-esg.html> [Accessed July 2023].
- Kubiszewski, I., Costanza, R., Anderson, S. & Sutton, P., 2017. The future value of ecosystem services: Global scenarios and national implications. *Ecosystem Services*, 26(A), pp. 289-301.
- Kuswandi, B. & Jumina, 2020. 12 - Active and intelligent packaging, safety, and quality controls. In: M. W. Siddiqui, ed. *Fresh-Cut Fruits and Vegetables*. London: Academic Press, pp. 243-294.
- Lawyers for Climate Action NZ, 2022. *Z Energy to face commerce commission complaint for greenwashing*. [Online] Available at: <https://www.lawyersforclimateaction.nz/news-events/z-energy-to-face-commerce-commission-complaint-for-greenwashing> [Accessed July 2023].
- Local Government Association, 2022. *Creating resilient and revitalised high streets in the ‘new normal’*. [Online] Available at: <https://www.local.gov.uk/publications/creating-resilient-and-revitalised-high-streets-new-normal> [Accessed July 2023].
- LSE, 2022. *Global trends in climate change litigation: 2022 snapshot*. [Online] Available at: <https://www.lse.ac.uk/granthaminstitute/publication/global-trends-in-climate-change-litigation-2022/> [Accessed July 2023].
- MBIE, 2023. *Mandatory climate-related disclosures*. [Online] Available at: <https://www.mbie.govt.nz/business-and-employment/business/regulating-entities/mandatory-climate-related-disclosures/> [Accessed July 2023].



- McKinsey, 2022a. *The net zero challenge: Accelerating decarbonisation worldwide*. [Online] Available at: <https://www.mckinsey.com/capabilities/sustainability/our-insights/the-net-zero-challenge-accelerating-decarbonization-worldwide> [Accessed July 2023].
- McKinsey, 2022b. *Economic conditions outlook during turbulent times, December 2022*. [Online] Available at: <https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/economic-conditions-outlook-2022> [Accessed July 2023].
- MFAT, 2023. *Agreement on Climate Change, Trade and Sustainability (ACCTS) negotiations*. [Online] Available at: <https://www.mfat.govt.nz/en/trade/free-trade-agreements/trade-and-climate/agreement-on-climate-change-trade-and-sustainability-accts-negotiations/> [Accessed July 2023].
- MfE, 2022. *Emissions budget and the emissions reduction plan*. [Online] Available at: <https://environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/emissions-budgets-and-the-emissions-reduction-plan/> [Accessed July 2023].
- MfE, 2023a. *Aotearoa New Zealand Waste Strategy*. [Online] Available at: <https://environment.govt.nz/what-government-is-doing/areas-of-work/waste/aotearoa-new-zealand-waste-strategy/> [Accessed July 2023].
- MfE, 2023b. *Government climate-change work programme*. [Online] Available at: <https://environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/about-new-zealands-climate-change-programme/#policy-framework> [Accessed July 2023].
- Ministry of Transport, 2022. *New Zealand freight & supply chain issues paper*. [Online] Available at: [https://consult.transport.govt.nz/policy/new-zealand-freight-and-supply-chain-issues/supporting\\_documents/Freight%20and%20supply%20chain%20issues%20paper%20%20A3%20summary.pdf](https://consult.transport.govt.nz/policy/new-zealand-freight-and-supply-chain-issues/supporting_documents/Freight%20and%20supply%20chain%20issues%20paper%20%20A3%20summary.pdf) [Accessed July 2023].
- Minter Ellison Rudd Watts, 2023. *Flood, landslips, cyclones and locusts*. [Online] Available at: <https://www.minterellison.co.nz/insights/floods-landslips-cyclones-and-locusts> [Accessed July 2023].
- New Zealand Parliament, 2022. *Survey of the New Zealand Public (February 2022)*. [Online] Available at: <https://www.parliament.nz/en/footer/about-us/parliamentary-engagement/engagement-research/survey-of-the-new-zealand-public-february-2022/> [Accessed July 2023].
- New Zealand Treasury, 2022a. *CBAX Tool User Guidance*. [Online] Available at: <https://www.treasury.govt.nz/sites/default/files/2022-10/cbax-guide-oct22.pdf#page=80> [Accessed 2023].
- New Zealand Treasury, 2022b. *A new Treasury paper and dashboard reveal wellbeing trends in New Zealand*. [Online] Available at: <https://www.treasury.govt.nz/publications/media-statement/new-treasury-paper-and-dashboard-reveal-wellbeing-trends-new-zealand> [Accessed July 2023].
- NGFS, 2022a. *NGFS Phase 3 Scenario Explorer*. [Online] Available at: <https://data.ene.iiasa.ac.at/ngfs/#/login?redirect=%2Fworkspaces> [Accessed July 2023].
- NGFS, 2022b. *NGFS Scenarios for central banks and supervisors*. [Online] Available at: [https://www.ngfs.net/sites/default/files/medias/documents/ngfs\\_climate\\_scenarios\\_for\\_central\\_banks\\_and\\_supervisors\\_.pdf.pdf](https://www.ngfs.net/sites/default/files/medias/documents/ngfs_climate_scenarios_for_central_banks_and_supervisors_.pdf.pdf) [Accessed July 2023].
- NGFS, n.d.b. NGFS Scenarios Portal: Frequently asked questions. [Online] Available at: <https://www.ngfs.net/ngfs-scenarios-portal/faq/> [Accessed July 2023].
- Nielson, 2020. *Wise up to Women*. [Online] Available at: <https://www.nielsen.com/insights/2020/wise-up-to-women/> [Accessed July 2023].
- NIWA, 2023. *Drought indicator charts*. [Online] Available at: <https://niwa.co.nz/climate/information-and-resources/drought/charts> [Accessed July 2023].
- NIWA, n.d.. *Sea levels and sea-level rise*. [Online] Available at: <https://niwa.co.nz/natural-hazards/hazards/sea-levels-and-sea-level-rise> [Accessed July 2023].
- NZIC, 2023. *The 2023 Auckland Anniversary weekend storm*. [Online] Available at: <https://tewaihang.govt.nz/our-work/research-insights/the-2023-auckland-anniversary-weekend-storm> [Accessed July 2023].
- NZIOTA, 2022. *IoT tech allowing a more sustainable NZ*. [Online] Available at: <https://iotalliance.org.nz/iot-tech-allowing-a-more-sustainable-nz/> [Accessed July 2023].
- Opimas, 2019. *ESG data is now worth it*. [Online] Available at: <https://www.opimas.com/research/742/detail/> [Accessed July 2023].
- Parliamentary Counsel Office, 2021. *Financial Sector (Climate-related Disclosures and Other Matters) Amendment Act 2021*. [Online] Available at: <https://www.legislation.govt.nz/act/public/2021/0039/latest/LMS479633.html> [Accessed July 2023].
- Preston, B. J., 2020. The Influence of the Paris Agreement on Climate Litigation: Causation, Corporate Governance and Catalyst (Part II). *Journal of Environmental Law*, 33(2), pp. 227-256.
- Riahi, K., van Vuuren, D. P., Kriegler, E. & Edmonds, J., 2017. The Shared socio-economic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview. *Global Environmental Change*, Volume 42, pp. 153-168.

- Richters, O. et al., 2022. *NGFS Climate Scenario Database: Technical Documentation V3.1*. [Online] Available at: [https://www.ngfs.net/sites/default/files/media/2022/11/21/technical\\_documentation\\_ngfs\\_scenarios\\_page\\_3.pdf](https://www.ngfs.net/sites/default/files/media/2022/11/21/technical_documentation_ngfs_scenarios_page_3.pdf) [Accessed July 2023].
- RNZ, 2022. *Four-day work week sees increase in employee productivity*. [Online] Available at: <https://www.rnz.co.nz/news/business/468717/four-day-work-week-sees-increase-in-employee-productivity> [Accessed July 2023].
- Science Daily, 2023. *Climate change could cause 'disaster' in the world's oceans*. [Online] Available at: <https://www.sciencedaily.com/releases/2023/01/230104154305.htm> [Accessed July 2023].
- Science Direct, n.d.. *e-textiles: an overview*. [Online] Available at: <https://www.sciencedirect.com/topics/engineering/e-textiles> [Accessed July 2023].
- Semedo, A., Sušelj, K., Rutgersson, A. & Sterl, A., 2011. A Global View on the Wind Sea and Swell Climate and Variability from ERA-40. *Journal of Climate*, 24(5), pp. 1461-1479.
- SportNZ, 2018. *Think Piece: Demographic Change*. [Online] Available at: <https://sportnz.org.nz/media/4300/futures-think-piece-demographic-change.pdf> [Accessed July 2023].
- SSP Public Database, 2018. *SSP Database (Shared socio-economic Pathways) - Version 2.0*. [Online] Available at: <https://tntcat.iiasa.ac.at/SspDb/dsd?Action=htmlpage&page=10> [Accessed July 2023].
- StatsNZ, 2018. *Estimated long-term soil erosion*. [Online] Available at: <https://www.stats.govt.nz/indicators/estimated-long-term-soil-erosion> [Accessed July 2023].
- StatsNZ, 2023. *Migration*. [Online] Available at: <https://www.stats.govt.nz/topics/migration> [Accessed July 2023].
- Stern, N., 2022. A Time for Action on Climate Change and a Time for Change in Economics. *The Economic Journal*, Volume 132, pp.1259-1289.
- Systemiq, University of Exeter, Bezos Earth Fund, 2023. *The Breakthrough Effect: How to trigger a cascade of tipping points to accelerate the net zero transition*. [Online] Available at: <https://www.systemiq.earth/breakthrough-effect/> [Accessed July 2023].
- TCFD, 2016. *Technical Supplement: The use of scenario analysis in disclosure of climate-related risks and opportunities*. [Online] Available at: <https://www.fsb.org/wp-content/uploads/Recommendations-of-the-Task-Force-on-Climate-related-Financial-Disclosures-Supplement.pdf#page=5> [Accessed July 2023].
- TCFD, 2017. *Final Report: Recommendations of the task force on climate-related financial disclosures*. [Online] Available at: <https://assets.bbhub.io/company/sites/60/2021/10/FINAL-2017-TCFD-Report.pdf> [Accessed July 2023].
- The Guardian, 2023. *Seismic shift: Younger Australians reject idea humans have right to use nature for own benefit, survey shows*. [Online] Available at: <https://www.theguardian.com/environment/2023/jun/23/seismic-shift-younger-australians-reject-idea-humans-have-right-to-use-nature-for-own-benefit-survey-shows> [Accessed July 2023].
- Tonnang, H. E., Sokame, B. M., Abdel-Rahman, E. M. & Dubois, T., 2022. Measuring and modelling crop yield losses due to invasive insect pests under climate change. *Current Opinion in Insect Science*, Volume 50, pp. 1-8.
- UNEP, 2022. *Emissions Gap Report 2022*. [Online] Available at: <https://www.unep.org/resources/emissions-gap-report-2022> [Accessed July 2023].
- UNFCCC, n.d.. *Global Stocktake*. [Online] Available at: <https://unfccc.int/topics/global-stocktake> [Accessed July 2023].
- United Nations Sustainable Development, 2021. *A New Global Framework for Managing Nature Through 2030: 1st Detailed Draft Agreement Debuts*. [Online] Available at: <https://www.un.org/sustainabledevelopment/blog/2021/07/a-new-global-framework-for-managing-nature-through-2030-1st-detailed-draft-agreement-debuts/> [Accessed July 2023].
- United Nations, n.d.a. *The Paris Agreement*. [Online] Available at: <https://www.un.org/en/climatechange/paris-agreement> [Accessed July 2023].
- United Nations, n.d.b. *Net Zero Coalition*. [Online] Available at: <https://www.un.org/en/climatechange/net-zero-coalition> [Accessed July 2023].
- University of Auckland, 2019. *Can kaitiakitanga save the planet?*. [Online] Available at: <https://www.auckland.ac.nz/en/news/2019/12/20/can-kaitiakitanga-save-planet.html> [Accessed July 2023].
- University of Auckland, 2023. *Addressing the challenges to social cohesion*. [Online] Available at: <https://informedfutures.org/wp-content/uploads/Addressing-the-challenges-to-social-cohesion.pdf> [Accessed July 2023].
- University of Auckland, 2023. *Addressing the challenges to social cohesion*. [Online] Available at: <https://informedfutures.org/wp-content/uploads/Addressing-the-challenges-to-social-cohesion.pdf> [Accessed July 2023].
- University of Oxford, 2022. *Decarbonising the energy system by 2050 could save trillions – Oxford study*. [Online] Available at: <https://www.ox.ac.uk/news/2022-09-14-decarbonising-energy-system-2050-could-save-trillions-oxford-study> [Accessed July 2023].

- Von Schuckmann, K., Minière, A., Gues, F. & Cuesta-Valero, F. J., 2023. Heat stored in the Earth system 1960–2020: where does the energy go?. *Earth System Science Data*, 15(4), pp. 1675-1709.
- Wada, Y., de Graaf, I. E. M. & van Beek, L. P. H., 2016. High-resolution modeling of human and climate impacts on global water resources. *Journal of Advances in Modeling Earth Systems*, Volume 8, pp. 735-763.
- WEF, 2018. *New Zealand firm adopts its four day work week permanently*. [Online] Available at: <https://www.weforum.org/agenda/2018/07/four-day-work-week-productivity-new-zealand-trial/> [Accessed July 2023].
- WEF, 2020. *India is now the world's 5th largest economy*. [Online] Available at: <https://www.weforum.org/agenda/2020/02/india-gdp-economy-growth-uk-france/> [Accessed July 2023].
- WEF, 2022. *Digital solutions can reduce global emissions by up to 20%. Here's how*. [Online] Available at: <https://www.weforum.org/agenda/2022/05/how-digital-solutions-can-reduce-global-emissions/> [Accessed July 2023].
- WEF, 2023. *Global Risks Report 2023*. [Online] Available at: <https://www.weforum.org/reports/global-risks-report-2023/> [Accessed July 2023].
- WHO, 2022. *Mental health and climate change: Policy brief*. [Online] Available at: <https://www.who.int/publications/i/item/9789240045125> [Accessed July 2023].
- WMO, 2023. *State of the Global Climate 2022*. [Online] Available at: [https://library.wmo.int/doc\\_num.php?explnum\\_id=11593](https://library.wmo.int/doc_num.php?explnum_id=11593) [Accessed July 2023].
- WWF, 2021. *An eco-wakening: Measuring awareness, engagement, and action for nature*. [Online] Available at: <https://www.worldwildlife.org/publications/an-eco-wakening-measuring-awareness-engagement-and-action-for-nature> [Accessed July 2023].
- XRB, 2022. *Aotearoa New Zealand Climate Standard 1*. [Online] Available at: <https://www.xrb.govt.nz/dmsdocument/4770> [Accessed July 2023].
- XRB, 2023. *Staff Guidance Sector scenario development: Getting started at a sector level*. [Online] Available at: <https://www.xrb.govt.nz/dmsdocument/4532> [Accessed July 2023].



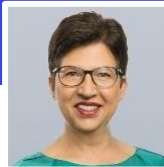
# Authors



**Dr Charles Ehrhart**

Global Head of Climate Risk,  
Resilience and Adaptation KPMG  
International, Co-lead Climate Change  
& Sustainability KPMG New Zealand

↘ [LinkedIn](#)



**Sanel Tomlinson**

Principal - IMPACT  
Measurement and Reporting

↘ [LinkedIn](#)



**Jack Bing**

Assistant Manager -  
Sustainable Value

↘ [LinkedIn](#)



**Claire Allan**

Advisor -  
Sustainable Value

↘ [LinkedIn](#)

© 2023 KPMG New Zealand, a New Zealand Partnership and a member firm of the KPMG global organisation of independent member firms affiliated with KPMG International Limited, a private English company limited by guarantee. All rights reserved. The information contained herein is of a general nature and is not intended to address the circumstances of any particular individual or entity. Although we endeavour to provide accurate and timely information, there can be no guarantee that such information is accurate as of the date it is received or that it will continue to be accurate in the future. No one should act on such information without appropriate professional advice after a thorough examination of the particular situation. The KPMG name and logo are trademarks used under license by the independent member firms of the KPMG global organisation.

**Document Classification: KPMG Public**

[kpmg.com/impact](https://kpmg.com/impact)

