Climate scenario narratives for the banking sector

New Zealand Banking Association
Te Rangapū Pēke

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Contents

Abbreviations

CCC	Climate Change Commission
CDR	Carbon Dioxide Removal
CMIP	Coupled Model Intercomparison Project
ETS	Emissions Trading Scheme
GFANZ	Glasgow Financial Alliance for Net Zero
GHG	Greenhouse gases
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
NDC	Nationally Determined Contributions
NGFS	Network for Greening the Financial System
NIWA	National Institute of Water and Atmospheric Research
NZBA	New Zealand Banking Association – Te Rangapū Pēke
RCP	Representative Concentration Pathway
SSP	Shared Socioeconomic Pathway
TCFD	Taskforce on Climate-related Financial Disclosure
The Act	Financial Sector (Climate-related Disclosures and Other Matters) Amendment Act 2021
XRB	External Reporting Board

> Forward-looking assessment approaches are crucial to adequately account for the unprecedented nature of climate change. Against this backdrop, scenario analysis is a critical tool for assessing the potential implications of climate change on economies and financial systems.

Financial Stability Board, 2022

About this report

This report is designed to support New Zealand Banking Association – Te Rangapū Pēke ("NZBA") members for their reporting of climate-related risks under the framework currently being developed by the External Reporting Board ("XRB"). The XRB has developed the 'Aotearoa New Zealand Climate Standard 1: Climate-related Disclosures' in response to Parliament's decision in 2021 to pass the Financial Sector (Climate-related Disclosures and Other Matters) Amendment Act 2021 ("The Act"). Many NZBA members are captured by the reporting mandate provided by The Act and will need to start publishing their disclosures over the next two years.

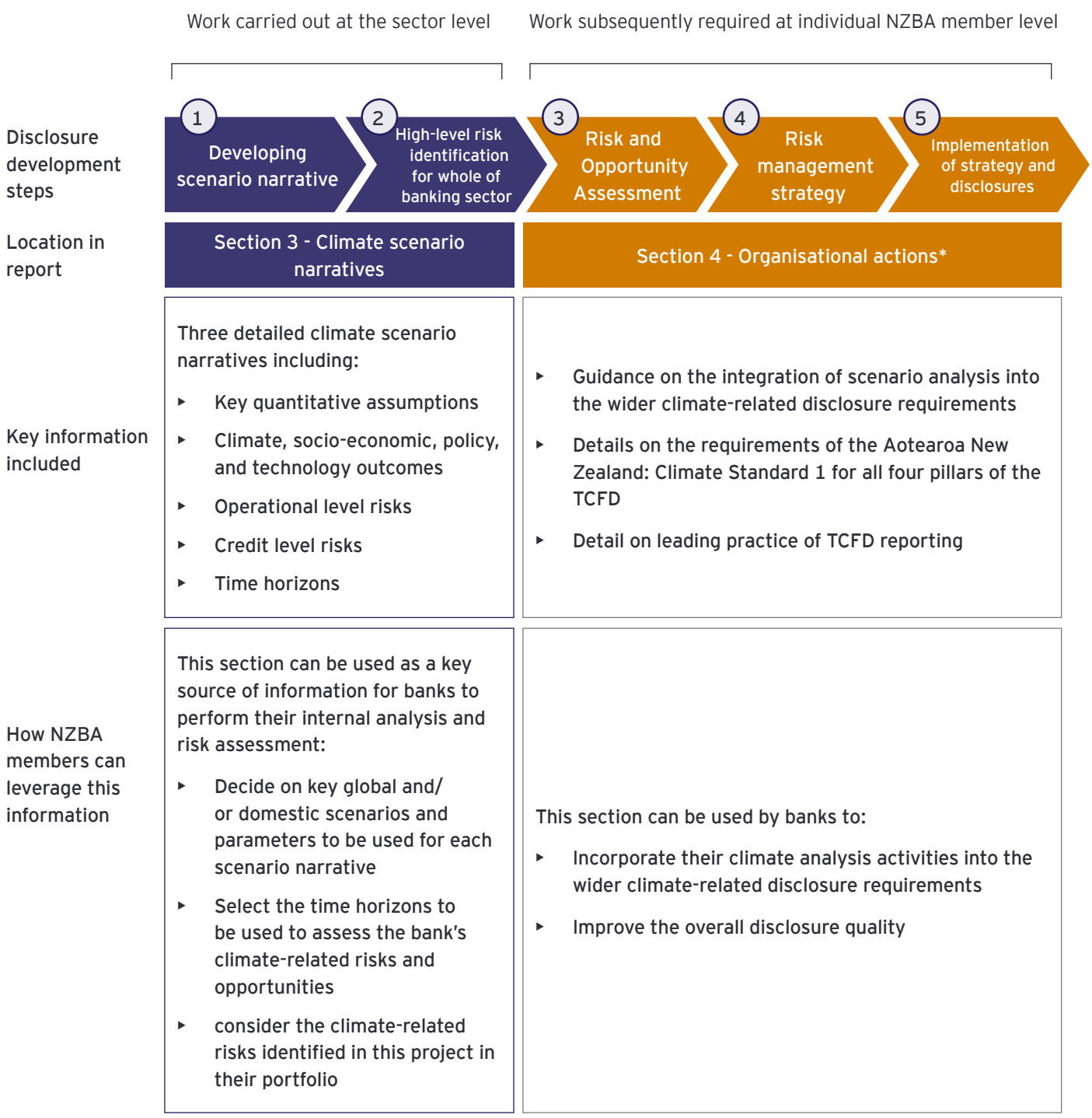
This report is aimed at supporting NZBA members to better understand and assess climate-related risks, and to understand the expectations of reporting against the Taskforce on Climate-related Financial Disclosure ("TCFD") recommendations and the Aotearoa New Zealand Climate Standard 1: Climate-related Disclosures ("the Standard"). To support this, this report provides the following:

1. **A common set of scenario narratives and horizons to be used in climate-related risk assessment and disclosures**
2. **A high-level set of climate-related risks that banks should consider as part of their risk assessment with risks identified based on input from project stakeholders**
3. **Organisational actions for climate disclosures on governance, strategy, risk management, and metrics and targets**

These three elements are designed to improve the comparability and consistency of climate-related risk disclosures in the banking sector, ultimately enabling primary users to be able to compare findings more readily.

The process required from NZBA members to publish their disclosures is set out in **Figure 1** in the next page. The chevrons in dark purple represent the work that is being done collectively at the sector-level and the chevrons in orange represent the work that will need to be done within each individual organization. This Report provides the outcomes from this collaborative work in section 3. This Report also provides direction on how the Climate Scenario Narratives can be used in broader climate-related disclosures in section 4. The different ways NZBA members can use the information contained in this Report is highlighted in the bottom row within **Figure 1**.

Figure 1: Key steps for climate-risk assessment and management, and scope of Climate Scenario Narratives for the Banking Sector



*Section 4 excluded from this version of the report

Report guidance

The key information in this report is presented in sections one to five and is supported by several appendices. Below is a summary of what each section of the report contains and how these can be used by a banking organisation as part of their scenario analysis process.

Section 1 – Background

Key information included in this section:

- Regulatory context that has led to the creation of this report
- Definition of scenario analysis and its importance

How banks could use this section:

- This section should be used by banks to provide context to internal stakeholders on the importance of climate-risk assessment and disclosures, and scenario analysis

Section 2 – Approach

Key information included in this section:

- Overview of process used to develop the scenario narratives and high-level risks
- Summary of stakeholder groups that were engaged throughout this project

How banks could use this section:

- This section should be used by banks when describing the collaborative and iterative approach used in the creation of these scenario narratives for the banking sector, and high-level risks
- If the scenario narratives described in this Report are used by a bank, this section can inform the methodology sections of their disclosures

Section 3 – Climate scenario narratives

Key information included in this section:

- Three detailed climate scenario narratives that follow the scenario analysis guidance set out in the XRB scenario analysis guidance. For each scenario narrative, this section provides:
  - Key quantitative assumptions that underpin the scenario narrative
  - Detailed narrative focusing on climate, socio-economic, policy and technology outcomes
  - Operational level risks that might arise in the scenario
  - Credit level risks that might arise in the scenario. Credit risks are identified for the five priority sectors chosen by the banking sector
- Time horizons to be used alongside the three scenario narratives to assess the variation in physical and transition risks

How banks could use this section:

- This section should be used as a key source of information for banks to perform their internal scenario analysis and risk assessment, as detailed below:
  - Decide on key global and/or domestic scenarios and parameters to be used for each scenario narrative e.g., carbon price
  - Select the time horizons to be used to assess the bank's climate-related risks and opportunities
  - Consider the risks in their climate-related risks assessment. This will support towards the goal that major climate-related risks are considered in all banks
- In leveraging the scenario narratives and risks presented in this report, banks can have comfort that their scenario analysis activities will be aligned to sector expectations

Section 4 – Organisation actions*

Key information included in this section:

- Guidance on the integration of scenario analysis into the wider climate-related disclosure requirements
- Detail on the requirements of the Aotearoa New Zealand: Climate Standard 1 for all four pillars of the TCFD
- Detail on leading practice TCFD reporting

How banks could use this section:

- This section could be used by banks to incorporate their scenario analysis activities into wider climate-related disclosure requirements. It can also be used to improve the overall disclosure quality

Appendices

Key information included in this section:

- Further detail on the scenario narratives and high-level risks presented in the body of the report

How banks could use this section:

- This section should be used by banks to provide further context and data to their scenario analysis

***Section 4 excluded from this version of the report**

Executive Summary

Scenario narratives

Three scenario narratives and four time horizons were developed to promote alignment of climate-related scenario analysis and risk disclosures across New Zealand's banking sector. **Table 1** provides an overview of the dimensions for each of the three scenario narratives selected by the NZBA members. It also shows the international and domestic scenarios relevant to each dimension. **Table 2** provides a summary of the time horizons chosen by the NZBA members.

Table 1: Scenario dimensions chosen by New Zealand's banking sector, and relevant international and domestic scenarios. Alignment of scenarios to chosen scenario dimensions was done in accordance with the XRB's guidance on sector-level scenario analysis (External Reporting Board, 2022b).

Category	Scenario dimensions		
	Orderly 1.5°C	Too Little Too Late >2°C	Hot House >3°C
Global climate & socio-economic parameters	IPCC SSP1-1.9	IPCC SSP2-4.5	IPCC SSP5-8.5
Global energy and emission pathway parameters	NGFS Net Zero 2050 IEA Net Zero Emissions by 2050 (NZE)	NGFS Nationally Determined Contributions (NDC's) IEA Announced Pledges (APS)	NGFS Current Policies IEA Stated Policies (STEPS)
New Zealand-specific climate parameters	NIWA RCP2.6	NIWA RCP4.5	NIWA RCP8.5
New Zealand-specific transition pathway parameters	CCC 'Tailwinds'	CCC 'Headwinds'	CCC 'Current Policy Reference'

Table 2: Time horizons chosen by New Zealand's banking sector

	Intermediate term	Short term	Medium term	Long term
Time horizon	3 years	10 years	30 years	50+ years
Year relative to 2022	2025	2030	2050	2080+
Rationale for selection	Aligned with stress-testing time horizons Aligned with average mortgage re-pricing time horizons Provides a current state assessment	Aligned with interim emissions reductions targets Broadly aligned with average maturity profile of business loans	Aligned with international emissions reductions targets Aligned with international banking sector climate scenario guidance documents	Aligned with further materialisation of physical risks, particularly relevant to Agriculture,Property and segments of the Energy sector due to the reliance on hydropower

To support an increased understanding of how climate related risks may materialise, high-level climate risks were identified for the banking sector. These are described for each scenario narrative developed as part of this report.

Figure 2 provides an overview of the framework used to develop the scenario narratives, and high-level risks for the banking sector. Climate-related risks are separated into:

Credit level – Climate-related risks which are faced by the 'priority' sectors in banks' lending portfolio, which might result in borrowers' inability to repay loans. Priority sectors were chosen to focus credit level risks on the most material industries to the banking sector. Chosen priority industries are Agriculture, Transport, Energy, Manufacturing, and Construction & Property.

Organisational level – Climate-related risks which are faced by the banks' operations, which might result in costs associated with transition and physical impacts at the operational level. Physical operational risks are those where the impact of climate change causes damage to the banks' branches, data centres and operations. Transition operational risks are those where policy, technology or market sentiment leads to higher liability risks of operational activities.

Figure 2: Framework for development of scenario narrative and high-level risks for the banking sector

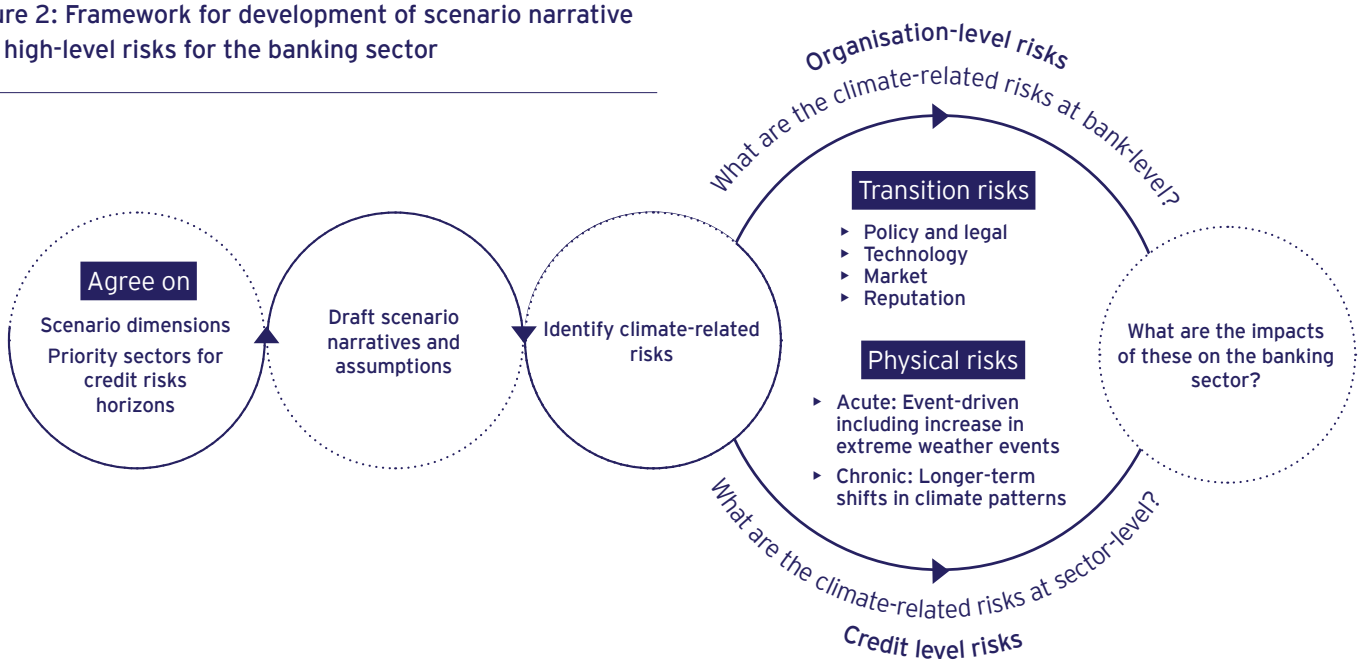


Figure 3 and **Figure 4** provide an overview of the physical and transition risk level over time for each of the three scenarios. These high-level climate-related risks were identified for the banking sector to support an increased understanding of physical and transition risks that may materialise over time, for each of the scenario narratives.

Physical and transition risk determinations over the short-, medium-, and long-term are based on the general themes in the NIWA and Climate Change Commission scenarios, literature reviews and stakeholder feedback. Each bank should assess the appropriateness of the risk determination to their analysis.

[1] For details on the coverage of each sector, see section 2.3

Figure 3 – Overview of the physical risk level for each scenario over the short-, medium-, and long-term

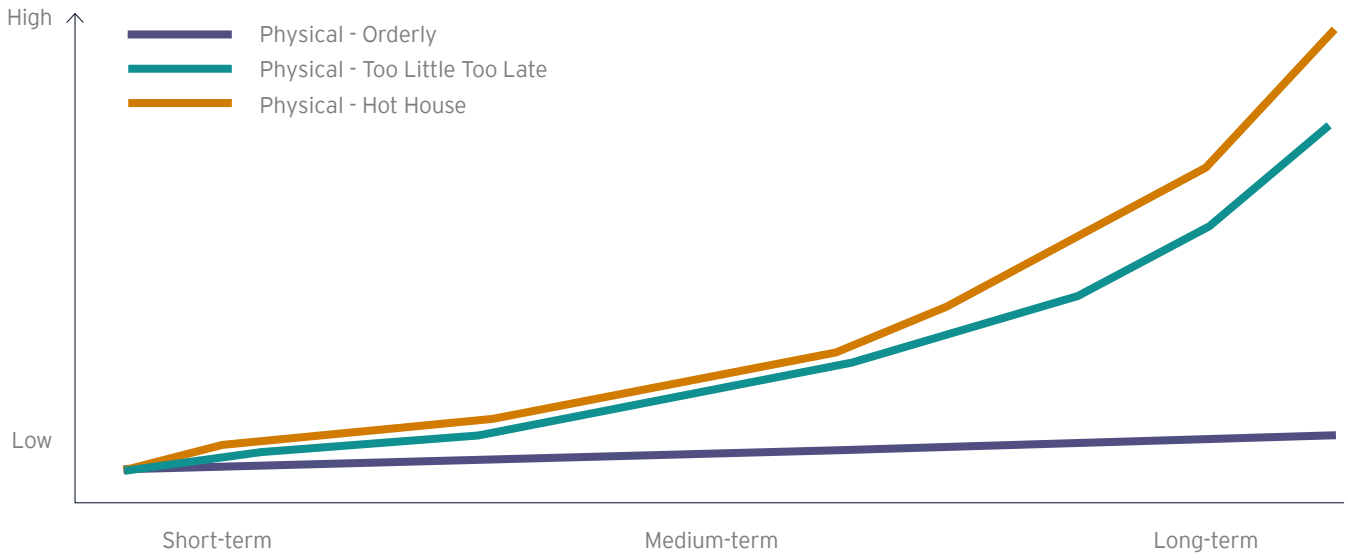
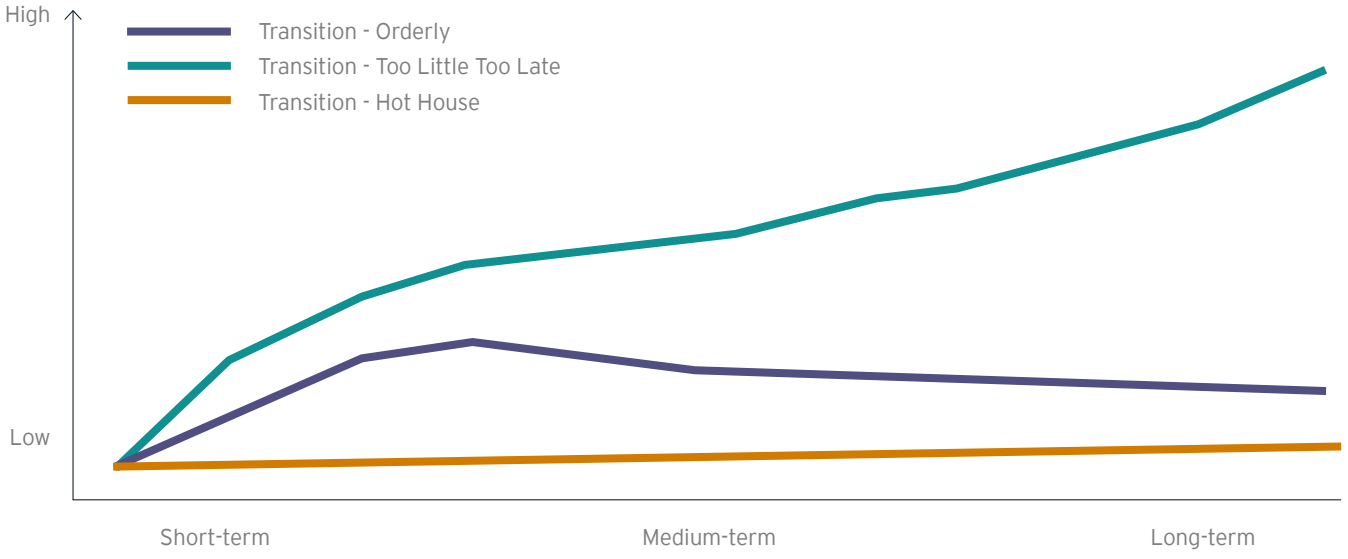


Figure 4 – Overview of the transition risk level for each scenario over the short-, medium-, and long-term



To support greater understanding of potential risks to each priority sector, credit level risks are separated into Tier 1, Tier 2 and Tier 3 risks:

- **Tier 1:** risks in the Tier 1 category are those very likely to be present under the scenario
- **Tier 2:** risks in the Tier 2 category are those likely to be present under the scenario
- **Tier 3:** risks in the Tier 3 category are not likely to be present under the scenario

Orderly scenario narrative

The Orderly scenario represents a future world where collective action is taken towards a low carbon global economy. In this scenario, there are steady and constant societal changes related to technology, policy and behaviour to support the transition to a lower emissions economy. This is matched by an increasing carbon price that incentivises low carbon behaviour change. The coordinated and timely action around the world to curb GHG which occurs within this scenario prevents the worst predicted impacts of climate change. However, the long-term chronic physical impacts from historic GHG emissions are still likely to occur, although not as severely in comparison with the other scenarios. Overall, when considered alongside the Too Little Too Late and Hot House scenarios, this scenario represents a medium level of transition risk and a lower level of physical risk. **Table 3** provides key assumptions under the Orderly scenario. **Appendix C** provides further detail on the underlying assumptions for key parameters as provided by the domestic and international scenarios that make up each scenario narrative.

Table 3: Scenario parameters under an Orderly scenario[1]

Climate outcomes

AVERAGE TEMPERATURE INCREASE

Global

+1.4°C

(1.0, 1.8) by 2100[3] (IPCC)

NET EMISSIONS (FOR ALL GASES)

Domestic: 49MtCO$_2$e by 2030, 5.9MtCO$_2$e by 2050 (CCC)

Global: 39BtCO$_2$e by 2030, 9.6BtCO$_2$e by 2050 (NGFS)

Socio-economic outcomes

GDP AND GDP% DUE TO CHRONIC PHYSICAL RISK

Acute impacts are excluded from this figure and would further negatively impact GDP

Global

US$ 176 trillion

(-1.2%) in 2030,
US$ 289 trillion (-2.0%) in 2050[4] (NGFS)

NZ

NZ$ 330 billion

(-0.5%) in 2030,
NZ$ 485 billion (-0.7%) in 2050[5] (NGFS)

POPULATION

Global: 8.0 billion by 2030, 8.5 billion by 2050 (IPCC)

Policy outcomes

CARBON PRICE (tCO$_2$e)

Domestic ETS

NZ$138 in 2030,
NZ$250 in 2050 (CCC)

Global

US$104 in 2030,
US$627 in 2050 (NGFS)

Technology outcomes

PERCENT OF RENEWABLE ELECTRICITY OF TOTAL ELECTRICITY PRODUCED

Domestic

93% by 2030, 98% by 2050 (CCC)

Global

61% by 2030, 88% by 2050 (IEA)

PERCENT OF RENEWABLE ENERGY OF TOTAL ENERGY PRODUCED

Domestic

55% by 2030, 90% by 2050 (CCC)

Global

30% by 2030, 67% by 2050 (IEA)

[2] Refer to Appendix C for the sources for these parameters
[3] Relative to 1850-1900
[4] Provided in % difference, 2017 PPP, US$
[5] Provided in % difference, 2009 prices; NZ$

Credit level risk

The Orderly scenario is dominated by transition credit level risks due to the heavy focus on moving towards a low carbon economy. However, as this transition is orderly, the overall level of risk is less than that experienced in the Too Little Too Late scenario. The agricultural sector has the highest exposure to Tier 1 risks under an Orderly scenario. In this sector, market drivers such as customer behaviour change, increased costs of raw materials, and regulatory impacts associated with emissions reductions requirements are likely to have an impact on operating costs and revenue. Customer behaviour change and regulatory impacts are key transition risk drivers for the Transport and Shipping, Energy and Manufacturing sectors. Changing customer behaviour may result in decreased revenue and higher operating costs, as market behaviour drives demand for products and services with lower emissions profiles.

Due to the orderly transition to a low carbon economy, many of the transition risks faced by the priority sectors are less likely to become a concern. Nevertheless, almost all sectors face at least a Tier 2 risk from increased cost of raw materials, regulatory impacts, emissions reduction requirements, litigation, emissions pricing, reputational impacts, lower emissions substitutes and stakeholder relations.

The rate of sea-level rise and other climate-related risks will likely be slower, giving homeowners and lenders more time to adapt and prepare for potential impacts. Managed retreat policies may be implemented gradually and in a more coordinated way, with government support and funding available to help affected homeowners and lenders transition to new areas or adapt their properties to mitigate risks.

Organisational level risk

Due to the transition to a low carbon economy under an Orderly scenario, transition impacts are likely to dominate the operational risk profile for the banking sector. Under an Orderly scenario, there may be increased stakeholder and investor expectation, requiring banks to be proactive in reducing emissions and disclosing progress against climate-related targets. Slower efforts to decarbonise may lead to banks losing competitive advantage to act on opportunities associated with the transition to a low emissions economy. There is also the potential introduction of compulsory emissions reduction targets for certain sectors through climate policy.

Too Little Too Late scenario narrative

The Too Little Too Late scenario represents a fragmented and delayed transition to a low carbon economy between New Zealand and the rest of the world. In this scenario, New Zealand is an early mover on the transition to a low emissions economy, introducing policy that brings about net zero emissions by 2050. Globally, however, there is less action to shape a low emissions future, with fossil fuel development continuing throughout much of the remaining first half of the century. From mid-century, global efforts to address climate change begin to align and may even exceed those in New Zealand. Large increases in carbon prices may drive a rapid improvement in low emissions technology efficacy and uptake. This shift is partly driven by the increasing evidence and awareness of the social, economic, and environmental degradation caused by a continued increase in fossil fuel development. Despite making a concerted effort to reduce emissions and move to a low emissions economy at mid-century, the changes come too late to prevent wide ranging acute and chronic physical climate impacts. Overall, when considered alongside the Orderly and Hot House scenarios, this scenario represents a high level of transition risk and a medium level of physical risk. **Appendix C** provides further detail on the underlying assumptions for key parameters as provided by the domestic and international scenarios that make up each scenario narrative.

Table 4: Scenario parameters under a Too Little Too Late scenario[6]

Climate outcomes

AVERAGE TEMPERATURE INCREASE

Global

+2.7°C

(2.1, 3.5) by 2100[7] (IPCC)

NET EMISSIONS (FOR ALL GASES)

Domestic: 58MtCO_2e by 2030, 24MtCO_2e by 2050 (CCC)

Global: 51BtCO_2e by 2030, 42BtCO_2e by 2050 (NGFS)

Socio-economic outcomes

GDP AND GDP% DUE TO CHRONIC PHYSICAL RISK

Acute impacts are excluded from this figure and would further negatively impact GDP

Global

US$ 175 trillion

(-1.6%) in 2030,
US$ 274 trillion (-5.1%) in 2050[8] (NGFS)

NZ

NZ$ 329 billion

(-0.7%) in 2030,
NZ$ 477 billion (-2.3%) in 2050[9] (NGFS)

POPULATION

Global: 8.3 billion by 2030, 9.2 billion by 2050 (IPCC)

Policy outcomes

CARBON PRICE (tCO_2e)

Domestic ETS

NZ$138 in 2030,
NZ$250 in 2050 (CCC)

Global

US$53 in 2030,
US$103 in 2050 (NGFS)

Technology outcomes

PERCENT OF RENEWABLE ELECTRICITY OF TOTAL ELECTRICITY PRODUCED

Domestic

92% by 2030, 96% by 2050 (CCC)

Global

46% by 2030, 71% by 2050 (IEA)

PERCENT OF RENEWABLE ENERGY OF TOTAL ENERGY PRODUCED

Domestic

49% by 2030, 78% by 2050 (CCC)

Global

19% by 2030, 37% by 2050 (IEA)

[6] Refer to Appendix C for the sources for these parameters
[7] Relative to 1850-1900
[8] Provided in % difference, 2017 PPP, US$
[9] Provided in % difference, 2009 prices; NZ$

Credit level risk

Credit level risks classified as Tier 1 risks under a Too Little Too Late scenario are primarily driven by the transition to a low-carbon economy. However, delayed action towards reducing emissions will result in Tier 1 physical risks for the agriculture, transport and shipping sectors, energy, construction, commercial and residential property sectors, largely in the form of drought, storms, floods, heatwaves and sea level rise.

Slower emissions reduction measures could result in greater uncertainty and risk. The timing and extent of managed retreat policies may be more difficult to predict. This could result in increased volatility in property values, and banks may face challenges in accurately assessing the value and risk of their mortgage portfolios in high-risk areas. Banks that hold mortgages on properties in high-risk areas could face losses as properties become less valuable or even abandoned due to managed retreat policies.

There is alignment of transition risk exposure across all sectors. Lower emissions substitutes pose some degree of risk for all but the transport & shipping sector. A global focus on low emissions technologies from mid-century sees their adoption become common place across the New Zealand economy from 2050 onwards. Emissions pricing will impact all sectors who fail to adopt new technologies, becoming a Tier 1 risk for all sectors. For the Manufacturing, Construction, Commercial and Residential property sectors these risks are compounded by emissions reduction requirements which become tier 1 risks under a Too Little Too Late scenario. The uncertainty over future technologies driven by the lack of investment in the first half of the century, sees the energy and manufacturing sectors face exposure to financial losses due to unsuccessful investment in new, low emissions technologies. Agriculture and construction & property sectors may face exposure from customer behaviour change, as this creates new demand for lower emissions substitutes as opposed to traditional products offered by these sectors e.g., plant proteins.

Organisational level risk

Tier 1 operational physical risks posed by a Too Little Too Late scenario are likely to materialise through flood and extreme weather events. This may limit the ability to reach customers due to branch closures or because of disruption to the transport network. Increased scrutiny from customers and investors may increase the pressure on banks to decarbonise. Operational expenditure may increase as the banking sector complies with regulatory requirements. The rapid shift towards decarbonisation may make it difficult to meet market expectations to decarbonise, causing some banks to fall behind their competitors. Increasing levels of climate policy and regulation may also pose a risk as governments seek to force laggard organisations to reduce emissions and meet emissions targets.

Hot House scenario narrative

This scenario represents a worst-case emissions trajectory with minimal ambition to transition towards a low carbon economy. Despite widespread increase in severe weather events, and associated destabilisation of social, political and economic structures, low demand for carbon alternatives continues to slow the rate of development and uptake of emissions saving technology. Continued and unabated expansion of emissions intensive industries is expected to exacerbate natural biophysical mechanisms that moderate global temperature, pushing them beyond operating thresholds, into a state of unprecedented climate volatility. Under this scenario, the second half of this century is characterised by high physical risk due to extreme weather events, exacerbated by rising sea levels. The Hot House scenario aims to capture impacts associated with high physical risk and low transition risk. Assumptions for this scenario are provided in **Table 5** below. For further detail on the underlying assumptions for key scenario parameters please refer to **Appendix C**.

Table 5: Scenario parameters under a Hot House scenario[10]

Climate outcomes

AVERAGE TEMPERATURE INCREASE

Global

+4.4°C

(3.3, 5.7) by 2100[11] (IPCC)

NET EMISSIONS (FOR ALL GASES)

Domestic: 64MtCO_2e by 2030, 40MtCO_2e by 2050 (CCC)

Global: 56BtCO_2e by 2030, 54BtCO_2e by 2050 (NGFS)

Socio-economic outcomes

GDP AND GDP% DUE TO CHRONIC PHYSICAL RISK

Acute impacts are excluded from this figure and would further negatively impact GDP

Global

US$ 175 trillion

(-1.6%) in 2030,
US$ 273 trillion (-5.7%) in 2050[12] (NGFS)

NZ

NZ$ 329 billion

(-0.7%) in 2030,
NZ$ 475 billion (-2.6%) in 2050[13] (NGFS)

POPULATION

Global: 8.1 billion by 2030, 8.6 billion by 2050 (IPCC)

Policy outcomes

CARBON PRICE (tCO_2e)

Domestic ETS

NZ$35 in 2030, NZ$35 in 2050 (CCC)

Global

US$6 in 2030, US$6 in 2050 (NGFS)

Technology outcomes

PERCENT OF RENEWABLE ELECTRICITY OF TOTAL ELECTRICITY PRODUCED

Domestic

90% by 2030, 92% by 2050 (CCC)

Global

42% by 2030, 60% by 2050 (IEA)

PERCENT OF RENEWABLE ENERGY OF TOTAL ENERGY PRODUCED

Domestic

45% by 2030, 58% by 2050 (CCC)

Global

16% by 2030, 26% by 2050 (IEA)

[10] Refer to Appendix C for the sources for these parameters
[11] Relative to 1850-1900
[12] Provided in % difference, 2017 PPP, US$
[13] Provided in % difference, 2009 prices; NZ$

Credit level risk

Credit level risk exposure under a Hot House scenario contains a polarised distribution of physical and transition risks. Due to the absence of any significant climate change mitigation, very few transition risks emerge.

In contrast, due to the continued rise in emissions, high physical risk can be expected. The agriculture sector is the most impacted by physical risk under this scenario due its inherent reliance on the natural environment to operate. Extreme climate events under this scenario will be compounded, amplifying the financial impact to the sector. The construction, property and manufacturing sectors are likely to be impacted by the disruption to supply chains driven by physical risks of floods and storms. Heat stress may have detrimental effects on the health and wellbeing of workers required to work outdoors, and low-lying coastal property and manufacturing sites may be at risk of coastal inundation from sea level rise. As emissions continue to rise, the frequency and severity of extreme weather events such as storms, flooding, and sea-level rise are very likely to increase, making managed retreat policies increasingly necessary. Properties located in high-risk areas such as coastal zones and floodplains would be most affected. The transport and shipping sector may face damage to infrastructure from floods, storms, and sea level rise, resulting in stranded assets. Extended drought conditions and changing precipitation levels may compound the impact of physical risks on hydropower generation for the energy sector. Higher temperatures may reduce power generation efficiency for the energy sector, as well as increase customers' cooling demands, stressing the capacity of generation and national grid networks.

Organisational level risk

The Hot House scenario generates the highest physical risk to bank operations, materialising in the latter half of the century due to continued increase in emissions. Under this scenario, there may be an increase in sites impacted by flood events, damaging equipment and ability to reach customers. Severe weather impacts may see branches and corporate offices closed or inaccessible due to weather impacts.

1 Background

Published in 2017, the Recommendations of the Task Force on Climate-related Financial Disclosures ("TCFD") aimed to provide a common framework for companies to disclosure how climate-related risks and opportunities are treated and assessed (Task Force on Climate-Related Financial Disclosures, 2022a). In 2021, New Zealand passed the Financial Sector (Climate-related Disclosures and Other Matters) Amendment Act 2021 ("The Act"), becoming one of the first countries in the world to introduce mandatory climate-related risk disclosures for large financial organisations and large listed equity and debt issuers (New Zealand Government, 2021). The Aotearoa New Zealand Climate Standards, developed by the External Reporting Board ("XRB"), are based on the TCFD recommendations, and provide a standard for which companies should be reporting these risks. Scenario analysis is included in both the TCFD recommendations and the Aotearoa New Zealand Climate Standards as a means for companies to consider and better understand how they might perform under different climate future states.

To help improve the comparability of climate-risk disclosures, this report provides sector-specific climate scenario narratives and time horizons for the banking sector. It also identifies high-level climate-related risks for the banking sector, for each scenario, to support increased understanding of physical and transition risks that may materialise over time.

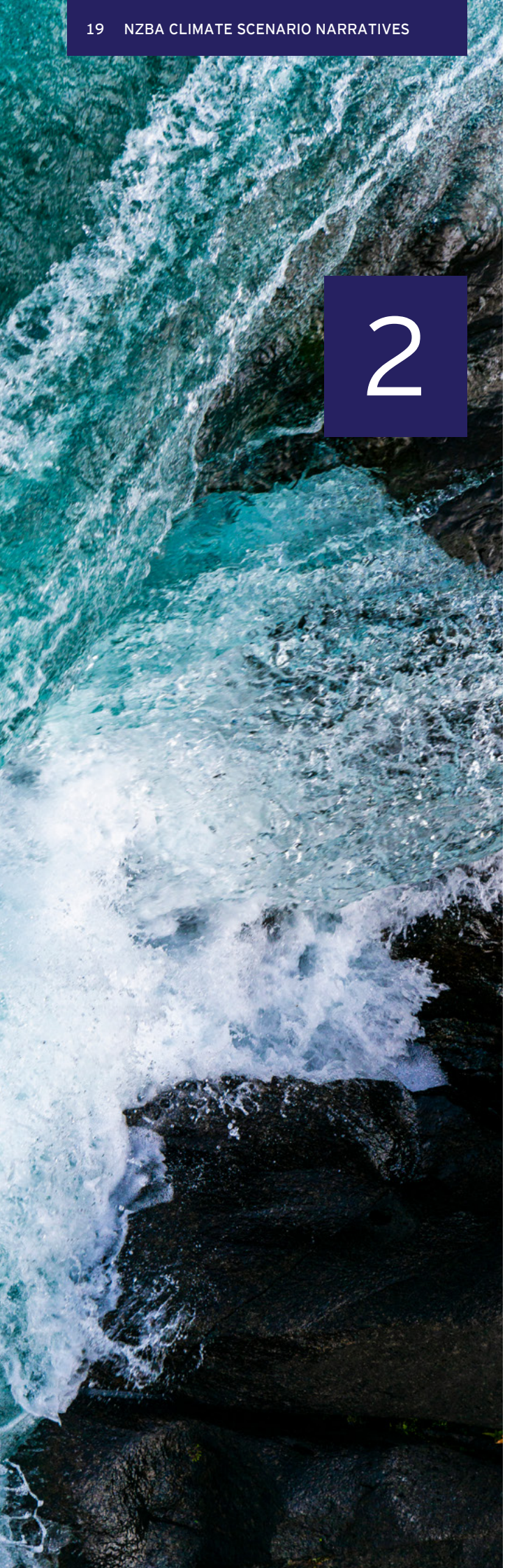
1.1 What is scenario analysis?

The impacts of climate change are systemic, affecting not only future climate outcomes, but also future social, economic, technological, and policy outcomes. These societal elements have complex relationships that impact climate change depending on the level of action towards combatting climate change that is achieved. Scenario analysis allows organisations to assess the potential organisational and financial implications of the various climate, social, economic, technological and policy outcomes that are driven by climate change impacts. Through the scenario analysis process, organisations can identify risks and opportunities which can inform strategic planning and enterprise risk management process improvements.

Scenarios focus on creating plausible, hypothetical future climate states to allow companies to better understand potential climate-related risks that might occur. The purpose of scenario analysis is to help entities explore the climate-related risks and opportunities they may face and therefore better understand the resilience of their business model and strategy (External Reporting Board, 2022a). Scenarios consist of assumptions which must have the following characteristics, as defined by the TCFD and recommended by the XRB (External Reporting Board, 2022a; Task Force on Climate-related Financial Disclosures, 2017).

1. Be plausible (the events in the scenario should be possible and the narrative credible)
2. Be distinctive (each scenario should focus on a different combination of the key factors)
3. Be consistent (each scenario should have strong internal logic)
4. Be relevant (each scenario, and the set of scenarios taken as a whole, should contribute specific insights into the future that relate to strategic and/or financial implications of climate-related risks and opportunities)
5. Be challenging (scenarios should challenge conventional wisdom and simplistic assumptions about the future)

Section 2.2 outlines the scenario architecture development for the purposes of creating the three plausible pathways for the banking sector. **Appendix A** provides descriptions of the various scenario sets drawn upon.



2 Approach

Figure 5 provides an overview of the framework used to develop the scenario narratives, and high-level risks for the banking sector. Climate-related risks are separated into:

- **Credit level** – Climate-related risks faced by the 'priority' sectors in banks' lending portfolio, which might result in borrowers' inability to repay loans. Priority sectors were chosen to focus credit level risks on the most material industries to the banking sector. Chosen priority sectors are Agriculture, Transport, Energy, Manufacturing, Construction and Property[14].
- **Organisational level** – Climate-related risks faced by the banks' operations, which might result in costs associated with transition and physical impacts at the operational level.

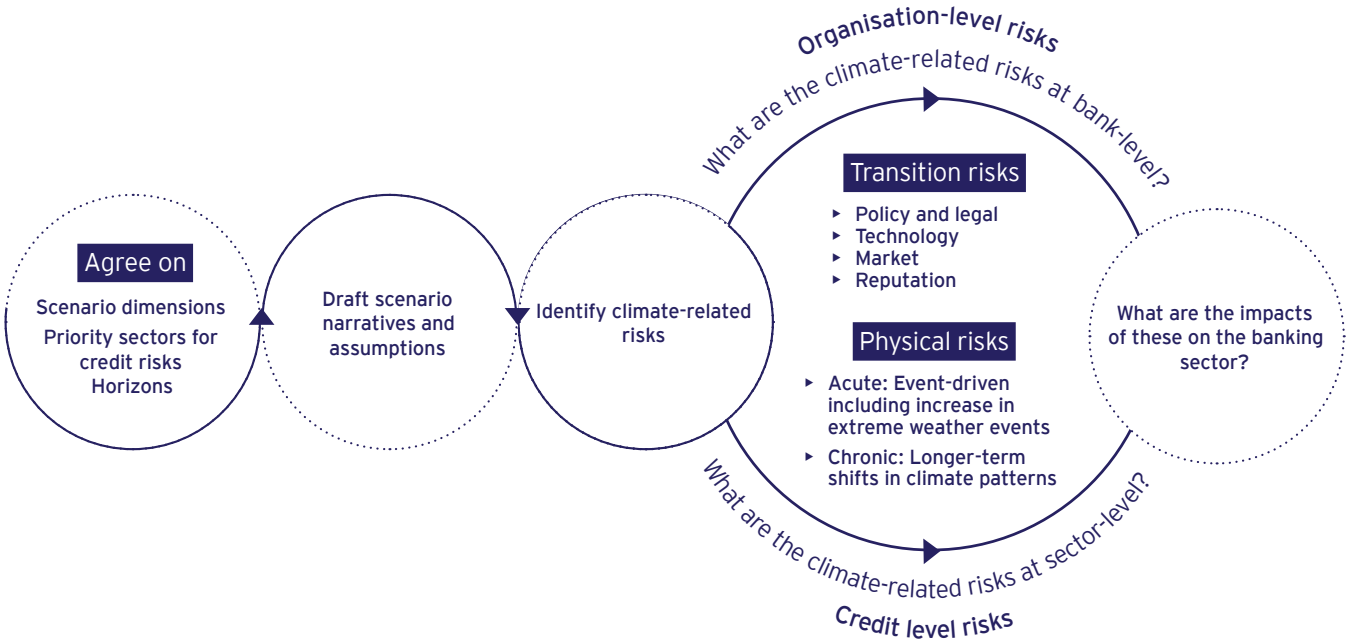
The following sections detail the approach to stakeholder engagement, development of scenario narratives and selection of time horizons, and high-level identification of climate-related risks to the banking sector. To support the consistent categorisation of risks, high-level Operational and Credit level risks were identified in accordance with the TCFD risk categories of transition and physical risks, as defined in the next page.

[14] For details on the coverage of each sector, see section 2.3

Physical	Acute: event-driven, including increased severity of extreme weather events, such as droughts, heatwaves, extreme storms, or floods. This type of climate impact has the potential to generate, and in some cases has generated, significant and recurring financial losses.
	Chronic: longer-term shifts in climate patterns are generally accepted to include rising sea levels, increased average temperatures and changes in precipitation patterns. These may lead to further development of chronic climate events, such as desertification. These changes could result in higher levels of migration and the increased risk of humanitarian crises.
Transition	Policy and legal: Policy actions that attempt to constrain actions that contribute to the adverse effects of climate change or those that seek to promote adaptation to climate change. This would also include climate-related legal claims being brought before the courts due to failure of an organisation to mitigate or adapt to climate change, and insufficiency of disclosure around material financial risk.
	Technology: Improvements or innovations that support the transition to a lower-carbon, energy efficient economic system. Existing business models based on technologies likely to become superseded creates the need for adaptation to minimise the downside impact to remain competitive. The timing of technology development and deployment is a key uncertainty in assessing technology risk.
	Market: Shifts in supply and demand for certain commodities, products, and services as climate-related risks are considered. A change in human behaviour is required to transition to an economy with lower carbon emissions. The increased awareness of, and explicit demand for, climate-friendly financial products and investment are a potential trigger for businesses and banks to adjust their business strategies, notwithstanding potential regulatory or supervisory approaches.
	Reputation: Changing customer or community perceptions of an organisation's contribution to or detraction from the transition to a lower-carbon economy. Equity and debt investor awareness and expectations with respect to climate change are increasing. Risk profile and valuation of debt and equity investments of businesses exposed to climate change as investors undertake a reassessment of investment decisions.

Given the broad range of climate-related risks faced by the banks across each economic sector they lend to, the stakeholders involved in this project assessed the significance of each risk under the three scenarios, in order to develop a short-list of risks. Credit level risks are identified within each scenario narrative and are those where climate-related risks will impact the ability of bank customers to repay loans. Organisational level risks are highlighted for each scenario. The financial impact of organisational level risks will differ depending on banks' individual risk assessments. Together, these provide a guide on potential focus areas for further exploration on climate-risks.

Figure 5: Framework for development of scenario narrative and high-level risks for the banking sector



2.1 Stakeholder engagement

To appropriately consult with not only the banking sector, but with wider stakeholders throughout this project, four stakeholder categories were established. These are outlined below:

Engagement with the banking sector occurred through two groups: the Technical Advisory Group, and the wider NZBA membership.

- **Technical Advisory Group ('TAG'):** The TAG was established at the start of this project to check that the development of the scenario narratives and time horizons, and the identification of high level risks are fit for future. The TAG was comprised of representatives from 13 banks in New Zealand. Five TAG meetings occurred throughout this project.
- **Wider NZBA membership:** The wider NZBA membership were invited to three key meetings: An opening meeting, and two workshops to provide feedback on key decisions.

Observers

Regulators and standard-setting bodies were engaged in this project as observers to give them the opportunity to provide feedback. Observers were invited to a workshop with the NZBA membership to discuss overall priority sector selection and scenario selection, as well as to separate meetings to discuss their feedback on the project. The observers to this project included:

- **Reserve Bank of New Zealand ("RBNZ")** – the RBNZ is currently developing an approach to stress test banks on their resilience to climate change.
- **External Reporting Board ("XRB")** – the XRB are responsible for developing and setting the climate-related disclosure standards and associated guidance for New Zealand entities.
- **Financial Markets Authority ("FMA")** – the FMA is responsible for independent monitoring and enforcement of the Aotearoa New Zealand Climate Standards. This includes the relevant legislation in the Financial Markets Conduct Act 2013, and the Aotearoa New Zealand Climate Standards.

External stakeholders

In addition to the Aotearoa New Zealand Climate Standards, the XRB has also published specific guidance on sector-level scenario analysis (External Reporting Board, 2022b). The guidance encourages sectors developing sector-level scenarios to engage with wider groups of stakeholders with the aim of ensuring different perspectives are heard, to minimise the risk of 'group-think' and business-as-usual construct. To this end, other groups outside of the NZBA membership and project observers ('external stakeholders') were engaged throughout the project. External stakeholders were classified in the following categories:

- **Other sector-level climate scenario working groups:** Other sector-level working groups ("WG") have also been working on the development on climate scenarios for their own sectors. Key working groups engaged as part of this project were the Agriculture WG, Insurance WG, and Property/Construction WG.
- **Climate science and data providers:** Key domestic climate science groups were consulted on the chosen scenario narratives for the banking sector, as well as the scenarios matched to each narrative, and chosen horizons, to accurately describe the scenario outcomes for the sector.
- **Advocacy groups:** Advocacy groups within the financial sector were engaged to provide feedback on the scenario narratives, horizons, and operational risks to the banking sector.
- **Mātauranga Māori:** EY Tahi supported the project team with an initial consideration of mātauranga Māori in the context of climate risk assessment. There is further opportunity to understand how the banking sector could support Māori approaches to managing climate-related risks and building climate resilience. Commentary on the integration of mātauranga Māori into climate-related risk assessments is provided in **section 4**.
- **Industry groups:** To appropriately consider credit level risks, and potential organisational risks for each priority sector, this project sought insights from additional industry groups. Experts from the Agricultural sector engaged with this project. However, industry groups from Transport, Energy, Manufacturing and Construction/Property were invited to engage but did not participate.

2.2 Scenario narrative development and selection of time horizons

An overview of the development process for the scenario narratives and the selection of time horizons is provided in **Figure 6**. XRB's Staff Guidance on scenario analysis (version 2022.C.1) requires that reporting entities include the following specifications in the development and selection of scenario analysis:

- Identify a range of driving forcers (named 'risk drivers' in this report) that span categories outlined in the 'STEEP' analysis framework, which focuses on Social, Technological, Economic, Environmental and Political categories for driving forces. The mapping between STEEP categories, related risk drivers, and the TCFD sub-categories is shown in the following page.
- Employ, at a minimum, a 1.5°C scenario, a greater than 3°C scenario, and a third climate related scenario.
- Selection of time horizons consider emissions reduction targets, the useful life of assets or infrastructure for each sector and availability of data.

Driving forces using STEEP analysis, scenarios and horizons were selected in alignment with these specifications.

Figure 6: Overview of process of development of scenario narratives and selection of time horizons

Desktop research and scenario mapping: This step supported the development of the methodology to follow domestic and international guidances and scenarios. Detail on domestic and international scenarios are presented in **Appendix A.**

Scenario methodology development: Broad risk drivers were identified and mapped in alignment with the TCFD framework. The methodology was discussed and accepted by the TAG.

Selection of "Orderly" and "Hot House" scenario dimensions: The first two scenario dimensions were chosen in alignment with recommendations from TCFD and XRB. These were accepted by the TAG.

Selection of "Too Little Too Late" scenario dimension: The third scenario dimension, "Too Little Too Late" was chosen by the TAG as the group believes this scenario best describes what might occur in the New Zealand context: Both high physical impacts of climate change, and impacts of transitioning towards a low carbon economy.

Selection of horizons: Desktop research was conducted on international peers, asset and liability maturity, and the variation in physical risk materialisation for the different priority sectors. Horizons were discussed and accepted by TAG.

Engagement with external stakeholders: External stakeholder were engaged to support that the scenarios were accurately represented, and horizons were appropriate to the New Zealand context. These stakeholders included other sector-level scenario working groups, NIWA, Climate Change Commission, Sustainable Business Council, and Toitū Tahua: Centre for Sustainable Finance.

Finalise scenario narratives: Scenario narratives were finalised based on feedback from stakeholders, and results from the high-level risk identification exercise.

Below, STEEP categories are mapped to TCFD sub-categories showing common risk drivers incorporated in the scenario development approach. This shows the alignment between the risk drivers identified under the TCFD framework and the STEEP analysis framework recommended in the XRB's guidance on scenario analysis.

STEEP Categories	Risk Driver Examples	TCFD Sub-Categories
Social	▸ Reputational impacts from delayed action harming stakeholder relations	Reputation
Technological	▸ Lower emissions substitutes ▸ Unsuccessful investment	Technology
Economic	▸ Increased cost of raw materials ▸ Change	Market
Environmental	▸ Drought ▸ Storm ▸ Sea level rise ▸ Biodiversity loss	Acute & Chronic Risk
Political	▸ Emissions reduction requirements ▸ Litigation risk ▸ Emissions pricing ▸ Stakeholder relations	Policy & Legal

2.3 High-level identification of climate-related risks

Figure 7 below provides a summary of the approach used to identify high-level climate-related risks for the banking sector. Here, a value chain approach was taken, identifying natural resource use and the corresponding environmental impacts within the socio-economic reality of production and consumption. Credit level risks were identified for "priority sectors" to focus on the most material industries to the banking sector. Climate-related impact of resource use was mapped along the value chain of the priority sectors. The priority sectors selected are as follows:

- **Agriculture:** including Sheep and Beef farming and manufacturing, Dairy farming and Dairy product manufacturing, Horticulture, and Forestry, logging, and wood product and paper manufacturing
- **Transport:** including Road, Rail, Air and Water transport, and Freight and Shipping
- **Energy:** including Electricity generation and on-selling, Electricity transmission and distribution, and Gas supply
- **Manufacturing:** including Petroleum and coal product manufacturing, basic chemical and polymer manufacturing, Fertiliser and pesticide manufacturing, Non-metallic mineral product manufacturing, and Metal product manufacturing
- **Construction** including Residential construction, Commercial property construction, Heavy & Civil engineering construction, Residential real estate (as assets), and Commercial real estate (as assets)

Appendix B provides a concordance table for priority sectors and the New Zealand Standard Industrial Output Classification industries - ANZSIC 2006. Credit level risks are categorised into Tiers 1, 2 and 3.

Figure 7: Overview of approach used to identify high-level climate-related risks for the banking sector

Climate-risk methodology development: The methodology was discussed and accepted by the TAG

Selection of priority sectors for credit risks: Priority sectors were selected based on the average value of lending to the sector, average GDP value generated by the sector, and potential level of exposure of the sector to either physical or transition risks. Priority sectors were discussed and accepted by the TAG

Organisational level risks

Desktop research: Desktop research was conducted to identify long-list of risks based on literature and risk tools available

Short-list of risks: Risks were short-listed based on their alignment with New Zealand banking context, and discussions with the TAG

Engagement with external stakeholders: External stakeholder were engaged to support in the accuracy of the short-list of risks, in the context of the New Zealand banking sector

Identification of priority risks for the banking sector: Risks were identified based on potential of the risk occurring, and potential exposure of the bank to the risk. Risks were discussed and accepted by the TAG and wider NZBA members

Credit level risks (sector-specific)

Desktop research: Desktop research was conducted to identify long-list of risks based on literature and risk tools available

Short-list of risks: Risks were short-listed, per sector, based on the operational impact to businesses in the sector, and potential to generate a credit risk. These were accepted by the TAG

Engagement with external stakeholders: External stakeholder were engaged to support in the accuracy of the short-list of risks for each sector

Identification of Tier 1 risks for the banking sector: Tier 1 risks were identified based on potential of the risk occurring, and potential exposure of the sector to the risk. Tier 1 risks were discussed and accepted by the TAG and wider NZBA members

2.4 Key Limitations

Volume of stakeholder engagement: This project ran over a restricted timeframe and relied on the voluntary contribution of stakeholders. With more time and resource, additional stakeholder engagement could be conducted by individual banks to confirm the appropriateness of the scenarios and climate-related risks identified in this Report.

Variances between global and domestic climate outcomes for similar scenario narratives: This project maps out different global and domestic climate, socio-economic, policy and technology outcomes to each scenario narrative. An inherent limitation of this is a variance that occurs between global and domestic outcomes driven by the differences in modelling approaches used to calculate the scenario parameters, alongside variances in the way New Zealand is predicted to react to climate change versus the rest of the world. This outcome is largely unavoidable when incorporating several independent scenarios together. In these situations, banks can consider which of these assumptions are most relevant for their purpose and provide a rationale for this.

Use of publicly available data: The nature and content of any information provided in this report is limited by the scope and limitations of the source scenarios used to inform the scenario narratives. The data provided in this report has been inputted directly from the source scenarios and has not been re-developed in any way for the banking sector.

Ongoing updates to publicly available data: The data contained in this report were sourced as of 19 May 2023. Updates to the publicly available data sources used in this report are likely to occur in the future as new technology and data becomes available, and updates might not directly align with the contents of this report.

Considerations of the financial impact of physical climate impacts on GDP figures: At a high level, the impact of climate change on GDP under a Hot House scenario is likely to generate a significant contraction in global GDP growth potential, particularly in the latter half of the century. Conversely, the curbing of emissions under an Orderly scenario has the potential to positively impact GDP figures going forward. Quantifying the impact of physical climate risk is a complex process, and figures declared to capture this should be used with the acceptance that a degree of uncertainty is unavoidably embedded within the produced values. Nonetheless, values attempting to partially capture physical risk have been produced by the NGFS and are used throughout this report to provide an indication of the impact of physical risk on GDP. Noting, only chronic risk is accounted for in this calculation, with the exclusion of impacts materialising from extreme weather events regarded as acute physical risk.

Uncertainties related to climate risk drivers: The speed in which climate-related impacts are evolving are unprecedented and little reliance can be placed on historical experience to assess both magnitude and patterns. This gives rise to a higher level of uncertainty for banks when assessing the magnitude and timing of climate risk drivers. These drivers are also subject to tipping points that exacerbate uncertainty, particularly given geographic diversity of physical and transition impacts across New Zealand and the rest of the world.

3

Scenario narratives for the banking sector

This section describes the three scenario narratives and the four time horizons developed to promote alignment of climate-related scenario analysis and risk disclosures across New Zealand's banking sector.

Table 6 provides an overview of the dimensions for each of the three scenario narratives selected by NZBA members. It also shows the international and domestic scenarios relevant to each dimension. For each scenario narrative, key parameters are provided for potential climatic, socio-economic, policy and technology outcomes. Further data for each scenario parameter can be found in Appendix C.

Table 7 provides a summary of the time horizons chosen by the NZBA members.

Figure 8 and Figure 9 provide an overview of the physical and transition risk level over time for each of the three scenarios. These high-level climate-related risks were identified for the banking sector to support an increased understanding of physical and transition risks that may materialise over time, for each of the scenario narratives. Physical and transition risk determinations over the short-, medium-, and long-term are based on the general themes in the NIWA and Climate Change Commission scenarios, literature reviews and stakeholder feedback. Each bank should assess the appropriateness of the risk determination to their analysis.

Table 6: Scenario dimensions chosen by New Zealand's banking sector, and relevant international and domestic scenarios. Alignment of scenarios to chosen scenario dimensions was done in accordance with the XRB's guidance on sector-level scenario analysis (External Reporting Board, 2022b)

Category	Scenario dimensions		
	Orderly 1.5°C	Too Little Too Late >2°C	Hot House >3°C
Global climate and socio-economic parameters	IPCC SSP1-1.9	IPCC SSP2-4.5	IPCC SSP5-8.5
Global energy and emission pathway parameters	NGFS Net Zero 2050 IEA Net Zero Emissions by 2050 (NZE)	NGFS Nationally Determined Contrubutions (NDC's) IEA Announced Pledges (APS)	NGFS Current Policies IEA Stated Policies (STEPS)
New Zealand-specific climate parameters	NIWA RCP2.6	NIWA RCP4.5	NIWA RCP8.5
New Zealand-specific transition pathway parameters	CCC 'Tailwinds'	CCC 'Headwinds'	CCC 'Current Policy Reference'

Table 7: Time horizons chosen by New Zealand's banking sector

	Immediate term	Short term	Medium term	Long term
Time horizon	3 years	10 years	30 years	50+ years
Year relative to 2022	2025	2030	2050	2080+
Rationale for selection	Aligned with stress-testing time horizons Aligned with average mortgage re-pricing time horizons Provides a current state assessment	Aligned with interim emissions reductions targets Broadly aligned with average maturity profile of business loans	Aligned with international emissions reduction targets Aligned with international banking sector climate scenario guidance documents	Aligned with further materialisation of physical risks, particularly relevant to Agriculture, Property and segments of the Energy sector due to the reliance on hydropower

Figure 8 – Overview of the physical risk level for each scenario over the short-, medium-, and long-term

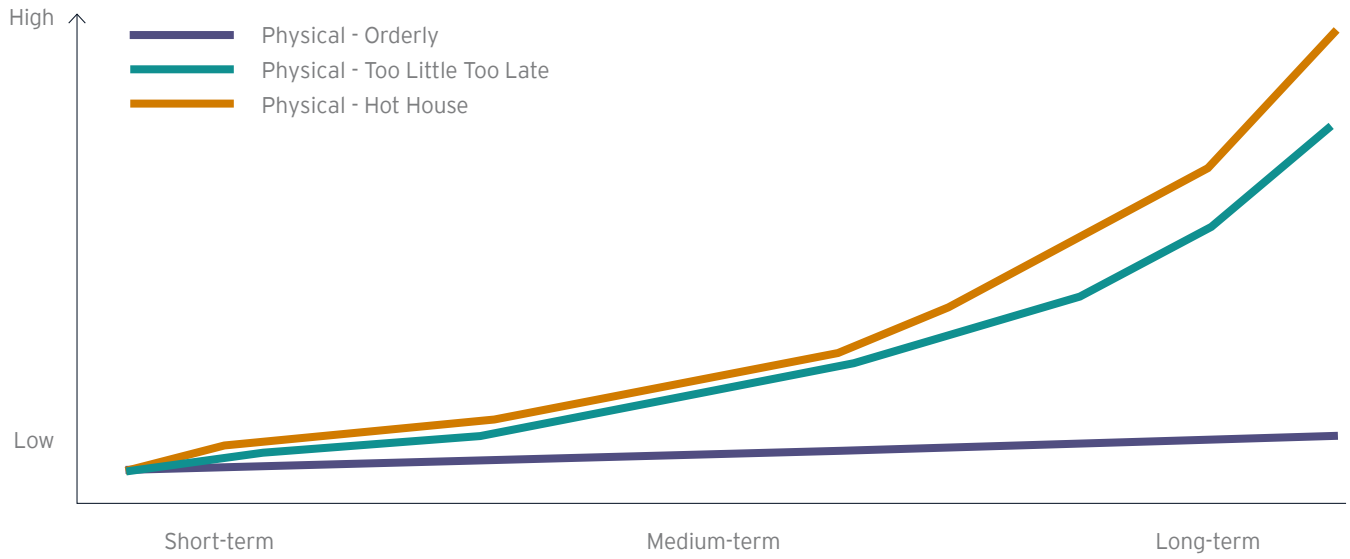
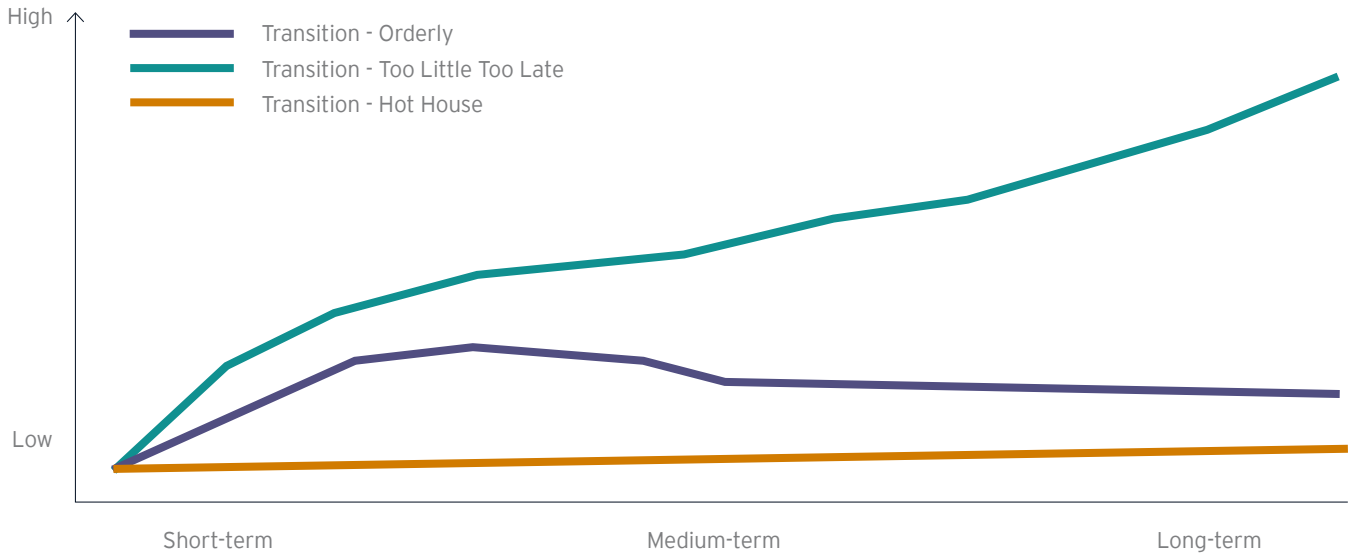


Figure 9 – Overview of the transition risk level for each scenario over the short-, medium-, and long-term



3.1 Orderly

3.1.1 Overview of scenario dimension

The Orderly scenario represents a future world where collective action is taken towards a low-carbon global economy. In this scenario, there are steady and constant societal changes related to technology, policy and behaviour to support the transition to a lower emissions economy. These changes are accompanied by an increasing carbon price that incentivises low-carbon behaviour change. In this scenario, the coordinated and timely action around the world to curb GHG emissions prevents the worst predicted impacts of climate change. However, the long-term chronic physical impacts from historic GHG emissions are still likely to occur, although to a less severe extent than the other scenarios. Overall, when considered alongside the Too Little Too Late and Hot House scenarios, this scenario represents a medium level of transition risk and a lower level of physical risk. Table 8 provides key assumptions under the Orderly scenario.

Table 8: Scenario parameters under an Orderly scenario[15]

Climate outcomes

AVERAGE TEMPERATURE INCREASE

Global

+1.4°C

(1.0, 1.8) by 2100[16] (IPCC)

NET EMISSIONS (FOR ALL GASES)

Domestic: 49MtCO_2e by 2030, 5.9MtCO_2e by 2050 (CCC)

Global: 39BtCO_2e by 2030, 9.6BtCO_2e by 2050 (NGFS)

Socio-economic outcomes

GDP AND GDP% DUE TO CHRONIC PHYSICAL RISK

Acute impacts are excluded from this figure and would further negatively impact GDP

Global

US$ 176 trillion

(-1.2%) in 2030,
US$ 289 trillion (-2.0%) in 2050[17] (NGFS)

NZ

NZ$ 330 billion

(-0.5%) in 2030,
NZ$ 485 billion (-0.7%) in 2050[18] (NGFS)

POPULATION

Global: 8.0 billion by 2030, 8.5 billion by 2050 (IPCC)

Policy outcomes

CARBON PRICE (tCO_2e)

Domestic ETS

NZ$138 in 2030,
NZ$250 in 2050 (CCC)

Global

US$104 in 2030,
US$627 in 2050 (NGFS)

Technology outcomes

PERCENT OF RENEWABLE ELECTRICITY OF TOTAL ELECTRICITY PRODUCED

Domestic

93% by 2030, 98% by 2050 (CCC)

Global

61% by 2030, 88% by 2050 (IEA)

PERCENT OF RENEWABLE ENERGY OF TOTAL ENERGY PRODUCED

Domestic

55% by 2030, 90% by 2050 (CCC)

Global

30% by 2030, 67% by 2050 (IEA)

[15] Refer to Appendix C for source data for these assumptions
[16] Relative to 1850-1900
[17] Provided in % difference, 2017 PPP, US$
[18] Provided in % difference, 2009 prices; NZ$

3.1.2
Datasets aligned with scenario dimension

Table 9: Overview of the Orderly scenario narratives

	Scenario	Description
Orderly	IPCC SSP1-1.9	SSP1-1.9 is the sustainability path scenario and represents the world shifting gradually, but persuasively, towards a more sustainable future, emphasising more inclusive development that respects perceived environmental boundaries. Increasing evidence of, and accounting for, the social, cultural, and economic costs of environmental degradation and inequality drive this shift. Emissions in this scenario decline rapidly, achieving net zero by 2050 and limiting global warming to 1.5°C relative to 1850-1900. The second half of the century is characterised by net negative CO_2e emissions, implying the use of carbon dioxide removals ("CDR").
	NGFS Net Zero 2050	The Net Zero 2050 scenario limits global warming to 1.5°C relative to 1850-1900 through stringent climate policies and innovation, reaching global net zero CO_2 emissions around 2050. This scenario sees strong climate policy, technological advances and behavioural change. While CDR is used to accelerate even further decarbonisation, its use is minimised wherever possible.
	IEA NZE	NZE sets out a narrow but achievable pathway for the global energy sector to achieve net zero CO_2 emissions by 2050. It does not rely on emissions reductions from outside the energy sector to achieve its goals. This scenario relies heavily on solar and wind generation and less on carbon capture, utilisation and storage ("CCUS"). It requires strong behavioural change (uptake of lower emissions technology) across all industries.
	NIWA RCP2.6	The NIWA scenarios leverage the IPCC's RCP modelling of varying levels of GHG concentrations on the earth's climate system. NIWA downscales the global models to study how these different atmospheric concentrations of GHGs might influence the New Zealand climate. As with RCP 2.6, NIWA RCP2.6 represents a world where carbon dioxide (CO_2e) emissions start declining in the 2020s and get to zero by 2100. Average temperature increases under the NIWA scenarios are relative to a 1986-2005 baseline, which differs from the IPCC baseline of 1850-1900. As such, the stated warming at various future points in time is lower in NIWA's scenarios than in the IPCC scenarios.
	CCC Tailwinds	The tailwinds scenario combines further technology and further behaviour change assumptions to provide a potential upper bound for how far and how quickly emissions could be reduced based on current evidence and judgements. This scenario assumes both strong behaviour and technology change across all sectors.

3.1.3 Detailed scenario description

Climate outcomes

In this scenario, the curbing of global GHG emissions through effective policies and the transition to a low carbon economy has helped to curb the most significant physical impacts of climate change. New Zealand's average temperature increase reaches 0.7ºC (0.2, 1.3) by 2050 relative to 1986-2005 levels, and remains constant out to 2100 (Ministry for the Environment, 2018). Limiting the increase in global temperatures to 1.5ºC relative to 1850-1900 levels has helped to minimise the increase in severity of extreme weather. By 2090, New Zealand faces slightly decreased precipitation across the eastern and northern regions of the North Island during the Spring months (Ministry for the Environment, 2018). This is coupled with a moderate increase in drought prevalence in northern and eastern regions of the North Island and eastern areas of the South Island (Ministry for the Environment, 2018). Alongside drought, the number of "hot days", those above 25ºC, are expected to increase by 40% by 2050 or sooner with this remaining relatively constant out to 2100 (Ministry for the Environment, 2018).

Although temperature increases have been curbed, New Zealand still faces the impacts of sea level rise, particularly in the second half of the century. By 2050, the median sea level rise around New Zealand is expected to be 0.23m, increasing to 0.46m by 2100 from 1986-2005 levels, posing a threat of inundation for low-lying coastal areas (Ministry for the Environment, 2017). However, owing to a limited increase in extreme weather events, there is a possibility that the acute impact of sea level rise may be limited. Rather, these areas are more likely to face a slower and more permanent inundation over a longer timeframe, allowing for adaptation and remediation activities to be carried out.

Policy outcomes

Proactive and collective action sees New Zealand reach net zero long-lived emissions in 2040, followed by the rest of the world around 2050 (Ministry for the Environment, 2018); (IPCC, 2021). This is enabled through progressive policy activity and the increasing carbon price that occur in the immediate and short term, which help to incentivise the adoption of low emissions technologies across several areas of the economy. For agriculture, the adoption of new technologies, the increased costs of livestock farming and the demand for alternative proteins lead to a diversification of farming activities, including an increase in arable cropping, horticulture and forestry planting. In the medium term, the manufacturing sector benefits from lower cost low-emissions energy compared to other countries, through sources such as electrification and green hydrogen, which become significant inputs to heavy industry. The widespread policy support for low emissions technologies reduces reliance on afforestation to absorb residual emissions, allowing for greater rates of native afforestation. The medium-term sees native forestry land reach 0.77Mha, up from 0.22Mha in the short term (Climate Change Commission, 2021a). Exotic forestry also increases over this period, reaching 2.5Mha in the medium term, up from 2.1Mha in the short term.

By the medium term, the combination of low emissions technologies and afforestation sees net long-lived gas emissions reach -8.4MtCO_2e while biogenic methane emissions reduce by 57% (from 2017 levels) to 14.3MtCO_2e (Climate Change Commission, 2021c; Climate Change Commission, 2021a). In the long term policy support is provided for further mitigation actions and greater afforestation in order to maintain the net zero status including further emissions for remaining high-emitting sectors and greater use of emissions removals (Climate Change Commission, 2021c).

Socio-economic and technology outcomes

In the Orderly scenario, the removal of barriers to technology adoption and extensive behaviour change across the population support the achievement of net zero by 2040 in New Zealand.

The transport sector sees widespread adoption of electric vehicles (EVs), with an average of 67% of all vehicles on the road running on electricity by the medium term (Climate Change Commission, 2021a). In the short and medium term, residual emissions remain in the heavy trucking and aviation sectors, where emissions reductions are the most difficult to achieve. A continued transition to a renewable electricity generation system supports the significant electrification of the transport fleet and wider economy. Foresight by the government and energy companies in the short term works to address whether sufficient capacity is

added to the grid, largely through the expansion of wind, solar, geothermal and some distributed generation and storage. Alongside investment in generation, there are improvements in electricity storage technology, including the Lake Onslow pumped hydro scheme and grid-sized battery backs. These improvements see electricity generation reach 93% renewable in the short term and 98% renewable in the medium term. The primary energy sector also sees success in adopting low emission alternatives, including waste heat recovery systems, biomass and some hydrogen applications. By the medium term 90% of all energy in New Zealand is sourced from renewables (Climate Change Commission, 2021a). Residual emissions remain for high process heat application and hard to abate emissions from industrial processes such as cement and steel making.

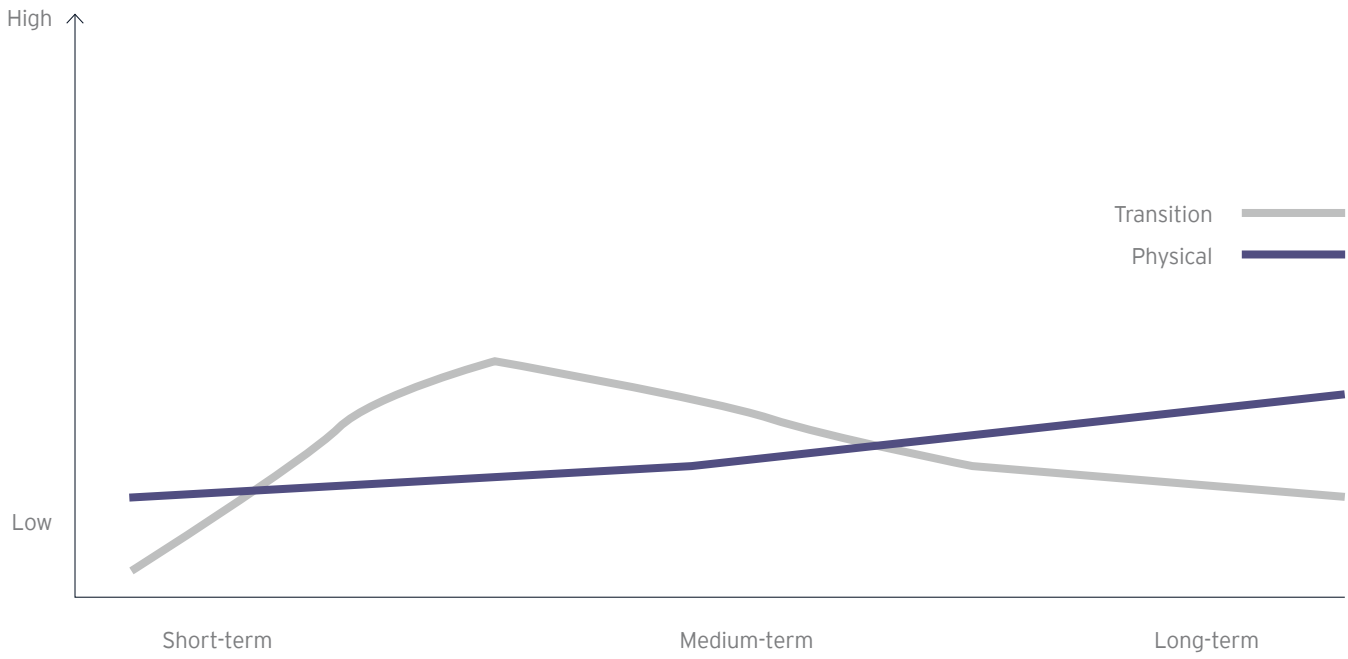
In New Zealand, the agriculture sector also undergoes major technology and behaviour changes to reduce biogenic methane emissions, largely through widespread adoption of biogenic methane inhibitors, vaccines, and low emissions stock variants (Climate Change Commission, 2021c). Although farmers successfully implement these new technologies alongside lower emission farming practices, these changes increase the average cost of farming in the medium term, undermining the viability of the least profitable farms, particularly those on marginal sheep and beef land. This impact is reflected in land area of sheep and beef farms reducing to 7Mha by the medium term. Dairy farming faces the greatest land area reduction, from 2.2Mha in 2019 to 1.6Mha in the medium term. Approximately 90,000 hectares of livestock farms are converted to horticulture in the medium term to support the demand for new plant-based proteins and other low emissions alternatives. A substantial fraction of the remaining farming area with livestock land is absorbed by forestry (Climate Change Commission, 2021c). Methane reductions are also supported in the waste sector, with a 73% organic waste recovery rate by the medium term alongside a major expansion of landfill gas capture across New Zealand (Climate Change Commission, 2021c).

Throughout the medium term, the global economy benefits from the stable transition to a low carbon economy, with GDP reaching US$289 trillion by the medium term (NGFS, 2022b). The continued improvement in human quality of life sees overall population growth slow in the medium term, with the global population hitting 8.5 billion (Riahi, et al., 2017). The concerted global effort to combat climate change helps to reduce any disparity of impact that climate change brings to developed and developing nations. All countries face internal challenges brought by transformational change to their economies, including job losses and skill shortages. However, these issues are managed effectively with the help of a stable climate, economy and international relations.

3.1.4 Key physical and transition risks to the banking sector

Under an Orderly scenario, the rate of physical risk remains relatively low, even in the long term, as there is a concerted effort to reduce emissions. Because of this transition, risks initially increase in the short and medium term before reducing as society shifts to a low carbon economy (Figure 10). The graph below describes the level of physical and transition risk for the Orderly scenario over the short-, medium-, and long-term.

Figure 10: Physical and transition risks out to 2100, for Orderly scenario[19]



The sections below outline key credit and organisational level risks for the banking sector. These are separated into physical and transition risks.

To support greater understanding of potential risks to each priority sector, credit level risks are separated into **Tier 1**, **Tier 2** and **Tier 3** risks:

- **Tier 1:** risks in the Tier 1 category are those very likely to be present under an Orderly scenario
- **Tier 2:** risks in the Tier 2 category are those likely to be present under an Orderly scenario
- **Tier 3:** risks in the Tier 3 category are not likely to be present under an Orderly scenario

Further detail on credit and organisational level risks are detailed in **Appendix D**.

[19] Physical and transition risk determinations over the short-, medium-, and long-term are based on the general themes in the NIWA and Climate Change Commission scenarios, literature reviews and stakeholder feedback. Each bank should assess the appropriateness of the risk determination to their analysis.

Credit Level Risks

Under an Orderly scenario, the Tier 1 credit level risks are dominated by transition risks due to the swift move to a low carbon economy. Under this scenario, physical risks are less significant. Flow on impacts for the banking sector, such as uninsurable assets, do not materialise across the country. **Table 10** and **Table 11** provide an overview of physical and transition risks for each priority sector under an Orderly scenario.

Table 10: Physical credit risks under an Orderly scenario

Sector	Physical risks							
	1	2	3	4	5	6	7	8
Agriculture	■	■	■	■	■	■	■	■
Transport & Shipping	■	■	■		■	■	■	
Energy	■		■	■	■	■	■	
Manufacturing	■	■	■	■	■		■	
Construction		■	■	■	■	■	■	
Residential real estate		■	■	■			■	
Commercial real estate		■	■	■			■	

Key	
1	Drought
2	Storm
3	Flood
4	Heatwave
5	Precipitation change
6	Temperature change
7	Sea level rise
8	Biodiversity loss
9	Customer behaviour change
10	Increased costs of raw materials
11	Regulatory impacts
12	Emissions reduction requirements
13	Litigation risks
14	Emissions pricing
15	Reputation impacts
16	Lower emissions substitutes
17	Emerging technologies
18	Unsuccessful investment
19	Stakeholder relations

Rating	
	Tier 1: Very likely to be present under the relevant scenario
	Tier 2: Likely to be present under the relevant scenario
	Tier 3: Not likely to be present under the relevant scenario

Table 11: Transition credit risks under an Orderly scenario

Sector	Transition risks										
	9	10	11	12	13	14	15	16	17	18	19
Agriculture											
Transport & Shipping											
Energy											
Manufacturing											
Construction											
Residential real estate											
Commercial real estate											

As seen in **Table 10** above, the priority sectors for banks have relatively low exposure to Tier 1 physical risks in an Orderly scenario. Tier 1 transition risks are also lower in comparison to the Too Little Too Late and Hot House scenarios given the orderly transition to a low emissions economy across all sectors. Tier 1 ratings associated with customer behaviour change are consistent across the identified sectors, as there is growing awareness of the potential for risks associated with climate change increasing in frequency and severity. This increased focus on climate related matters is due to a better understanding of climate risks and increased political and activist positioning.

Agriculture sector

Compared to other sectors, agriculture has a slightly higher risk exposure to physical risks under an Orderly scenario due to the sector's inherent reliance on climatic systems to operate successfully. As rated Tier 2, the agricultural sector will likely be impacted by all physical risks identified in this assessment. However, as efforts are made nationally to lessen the impact of physical climate risks through emissions reductions, the impact on the ability of organisations within this sector to repay loans is expected to be less significant under this scenario.

The Tier 1 transition risks very likely to be present under this scenario may decrease revenue and/or operational costs of organisations within the agricultural sector, which may lead to an inability to repay loans and discourage new market entrants, thereby reducing demand for new loans. Market drivers such as customer behaviour change, increased costs of raw materials, regulatory impacts of emissions reductions requirements and agricultural emissions pricing are likely to have an impact on operating costs and revenue of organisations in this sector. Customer behaviour change may impact the demand for agricultural products as consumers switch to alternative proteins and lower emissions substitutes.

Transport and Shipping sector

Although rated Tier 2, physical risks such as drought, storm, floods, and sea level rise have the potential to disrupt key supply chain routes for the transport and shipping sectors. However, the impact on operational costs and revenue, and the ability of organisations to repay loans, will be less significant under an Orderly scenario.

The transport and shipping sector faces exposure to transition risks, leading to the potential inability of organisations in the sector to repay loans. Consumer behaviour may shift towards lower emissions substitutes, lowering demand for fossil-fuelled vehicles. An increase in climate action, fuel taxes and carbon price may lead to increased use of public transportation and shared mobility and, therefore, lower demand for personal road and air travel. Shifts in market behaviour may reduce demand for emissions-intensive modes of transport, increasing stranded asset risk for fossil fuel transport assets and supporting infrastructure and resulting in reduced revenues.

Under an Orderly scenario, an increase in operating and capital costs would be required to shift fleets towards lower-emitting vehicles, driven by a regulatory focus on reducing emissions within the transport sector. These risks are already present and evolving in the transport and shipping sector and may continue to influence consumer demand under current emissions reduction targets in New Zealand.

Energy sector

The energy sector may be particularly vulnerable to physical climate risks associated with changing precipitation patterns given the reliance of the national grid on hydropower generation. Although Tier 2 under this scenario, risks associated with droughts, floods, heatwaves, and precipitation and temperature change may impact the energy sector through 'dry years' and damage to transmission lines and assets.

The energy sector may face exposure to transition risks through the impact of changing customer behaviour and impact of emissions pricing. For the banking sector, there may be an increased risk incurred due to divestment and reduced profitability, which may impact loan repayments. Consumer awareness may increase demand for renewable energy alternatives and availability of energy storage capacity. Increased investment in solar panels may reduce consumer reliance on energy provided by the grid. Rising costs of fossil fuel-based energy may reduce affordability and demand, increasing risk exposure for organisations relying on carbon-intensive processes and negatively impacting their revenue and reputation.

Manufacturing sector

Tier 2 physical risks likely to be present under this scenario for the manufacturing sector relate to those that will disrupt the manufacturing processes. Acute climate risks may damage assets, disrupt power and water supply and impact supply chains. However, the impact on operational costs and revenue from delays in production, and the ability of organisations to repay loans, will be less significant under an Orderly scenario.

Under an Orderly pathway, the manufacturing sector faces the Tier 1 transition risk of changing customer behaviour. In particular, those organisations that manufacture carbon-intensive products such as steel and concrete. Operational costs may increase due to significant restructuring of manufacturing companies required to meet changing consumer demand, which may impact the ability of some organisations to repay loans.

Construction sector

Tier 2 physical risks likely to be present under this scenario for the construction sector are those that will cause damage to construction sites, delay projects, and lead to higher construction costs. As above, the impact on operational costs and revenue from delays in production, and the ability of organisations to repay loans, will be less significant under an Orderly scenario.

Similar to the manufacturing sector, the construction sector faces the risk of changing customer behaviour influencing investment in construction projects. Under an Orderly scenario, construction projects are likely to have lower GHG emissions profiles and incorporate sustainable design features. Adapting to changing consumer preferences will be necessary to remain competitive. Carbon-intensive construction materials, such as concrete and steel, will increase costs within the supply chain given the lack of commercially available substitutes. Higher costs associated with new sustainable design standards and delays to construction timelines has the ability to impact loan repayments.

Residential property sector

Physical risks under an Orderly scenario are lower compared to the Too Little Too Late or Hot House scenario for the residential property sector. There will be isolated communities at risk from sea level rise in the long term, as some coastal properties are damaged by coastal flooding due to storms and king tides. However, the impact on operational costs and revenue, and the ability of organisations to repay loans, will be less significant under an Orderly scenario.

The rate of sea-level rise and other climate-related risks will likely be slower, giving homeowners and lenders more time to adapt and prepare for potential impacts. Managed retreat policies may be implemented gradually and in a more coordinated way, with government support and funding available to help affected homeowners and lenders transition to new areas or adapt their properties to mitigate risks. Increased investment in sustainable housing and the development of financial instruments and insurance products that better reflect climate risks may help offset any potential declines in property values in vulnerable areas, reducing the risk of loan defaults or foreclosure for lenders.

Customer behaviour change is the Tier 1 transition risk that is very likely to be present for the residential property sector. Growing awareness of the risks associated with climate change will increase property owner preference for resilient, efficient buildings that are not situated in high-risk areas, such as flood prone coastal areas. Delayed action on climate risk mitigation by property owners will impact the demand for certain types of residential properties. Properties owned by companies or individuals with a poor environmental reputation may also struggle to attract tenants. These factors may decrease valuation of properties in previously high value areas.

Commercial property sector

Similar to the residential property sector, physical risks under an Orderly scenario are lower compared to the Too Little Too Late or Hot House scenarios. There will be areas located in close proximity to the coast at risk from sea level rise in the long term. However, the impact on operational costs and revenue, and the ability of organisations to repay loans, will be less significant under an Orderly scenario.

There will be an increased demand for sustainable commercial buildings and higher expectations for energy efficiency as a response to changing customer behaviours. Properties owned by companies that are known for high carbon emissions may be seen as less desirable, leading to a decrease in demand and property values. Building owners and property managers must adapt their properties to meet the growing demand for sustainable, energy-efficient, and environmentally responsible buildings. Failure to adapt to these changing market trends could result in a loss of tenants and decreased property value over time.

Organisational Level Risks

Due to a more stabilised average temperature increase and climate in the Orderly scenario, key organisational level risks identified by the banking sector are transition risks. These are outlined in **Table 12** below.

Table 12: Key operational level risks under an Orderly scenario

Risk category	Risk Driver	Risk	Financial impact to the banks
Reputation	Consumer preference	The focus on decarbonisation may increase stakeholder expectations of banks to be proactive in reducing emissions and disclosing progress.	Revenue may decrease due to reputation loss if banks do not reduce emissions or produce disclosures in line with stakeholder expectations.
Reputation	Investor preference	Investor confidence may be lost if a bank is not seen to be adapting quickly enough to changing risks & opportunities.	The funding costs may increase or the overall ability to raise capital may be lost.
Reputation	Investor preference	A divergence in stakeholder expectations may drive a difference in operational practices between New Zealand and home/other markets.	Operational expenditure may increase as New Zealand branches of international banks implement New Zealand specific policies to meet stakeholder expectations.
Market	Consumer preference	If transition plans lack ambition (relative to peers), borrowers may be concerned about future climate-related borrowing clauses and switch banks.	Revenue may decrease due to shrinkage of market share.
Market	Governance	A slow reaction to decarbonisation may lead to a bank falling behind competitors in identifying and capturing opportunities relating to the transition.	Capital expenditure and operational costs may increase as banks try to catch up to competitors. Revenue may be lost due to a loss of market share.
Market	Governance	Increased employee attrition due to their prioritisation of climate-resilient and purpose-led organisations may lead to reduced effectiveness and innovation to execute strategy, reduced diversity and overall reduced competitiveness in the market. It may also increase the cost of human capital for banks.	Increased employee attrition may lead to reduced effectiveness and innovation to execute strategy, reduced diversity and overall reduced competitiveness in the market. It may also increase the cost of human capital for banks.
Policy and legal	Litigation	Shareholder/stakeholder litigation may result in banks being financially responsible for their share of existing emissions.	Operational expenditure may increase to cover the financial cost of litigation and the outcome from the court's ruling.
Policy and legal	Stakeholder activism	Allegations of climate change inaction and/or greenwashing may be directed towards banks that are perceived as falling behind market expectations.	Operational expenditure may increase due to lost employee productivity through business disruption and any costs required to remediate concerns. Potential loss of customer and investor confidence due to adverse publicity which damages the brand value.
Policy and legal	Climate policy	Increased focus on climate policy between successive governments may add additional regulatory compliance requirements, leading to adopt new policies in order to meet/align with new climate regulation.	Operational expenditure may increase due to the need to begin new work programmes that align with the latest climate policy and associated costs of compliance.

3.2 Too Little Too Late

3.2.1 Overview of scenario dimension

The Too Little Too Late scenario describes a misaligned and delayed transition to a low carbon economy between New Zealand and the rest of the world. In this scenario, New Zealand is a first mover on the transition to a low emissions economy, introducing policies that bring about net zero emissions by 2050. Globally, however, there is very limited action towards a low emissions future, with fossil-fuelled development continuing throughout much of the remaining first half of the century. From the medium term, global efforts to address climate change begin to align and may even exceed those in New Zealand. Large increases in carbon prices may drive a rapid improvement in low emissions technology efficacy and uptake. This shift is partly driven by the increasing evidence and awareness of the social, economic, and environmental degradation caused by a continued increase in fossil-fuelled development. Despite making a concerted effort to reduce emissions and move to a low emissions economy in the medium term, the changes come too late to prevent wide-ranging acute and chronic physical climate impacts. Overall, when considered alongside the Orderly and Hot House scenarios, this scenario represents a high level of transition risk and a moderate to high level of physical risk.

The following table summarises the various scenario parameters of the Too Little Too Late scenario narrative:

Table 13: Scenario parameters under a Too Little Too Late scenario[20]

Climate outcomes

AVERAGE TEMPERATURE INCREASE

Global

+2.7°C

(2.1, 3.5) by 2100[21] (IPCC)

NET EMISSIONS (FOR ALL GASES)

Domestic: 58MtCO_2e by 2030, 24MtCO_2e by 2050 (CCC)

Global: 51BtCO_2e by 2030, 42BtCO_2e by 2050 (NGFS)

Socio-economic outcomes

GDP AND GDP% DUE TO CHRONIC PHYSICAL RISK

Acute impacts are excluded from this figure and would further negatively impact GDP

Global

US$ 175 trillion

(-1.6%) in 2030,
US$ 274 trillion (-5.1%) in 2050[22] (NGFS)

NZ

NZ$ 329 billion

(-0.7%) in 2030,
NZ$ 477 billion (-2.3%) in 2050[23] (NGFS)

POPULATION

Global: 8.3 billion by 2030, 9.2 billion by 2050 (IPCC)

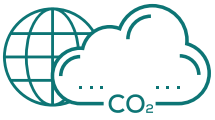
Policy outcomes

CARBON PRICE (tCO_2e)

Domestic ETS

NZ$138 in 2030,
NZ$250 in 2050 (CCC)

Global



US$53 in 2030,
US$103 in 2050 (NGFS)

Technology outcomes

PERCENT OF RENEWABLE ELECTRICITY OF TOTAL ELECTRICITY PRODUCED

Domestic

92% by 2030, 96% by 2050 (CCC)

Global

46% by 2030, 71% by 2050 (IEA)

PERCENT OF RENEWABLE ENERGY OF TOTAL ENERGY PRODUCED

Domestic

49% by 2030, 78% by 2050 (CCC)

Global

19% by 2030, 37% by 2050 (IEA)

[20] Refer to Appendix C for source data for these assumptions
[21] Relative to 1850-1900
[22] Provided in % difference, 2017 PPP, US$
[23] Provided in % difference, 2009 prices; NZ$

3.2.2
Datasets aligned with scenario dimension

Table 14: Overview of the Too Little Too Late scenario narratives

	Scenario	Description
Too Little Too Late	IPCC SSP2-4.5	SSP2-4.5 is the middle of the road scenario and represents a moderate approach to transitioning towards a low carbon future. With a disjointed global approach, policies shift over time to become increasingly oriented toward national and regional issues, at the expense of broader-based development. Strong environmental degradation is experienced in some areas due to a low international priority for addressing environmental concerns. Lack of international cooperation increases challenges to mitigation. The use of carbon dioxide removals ("CDR") is limited to its direct application to the exhaust streams of point-source facilities such as power plants or factories.
	NGFS 'Nationally Determined Contributions' (NDC)	NDC scenario projects 2.6°C average global temperature rise relative to pre-industrial levels, associated with moderate to high physical risk exposure. This scenario is also characterised by a slower uptake in technology in the first half of the century, accompanied by less transition risk on a global scale in the medium term.[24]
	IEA APS	The APS scenario assumes that all recent major national announcements of emission targets from 2030 onwards are achieved (regardless of whether these have been anchored in implementing legislation or updated NDCs). This includes the commitment made by the New Zealand Zero Carbon amendment to the Climate Change Response Act setting a net zero emission target for all GHG except biogenic methane by 2050.
	NIWA RCP4.5	The NIWA scenarios leverage the IPCC's RCP modelling of varying levels of GHG concentrations on the earth's climate system. NIWA downscales the global models in order to study how these different atmospheric concentrations of GHGs might influence the New Zealand climate. As with RCP 4.5, NIWA RCP4.5 represents a world where carbon dioxide (CO_2e) emissions start declining by approximately 2045 to reach roughly half of the levels of 2050 by 2100. Average temperature increases under the NIWA scenarios are relative to a 1986-2005 baseline which differs from the IPCC baseline of 1850-1900. As such, the stated warming at various future points in time are lower in NIWA's scenarios than they are in the IPCC scenarios.
	CCC 'Headwinds'	In this scenario, there are higher barriers to uptake of both technology and behaviour changes across key measures. It assumes conservative improvements in technology relative to the Current Policy Reference case. This scenario also assumes a modest change from existing behaviour trends among people and businesses.

[24] This scenario was only used for GDP projections for the first half of the century, therefore assumptions for this scenario in the latter half of the century have been ignored.

3.2.3 Detailed scenario description

Climate outcomes

In this scenario, global emissions continue to increase in the immediate and short term and only begin to reduce in the medium term. This delay in abatement efforts results in the materialisation of a number of physical climate risks. In the immediate and short term, New Zealand faces an increased prevalence of extreme weather events, such as floods and storms around the country (Ministry for the Environment, 2018). By the medium term, global temperatures have increased by an average of 1.7°C (IPCC, 2021). This results in a greater intensity of the extreme weather events felt in the short and medium term, driving up insurance premiums in areas that are repeatedly impacted. As a result, some people begin to move to less impacted areas of the country, particularly to those areas that are inland or elevated. This drives up the demand for construction and property in these areas, spurring new housing developments.

In the medium and long term, greater variations in weather patterns are experienced by different regions around the country. Northland, Hawkes Bay, and Canterbury all face an increased prevalence of drought (Ministry for the Environment, 2018). This is driven by the number of hot days (defined as those reaching over 25°C) increasing by an average of 54% in the medium term, increasing to 96% in the long term (Ministry for the Environment, 2018). At the same time, the level of precipitation in the same regions is decreasing, reaching a 10% reduction in the long term (Ministry for the Environment, 2018). Despite efforts to adapt to the changing weather, farms in these regions begin to suffer from lost productivity in the medium term as gains made from new on farm technologies and farm management practices struggle to compensate for the lack of water. As a result, farmers face challenges in recouping investment costs for new technologies. In the long term, the West Coast and south of the South Island are facing higher average precipitation. The West Coast of the South Island experience 20% more precipitation during the winter months bringing an increased risk of floods to the area (Ministry for the Environment, 2018). The intensity of precipitation around the lower South Island also increases, driving up the risk of heavy downpours and flash flooding. Despite increasing precipitation, in the long term, the number of snow days is expected to decrease by 30 days over the Southern Alps, reducing the size of the snowpack and impacting river flows (Ministry for the Environment, 2018).

The significant delay in emissions reduction creates greater levels of sea level rise around New Zealand. The increased frequency of acute extreme weather events combined with higher rates of sea level rise result in more frequent damage and inundation of more coastal homes and properties than under an Orderly scenario. In the short term, this damage is largely covered by insurance payments, allowing for properties to be repaired and rebuilt. By the medium and long term, New Zealand experiences a median increase in sea level of 0.24 and 0.55m, respectively (Ministry for the Environment, 2017). This increased scale of coastal inundation and property damage from sea level rise sees insurance premiums rise significantly from the medium term for coastal and low-lying areas. The impacts of sea level rise on the coastline become more evident through coastal inundation, and coastal erosion of beaches, estuaries and cliffs. In the long term, these impacts undermine the liveability of some beachfront properties repeatedly damaged beyond reasonable repair during storms. This sees an increase in property owners facing total losses of their homes and businesses, which leads to some funding support for managed coastal retreat from councils and central government.

Policy outcomes

Despite global hesitancy, New Zealand takes a proactive approach to climate change in the short term that enables the country to reach net zero long-lived emissions by 2048 (Climate Change Commission, 2021b). However, the transition to net zero emissions proves challenging as the limited development and availability of low emissions technology, combined with a reluctance to reduce emissions in some sectors, drives up the cost of emissions reductions (Climate Change Commission, 2021a).

New Zealand's net long-lived gas emissions reach -1.4MtCO_2e in the medium term (Climate Change Commission, 2021a). Despite the low availability of methane mitigation technologies, the 2030 and 2050 current methane policy targets are still met, achieving a 10% and 25% reduction from 2017 levels, respectively (Climate Change Commission, 2021). Agricultural emissions pricing is used as the primary driver for emissions reduction in the sector, helping to make mitigation activities cost-competitive without taking action. As a result, low emissions technologies such as methane vaccines become a viable adoption for livestock farming despite their high cost and low availability. In the short and medium term, a lack of global policy support for low emissions alternatives to high process heat, such as hydrogen, leaves much of New Zealand's heavy manufacturing without the ability to decarbonise. However, local support for biomass use in low and medium process heat applications enables cost-effective

emissions reductions across this area of the manufacturing sector. Without low emissions steel or other core building materials, the construction and property sector focuses on energy efficiency to drive emissions reductions. Homes and buildings are increasingly constructed with heat pumps and electric boilers. Despite this, gas usage by buildings around the country remains at 50% of current rates in the medium term (Climate Change Commission, 2021).

With the limited availability of low emission technology in New Zealand, afforestation becomes a key tool to achieve net zero by 2050. Exotic forestry is heavily relied upon to help bring down net GHG emissions before 2050, with the total exotic forestry area reaching 2.6Mha in the medium term, up from 2.2Mha in the short term (Climate Change Commission, 2021c). Due to its slower growth and carbon absorption rate, native forestry is relied upon less to meet 2050 emissions targets, reaching only 0.5Mha in the medium term, up from 0.2Mha in the short term (Climate Change Commission, 2021c). As a result, the demand for unused rural land and less profitable farmland that can be converted into exotic forestry increases. Greater global support for low emission technology from the medium term helps to reduce the reliance on forestry somewhat. However, the lag in leveraging this technology sees forestry rates continue to climb.

Socio-economic and technology outcomes

Delayed development of low emissions technologies combined with slow behaviour change restrict New Zealand's decarbonisation options until closer to the medium term, when global efforts to decarbonise begin to align to those of New Zealand. The sharp change in approach towards climate change action in the medium-term impacts global economic growth, with GDP reaching US$274 trillion by 2050, a reduction of approximately US$9 trillion compared to an Orderly scenario (NGFS, 2022a). On the other hand, global population growth exceeds that of an Orderly scenario, with a global population of 9.2 billion people resulting in a lower standard of living for many across the globe as a smaller GDP is shared amongst a greater population (Riahi, et al., 2017). Lower GDP growth together with higher population estimates and transition costs suggests greater polarisation, as the worlds more marginalised nations are exposed to higher rates of poverty, political and economic instability and more severe physical climate change impacts. Prioritisation by developed nations on covering internal transition costs will likely increase geopolitical tensions, as displaced people migrate to seek safer living conditions.

With renewable electricity technologies already well developed, New Zealand achieves a 92% renewable electricity rate in the short term due to the continued expansion of New Zealand's renewable electricity network, especially through wind, solar and geothermal (Climate Change Commission, 2021a). The expansion of New Zealand's renewable electricity continues in the medium term. However, a lack of viable renewable energy storage technology and the failure to invest in the pumped hydro scheme at Lake Onslow prevents a 100% renewable electricity generation rate. Some natural gas usage remains in the system to provide base load electricity which results in 96% renewable electricity rate by 2050 (Climate Change Commission, 2021a). Unlike electricity, the uptake of renewable primary energy in New Zealand is limited in the short term as New Zealand faces challenges in decarbonising process heat systems due to a lack of investment into low emissions alternatives. In the medium term, renewable primary energy in New Zealand increases significantly, reaching 78% (Climate Change Commission, 2021a). Much of this increase is driven by the rise in renewable electricity and the conversion of low-process heat boilers to biomass and electricity.

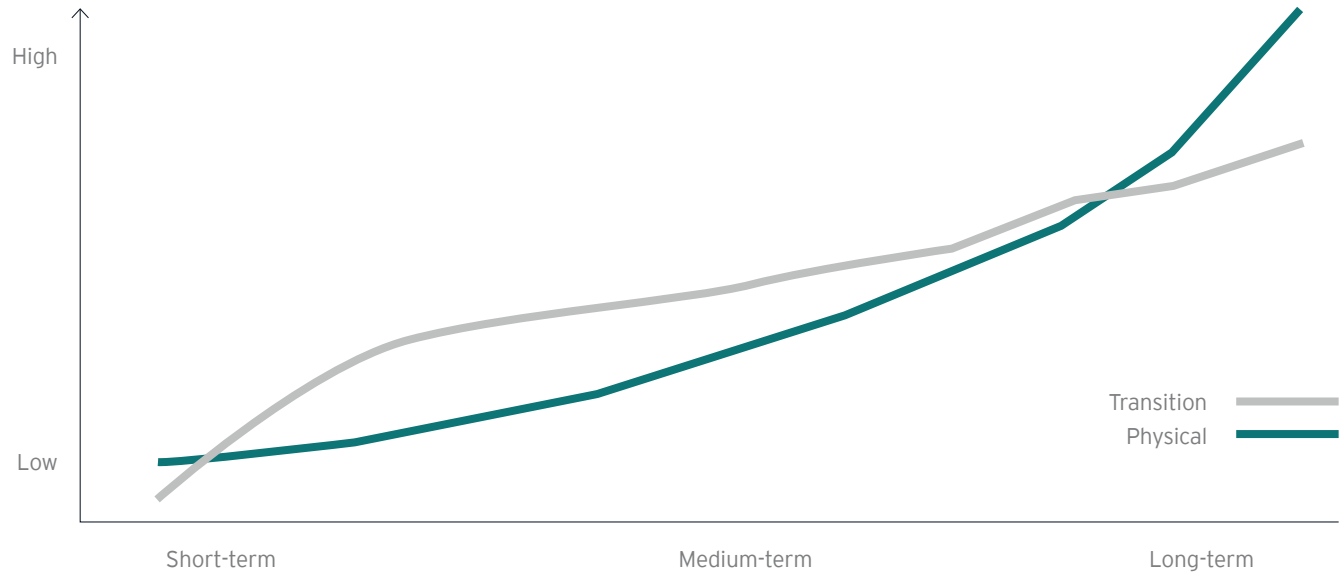
In the transport sector, emissions reductions happen slowly, with only 6% of the fleet electrified in the short term (Climate Change Commission, 2021a). The push for low emissions technology adoption in the agriculture sector is met with some reluctance by farmers and a general lack of availability of technologies. In the short and medium term, some of this reliance on technology is reduced through the selective breeding of lower emission animal variants and reduced stocking rates (Climate Change Commission, 2021e). However, the cost impacts of emissions pricing and limited reduction opportunities lead to a loss of viability for some livestock farms. By the medium term, the rate of fleet electrification reaches 59%. As electric vehicle sales reach critical mass and steadily take over the national vehicle fleet nearer in the medium term, the overall emissions from the transport sector reduce to 3MtCO_2e, down from 15.4MtCO_2e in the short term (Climate Change Commission, 2021a). Residual emissions are largely the result of aviation emissions, which see little to no reduction, even by the medium term.

The increased cost of emissions pricing in the agriculture sector, coupled with limited reduction opportunities, sees a reduction in livestock farming area from 9.7Mha in 2019 to 8.6Mha in the medium term (Climate Change Commission, 2021a; Stats NZ, 2021). The majority of this land use change is absorbed by exotic forestry planting as farmers see greater viability from planting their farms than raising livestock. Horticulture also sees a small amount of growth as low emissions plant proteins continue to increase in popularity both locally and globally.

3.2.4
Key physical and transition risks to the banking sector

Under a Too Little Too Late scenario for New Zealand, the rate of physical risk climbs steadily out to the long term. Due to New Zealand's current decarbonisation commitments, transition risk increases rapidly in the short-term, plateauing in the medium term as net zero targets are reached (Figure 11). Transition risk exposure then increases again in the long term due to increased global action and the emergence of new technologies facilitating decarbonisation. **Figure 11** below shows the overall physical and transition risk level for the Too Little Too Late scenario over the short-, medium-, and long-term.

Figure 11: Physical and transition risks out to 2100, for Too Little Too Late scenario[25]



The sections below outline key credit and organisationa level risks for the banking sector. These are separated into physical and transition risks.

To support greater understanding of potential risks to each priority sector, credit level risks are separated into **Tier 1**, **Tier 2** and **Tier 3** risks:

- **Tier 1:** risks in the Tier 1 category are those very likely to be present under a Too Little Too Late scenario
- **Tier 2:** risks in the Tier 2 category are those likely to be present under a Too Little Too Late scenario
- **Tier 3:** risks in the Tier 3 category are not likely to be present under a Too Little Too Late scenario

Further detail on credit and organisational level risks are detailed in **Appendix D**.

[25] Physical and transition risk determinations over the short-, medium-, and long-term are based on the general themes in the NIWA and Climate Change Commission scenarios, literature reviews and stakeholder feedback. Each bank should assess the appropriateness of the risk determination to their analysis.

Credit Level Risks

Under Too Little Too Late, the Tier 1 credit level risks remain primarily dominated by transition risks. However, the delayed action on emissions reductions have resulted in Tier 1 physical risks in the transport and shipping, and agriculture sectors. **Table 15** provides an overview of the physical risks.

Table 16 showcases the transition risks per sector under the Too Little Too Late scenario. Under this scenario, there is an increasing level of risk that assets may become uninsurable or face unaffordable insurance premiums as physical risks become more pronounced, particularly for those sectors that face higher likelihood of risks driven by the impacts of storms, flooding and sea level rise.

Table 15: Physical credit risk ratings for the Too Little Too Late scenario

Sector	Physical risks							
	1	2	3	4	5	6	7	8
Agriculture								
Transport & Shipping								
Energy								
Manufacturing								
Construction								
Residential real estate								
Commercial real estate								

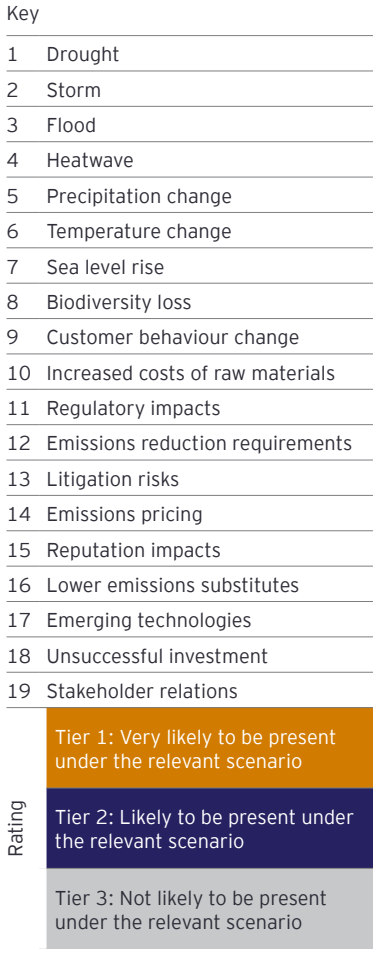


Table 16: Transition credit risk ratings for the Too Little Too Late scenario

Sector	Transition risks										
	9	10	11	12	13	14	15	16	17	18	19
Agriculture											
Transport & Shipping											
Energy											
Manufacturing											
Construction											
Residential real estate											
Commercial real estate											

The continued lack of stringent climate-related policy on a global scale result in further materialisation of physical risk exposure, jeopardising the environment in an already fragile system. As with the Orderly scenario, agriculture again holds the greatest exposure to physical risks under a Too Little Too Late scenario, with drought, flood, heatwaves and biodiversity degradation noted as Tier 1 risks. Transition risks under a Too Little Too Late scenario are abundant across all sectors. In New Zealand, these risks are likely to materialise in the short to medium-term. However, the risks further increase in the medium to long-term because of rapid government intervention around the world to curb climate change.

Agriculture sector

Under a Too Little Too Late scenario, several Tier 1 physical climate risks are very likely to be present. This will lead to an increase in operational costs of agricultural companies and a reduction in revenue, leading to an inability to repay their loans. The agriculture sector is exposed to drought, floods, heatwaves and biodiversity loss, creating resource pressure on farming systems. Delayed emissions reduction measures exacerbate these physical risks, leading to increased crop failures and reduced agricultural productivity, impacting banks that have significant agricultural lending portfolios.

This sector is also exposed to transition risks linked to customer behaviour change, increased costs of raw materials, regulatory changes, emissions pricing, and reputational risk. Shifting customer behaviour and lower emissions substitutes pose transition risks to the agriculture sector as there is a growing awareness of climate risks. Increased consciousness around these topics leads to a shift in demand for cleaner, more environmentally friendly farming practices. Delayed implementation of emissions reduction measures could lead to sudden and more stringent regulatory measures in the future, affecting the competitiveness of the sector. Introductions of emissions pricing would increase the cost of production for farmers, resulting in higher prices for agricultural products. Reduced demand for agricultural products as consumers switch to alternative products would impact lending to businesses in the agricultural sector that experience reduced revenues and profits.

Transport and Shipping sector

The transport and shipping sector faces Tier 1 risks resulting from flooding, storms, and sea level rise, reducing the ability of companies in this sector to continue servicing their loans. Flooding and storms have been identified as a Tier 1 risk, largely due to the interruption that severe flood and storm events can have on transport routes and infrastructure, causing flow on impacts to supply chains. This risk is compounded by sea level rise, which in a compound event, threatens to make floods and storms worse in coastal areas. Physical climate risks will permanently affect coastal transport routes due to inundation and greater levels of erosion. These risks are expected to become more apparent in the latter half of the century as the average global temperature increases.

The transport and shipping sector is likely to face a range of transition risks under a Too Little Too Late scenario. Tier 1 transition risks very likely to be present are the impacts of emissions pricing. The slow response to climate change mitigation and adaptation results in more stringent regulation of emissions from the transport and shipping sector towards mid-century, including the introduction of a high emissions price. This will increase operating costs, impacting the ability for loan repayment.

Energy sector

New Zealand's reliance on renewables for electricity generation means that the energy sector faces greater impacts from physical risks under a Too Little Too Late scenario, caused by precipitation levels and drought, which both pose a risk to hydro generation reliability. This may lead to increased operational costs due to delays in production and/or decreased revenue, consequently impacting loan repayments of companies in the energy sector. If rainfall levels are insufficient to replenish hydro lakes, particularly over several seasons, the electricity sector will struggle to meet demand requirements from its current generation mix without significant reliance on additional fossil fuels. The impact of drought on water availability may also impact river flows further reducing water supplies for hydro lakes, particularly in the North Island where hydro lakes are often downstream of farming and industrial operations. An increase in the number of hot days and heatwave conditions under a Too Little Too Late scenario may increase pressure on the energy sector due to electricity consumption for cooling in peak demand periods throughout New Zealand.

Although the New Zealand electricity sector relies predominantly on hydropower to produce electricity, fossil fuel-derived electricity is still relied upon during winter or when lake water levels are low. Beyond electricity, low emissions regulation runs the risk of devaluing emissions intensive capital leading to stranded assets and premature write-downs. Failing to recognise the shifting market may result in unsuccessful investment, particularly in oil and gas industries, due to shifting demand towards renewable energy production alternatives.

Manufacturing sector

Under a Too Little Too Late scenario, the manufacturing sector primarily faces transition risks as Tier 1 risks, leading to companies' potential inability to continue to repay their loans. Heavy emissions pricing may impact the cost of raw

materials and increase the costs of production. In addition, greater scrutiny of emissions reporting and disclosures may drive up reporting costs for manufacturing firms.

Manufacturing firms that are seen as less mature in reporting and reducing their emissions may face litigation risks from shareholders or other concerned parties, bringing about reputational damage as society increasingly opposes high-emitting organisations. Attempts to reduce emissions and exposure to litigation risks also pose a risk to manufacturing firms if investment into new technologies that would enable emissions reductions is unsuccessful. In these situations, manufacturing firms may face not only litigation and reputation risk, but also financial losses from failed technology investments.

Construction sector

Flooding is a Tier 1 physical risk present for the construction sector under this scenario. Flooding interrupts construction operations, causing delays to project timelines, and disrupts logistics for delivery of supplies and removal of waste. Damage caused by floods and other extreme weather events increases costs for the construction sector. Companies in the construction sector may be unable to pay back their loans due to increased costs from repairing and replacing damaged infrastructure.

The construction sector also faces several Tier 1 transition risks, particularly in relation to emissions. The impact of regulation on emissions pricing and emissions reduction requirements may increase overall operational and supply chain costs. The use of cement and steel in construction may be particularly impacted by these changes due to the high level of emissions associated with their manufacturing. Companies face risks in their supply chain, particularly if they rely on suppliers that are heavily invested in fossil fuels or other high-emitting industries.

Regulatory requirements to use low emissions technologies or alternatives in buildings may increase the overall cost of construction. This may also have flow-on impacts for existing properties where retrofits are required to meet new building requirements, increasing overall operating costs. Decreased profitability may cause an inability to meet loan repayments.

Residential property sector

The residential property sector faces Tier 1 physical risks from flooding and sea level rise, particularly communities in low-lying areas. Delayed action against climate impacts exacerbates the impacts of flooding and sea level rise, leading to increased damage and loss of residential properties. This results in decreased property values, increased insurance costs, and potential loan defaults for homeowners who are unable to afford repairs or insurance costs.

Slower emissions reduction measures could result in greater uncertainty and risk, as the timing and extent of managed retreat policies may be more difficult to predict. This could result in increased volatility in property values, and banks may face challenges in accurately assessing the value and risk of their mortgage portfolios in high-risk areas. Banks that hold mortgages on properties in high-risk areas could face losses as properties become less valuable or even abandoned due to managed retreat policies. Additionally, banks that have invested in properties or developments in high-risk areas could also face losses if they are unable to recoup their capital.

The flow-on impacts of higher construction costs will pass through to the residential property sector for refurbishments and new developments. Slower action against climate change under a Too Little Too Late scenario could increase the credit risk for banks that have exposure to the residential property sectors. If property values decline due to factors such as stranded assets, increased regulatory risk, or business interruption, borrowers may be more likely to default on their loans, leading to losses for the banks.

Commercial property sector

Tier 1 physical risks present under this scenario for the commercial property sector are flooding and sea level rise. Commercial properties that are located in areas that are vulnerable to climate change may become less desirable over time, leading to a decline in property values. As with the residential property sector, there will be decreased property values, increased insurance costs, and loan defaults for commercial building owners who are unable to attract tenants, afford repairs or increased insurance costs.

As Government introduces regulations that limit emissions and energy consumption, commercial properties that do not meet these standards face penalties and fines, leading to decreased cash flows and lower property values. When policymakers eventually decide to tighten regulations on emissions, energy efficiency, or other environmental factors, commercial properties that do not meet the new standards could become liabilities for investors and lenders. This increases the credit risk for banks that hold loans against these properties.

Organisational Level Risks

The Too Little Too Late scenario generates the highest transition risk exposure, materalising in New Zealand well before the short term and increasing around the world in the medium term. Despite the global delay in transition risk onset, all types of transition risk materialise including reputation, market, technology, and legal/policy related risks. The lack of action on climate change also generates greater levels of physical risks for banks. These risks are presented in **Table 17** below.

Table 17: Key operational level risks for Too Little Too Late scenario

Risk category	Risk Driver	Risk	Financial impact to the banks
Acute	Flood	Increase in physical sites impacted by flood, damaging equipment and ability to reach customers.	Operational costs may increase to cover repair costs and any potential increase in insurance premiums if bank assets are in a flood-prone zone.
Acute	Extreme weather	Severe weather impacts may see branches and corporate offices closed or inaccessible due to weather impacts. Travelling staff may be stranded away from home. Impacts on electricity supply may impact call and data centre reliability leading to digital business disruptions alongside physical business interruptions.	Revenue may decrease due to lower staff productivity and potential loss of customers if some banks are affected and others are not (in any given locality). Operational costs may increase due to increased costs for site repairs and increased costs due to travel disruption for stranded staff.
Reputation	Consumer preference	The latter focus on decarbonisation may increase stakeholder expectations of banks to be proactive in reducing emissions and disclosing progress.	Revenue may decrease due to reputation loss if banks do not reduce emissions or produce disclosures that align with stakeholder expectations.
Reputation	Investor preference	Investor confidence may be lost if a bank is not seen to be adapting quickly enough to changing risks & opportunities.	Increased or unavailable wholesale funding as a result of banks not transitioning to Net Zero. The funding costs may increase, or the overall ability to raise capital may be lost.
Reputation	Investor preference	A divergence in stakeholder expectations may drive a difference in operational practices between New Zealand and home/other markets.	Operational expenditure may increase as New Zealand branches of international banks implement New Zealand specific policies to meet stakeholder expectations
Market	Governance	A slow reaction to decarbonisation may lead to a bank falling behind competitors in identifying and capturing opportunities relating to the transition.	Capital expenditure and operational costs may increase as banks try to catch up to competitors. Revenue may be lost due to a loss of market share.
Technology	Changes to technology	Uncertainty around the feasibility of new technologies may make it difficult to decide on new investment pathways.	Sunk costs may increase as investment decisions fail to align with the adoption of future technologies and require earlier replacement.
Technology	Changes to technology	Technological solutions to help banks analyse climate risks from a credit perspective are either not available or not fit for purpose.	Increase in financial losses for banks who fail to properly analyse climate risk and therefore do not hold the proper amount of capital or require an appropriate return for the level of climate risk they hold
Policy and legal	Regulation	Sudden regulation changes at mid-century may lead to rapid industry collapse/change creating stranded assets in the process.	Revenue may decrease due to stranded asset value loss and business performance decline for customers in the affected industries
Policy and legal	Climate policy	Radical shifts in climate policy between successive governments may undermine the route taken by banks, leaving them to abandon their existing strategies and adopt new ones in order to meet/align with new climate policy.	Sunk costs may increase due to the need to stop existing programmes of work to begin new ones that will meet the latest climate policy. Operational costs may increase due to the cost to comply/meet legislative requirements.

3.3 Hot House world

3.3.1 Overview of scenario dimension

This scenario represents a worst-case emissions trajectory with minimal ambition to transition towards a low carbon economy. Despite widespread increase in severe weather events, and associated destabilisation of social, political and economic structures, low demand for carbon alternatives continues to slow the rate of development and uptake of emissions saving technology. Continued and unabated expansion of emissions intensive industries is expected to exacerbate natural biophysical mechanisms that moderate global temperature, pushing them beyond operating thresholds, into a state of unprecedented climate volatility. Under this scenario, the second half of this century is characterized by high physical risk due to extreme weather events, exacerbated by rising sea levels. The Hot House scenario aims to capture impacts associated with high physical risk and low transition risk.

The following table summarises the various scenario parameters under this Hot House scenario narrative:

Table 18: Scenario parameters under a Hot House scenario[26]

Climate outcomes

AVERAGE TEMPERATURE INCREASE

Global

+4.4°C

(3.3, 5.7) by 2100[27] (IPCC)

NET EMISSIONS (FOR ALL GASES)

Domestic: 64MtCO_2e by 2030, 40MtCO_2e by 2050 (CCC)

Global: 56BtCO_2e by 2030, 54BtCO_2e by 2050 (NGFS)

Socio-economic outcomes

GDP AND GDP% DUE TO CHRONIC PHYSICAL RISK

Acute impacts are excluded from this figure and would further negatively impact GDP

Global

US$ 175 trillion

(-1.6%) in 2030,
US$ 273 trillion (-5.7%) in 2050[28] (NGFS)

NZ

NZ$ 329 billion

(-0.7%) in 2030,
NZ$ 475 billion (-2.6%) in 2050[29] (NGFS)

POPULATION

Global: 8.1 billion by 2030, 8.6 billion by 2050 (IPCC)

Policy outcomes

CARBON PRICE (tCO_2e)

Domestic ETS

NZ$35 in 2030,
NZ$35 in 2050 (CCC)

Global

US$6 in 2030,
US$6 in 2050 (NGFS)

Technology outcomes

PERCENT OF RENEWABLE ELECTRICITY OF TOTAL ELECTRICITY PRODUCED

Domestic

90% by 2030, 92% by 2050 (CCC)

Global

42% by 2030, 60% by 2050 (IEA)

PERCENT OF RENEWABLE ENERGY OF TOTAL ENERGY PRODUCED

Domestic

45% by 2030, 58% by 2050 (CCC)

Global

16% by 2030, 26% by 2050 (IEA)

[26] Refer to Appendix C for source data for these assumptions
[27] Relative to 1850-1900
[28] Provided in % difference, 2017 PPP, US$
[29] Provided in % difference, 2009 prices; NZ$

3.3.2
Datasets aligned with scenario dimension

Table 19: Datasets aligned with a Hot House scenario

	Scenario	Description
Hot House world	IPCC SSP5-8.5	SSP5 is the fossil-fuelled development path scenario. This scenario sees a focus on immediate economic growth, with strong GDP growth, increases in materialism and meat consumption, and minimal environmental policy. In response, the emissions are forecast to be the highest, with the greatest climate variability across all climate variables expected. The lack of focus on emissions reductions means carbon dioxide removals ("CDR") see little to no deployment across the globe.
	NGFS 'Current Policies'	Current Policies assumes that only currently implemented policies are preserved, leading to high physical risks, slow technology uptake and low carbon dioxide removal activity.
	IEA STEPS	STEPS reflects current policy settings based on a sector-by-sector assessment of the specific policies that are in place, as well as those that have been announced by governments around the world.
	NIWA RCP8.5	The NIWA scenarios leverage the IPCC's RCP modelling of varying levels of GHG concentrations on the earth's climate system. NIWA downscales the global models in order to study how these different atmospheric concentrations of GHGs might influence the New Zealand climate. As with RCP 8.5, NIWA RCP 8.5 represents a world where carbon dioxide (CO_2e) emissions continue to rise throughout the 21st century. RCP 8.5 is the worst-case climate change scenario and assumes a world that continues to be fuelled by fossil fuel energy. Average temperature increases under the NIWA scenarios are relative to a 1986-2005 baseline, which differs from the IPCC baseline of 1850-1900. As such, the stated warming at various future points in time are lower in NIWA's scenarios than they are in the IPCC scenarios.
	CCC 'Current policy reference'	An estimation of NZ's emission profile if we carry on our current trajectory from a behavioural, technology, and policy perspective.

3.3.3 Detailed scenario description

Climate outcomes

The lack of action towards climate change allows greenhouse gas emissions to continue rising unabated, leading to a high prevalence of physical risk. A leading driver of this physical risk is the increase in global average temperature, which reaches 2.4°C in the medium term, climbing to 4.4°C in the long term (IPCC, 2021). In the medium term, the frequency of extreme weather becomes a significant threat to business-as-usual operations across the country as weather patterns become increasingly unpredictable. As a result, cities and towns located in areas prone to extreme weather see a significant loss of population as people move away from affected areas and towards elevated, inland areas perceived as lower risk. This causes a substantial loss of value for properties in the areas experiencing population loss, while the areas people are moving to see a significant increase in property values and a housing shortage. Transport and shipping around the country are also impacted, with flooding and storms damaging transport infrastructure, and restricting the ability for goods to move around the country. This has a flow-on effect on the construction and property sector, causing issues with the supply of raw materials to building sites and delaying the construction of new housing, especially in high-demand areas. As a result, building costs rise steadily in the medium term, making it even more challenging to adapt to the impacts of climate change.

As time goes on, the variability of climate changes across the country becomes increasingly apparent. In the long term, New Zealand sees large precipitation changes, such as on the West Coast in the winter season, where area-average increases of up to 40% are experienced (Ministry for the Environment, 2018). The long term also brings an overall increase in drought intensity that manifests in several ways. The north and east of the North Island experience an increase in dry days and lower rainfall levels (Ministry for the Environment, 2018). This coincides with an average increase of 50mm in the July-June potential evapotranspiration deficit (PED), with the biggest changes arising in the northern and eastern North Island and areas to the east of the South Island's main divide (Ministry for the Environment, 2018). With a lack of adaptation action and limited technology to mitigate the impact of these weather changes, the agricultural sector sees significant losses in productivity for the regions affected from the medium term onwards as stock numbers and crop sizes are reduced to limit water usage. In addition to drought, the level of snowfall reduces, with the number of snow days decreasing by at least 30 days in the long term, reducing the overall snowpack that supplies several lakes and rivers in the South Island (Ministry for the Environment, 2018). Combined with the increase in drought in the South Island, hydro lake levels reach critically low levels, threatening the reliability of New Zealand's electricity supply.

As with other physical risks, the high level of emissions has increased the overall impact of sea level rise around the country. The median sea level rise around New Zealand reaches 0.28m in the medium term, increasing to 0.79m in the long term (Ministry for the Environment, 2017). In the medium term, the high frequency of extreme weather events sees coastal areas regularly faced with storm damage. Initial efforts to adapt to these changes include the raising of houses. However, the lack of insurance cover for these properties means many are unable to afford this change. Councils are unwilling to invest in adapting areas of the coast hardest hit by sea level rise due to the belief that it will not be sufficient to prevent further property and infrastructure damage. In the long term, coastal erosion has driven a widespread coastal retreat around the country as some areas become permanently inundated. Coastal properties are largely abandoned as they become uninhabitable and worthless. Inundated with requests for financial assistance, the government and local councils have limited funding for redress, leaving property owners without the means to recover their property losses.

Policy outcomes

New Zealand's approach to climate change in the immediate and short term enables a limited amount of emissions reduction out to 2050. Under these existing policies, both long-lived greenhouse gas emissions and biogenic methane emissions fall. However, it is not sufficient to meet the 2030 and 2050 targets laid out in the Zero Carbon amendment of the Climate Change Response Act (Climate Change Commission, 2021a). A lack of further policy intervention sees little support provided for any form of adaptation or mitigation actions across the economy. Low emissions alternatives such as renewable electricity and electric vehicles are employed largely on the basis of their ability to reduce costs for the economy, rather than their ability to reduce emissions. Low emissions alternatives for agriculture and manufacturing remain largely unavailable as the focus remains on short-term output from these industries to continue to fuel global growth at the lowest cost. Despite these headwinds, net greenhouse gas emissions in New Zealand fall from 54MtCO_2e in 2019 to 40MtCO_2e by

the medium term (Climate Change Commission, 2021a; Ministry for the Environment, 2019). This decrease is due in large part to the expansion of renewable electricity and electric vehicles. The lack of low emissions technology in agriculture combined with a high global demand for meat sees successive governments fail to meet methane targets, leading to gross methane emissions falling by only 12% (3MtCO_2e) from 2019 levels by the medium term (Climate Change Commission, 2021a).

The retention of the New Zealand ETS and the high carbon price in the mid-2020s continues to generate a financial incentive to plant forests. In the short term, exotic forestry expands at the rate of 25,000ha per year (Climate Change Commission, 2021c). In the medium term, the scale of forest planting scales back as the focus on meeting carbon budgets is lost and the NZ ETS price settles at $35/t$CO_2$e (Climate Change Commission, 2021c). However, the global growth demands help to provide incentives to expand forests around New Zealand for logging purposes, which sees exotic land area expand from 2.1Mha in the short term to 2.8Mha in the medium term (Climate Change Commission, 2021a).

Socio-economic and technology outcomes

With insufficient global efforts to limit climate change, New Zealand faces insufficient technological and behavioural changes to support substantial emissions reductions. By the medium term, fossil fuels continue to be the dominant source of primary energy, even after accounting for current technology trends (IPCC, 2021). This is reflected in New Zealand's renewable primary energy levels, which only reach 58% in the same period, owing to the lack of low emissions alternatives for all types of process heat (Climate Change Commission, 2021a). In addition, renewable electricity sourcing, while high by global standards, has only increased by 2% from the short term, to reach 92% in the medium term (Climate Change Commission, 2021a). No investments have been made in grid storage infrastructure, leading to continued reliance on gas to provide baseload and peaking electricity generation, particularly during dry hydro years. Although fossil fuels continue to dominate in the world's energy mix, the financial benefits of transport electrification help to drive the level of electrification across New Zealand, with 39% of the national road transport fleet electrified in the medium term (Climate Change Commission, 2021a).

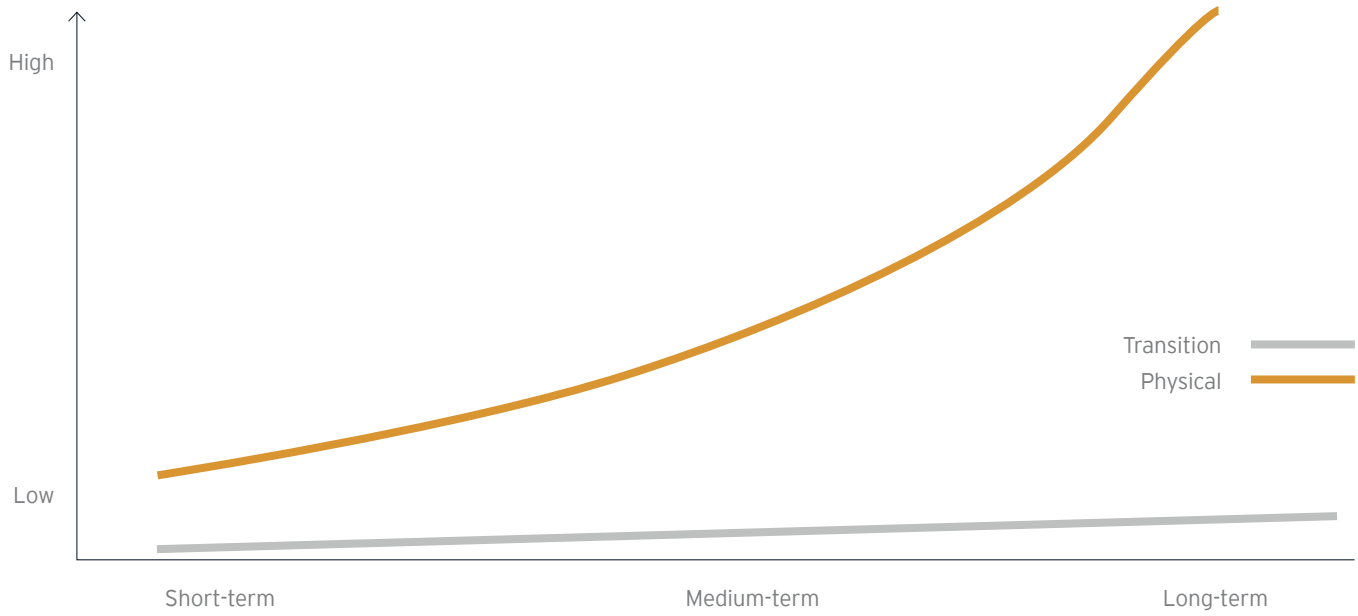
Agriculture continues to grow using industrial agriculture fuelled mostly by fossil fuel-based fertiliser and machinery. Over the short and medium term, New Zealand's meat and milk solids exports increase from 2.6 billion kilograms in the short term to 2.7 billion kilograms in the medium term (Climate Change Commission, 2021a). In the long term, however, the ability for continued growth in the Agriculture sector becomes increasingly difficult due to the impacts of extreme weather around New Zealand. Alternative proteins increase in popularity in the medium and long term, largely due to their lower costs to produce and the ability to improve food security for nations with limited agricultural land (Te Puna Whakaaronui, 2022). A lack of policy support and behavioural change sees alternative protein manufacturing remain a niche industry in New Zealand.

Unabated productivity by emissions intensive industries spur income accumulation within these sectors, however surmounting costs from increasingly pervasive chronic physical climate change impacts negatively affect GDP at national and global scales. Despite only partial accountability of physical risk impacts on GDP currently available, global estimates are expected to decrease relative to alternate scenario's. US$273 trillion is expected by the medium term under this scenario, capturing a decrease of 5.7% due to chronic physical risk, a difference of US$ 11 trillion when compared to an orderly scenario (NGFS, 2022b). This estimate only partially captures the full extent of physical risk. Acute physical risk events are known to be highly destructive and have the potential to result in widespread displacement, reduced productivity due to temporary closure and income losses from damage to assets at a high level. Alongside GDP growth, global population growth exceeds that of the Orderly scenario, with a total of 8.6 billion people in the medium term (Riahi, et al., 2017). The focus on global growth by any means necessary drives higher rates of economic inequality, increasing political instability and geopolitical tensions around the world.

3.3.4
Key physical and transition risks to the banking sector

Under a Hot House scenario, the rate of physical risk increases exponentially out to 2100 as global emissions continue to rise throughout the century (**Figure 12**). The lack of action to abate these emissions sees transition risk remain low even in the long term. Further detail on credit level and organisational level risks are detailed in **Appendix D**.

Figure 12: Physical and transition risk out to 2100 under a Hot House scenario[30]



The sections below outline key credit level and organisational level risks for the banking sector. These are separated into physical and transition risks.

To support greater understanding of potential risks to each priority sector, credit level risks are separated into **Tier 1**, **Tier 2** and **Tier 3** risks:

- **Tier 1:** risks in the Tier 1 category are those very likely to be present under a Hot House scenario
- **Tier 2:** risks in the Tier 2 category are those likely to be present under a Hot House scenario
- **Tier 3:** risks in the Tier 3 category are not likely to be present under a Hot House scenario

Further detail on credit and organisational level risks are detailed in **Appendix D**.

[30] Physical and transition risk determinations over the short-, medium-, and long-term are based on the general themes in the NIWA and Climate Change Commission scenarios, literature reviews and stakeholder feedback. Each bank should assess the appropriateness of the risk determination to their analysis.

Credit Level Risks

Credit risk exposure under a Hot House scenario shows a polarised distribution of physical and transition risks. Due to the absence of emissions reform, very few Tier 1 transition risks emerge. In contrast, Tier 1 physical risk can be expected due to the continued increase in emissions. **Table 20** provides an overview of the prioritisation of physical risks, and **Table 21** showcases the prioritisation of transition risks per sector under a Hot House scenario. Under this scenario, there is expected to be a higher risk that assets may become uninsurable or face unaffordable insurance premiums as physical risks become increasingly prevalent, particularly for those sectors that face higher levels of risks driven by storms, flooding and sea level rise.

Table 20: Physical credit risks under a Hot House scenario

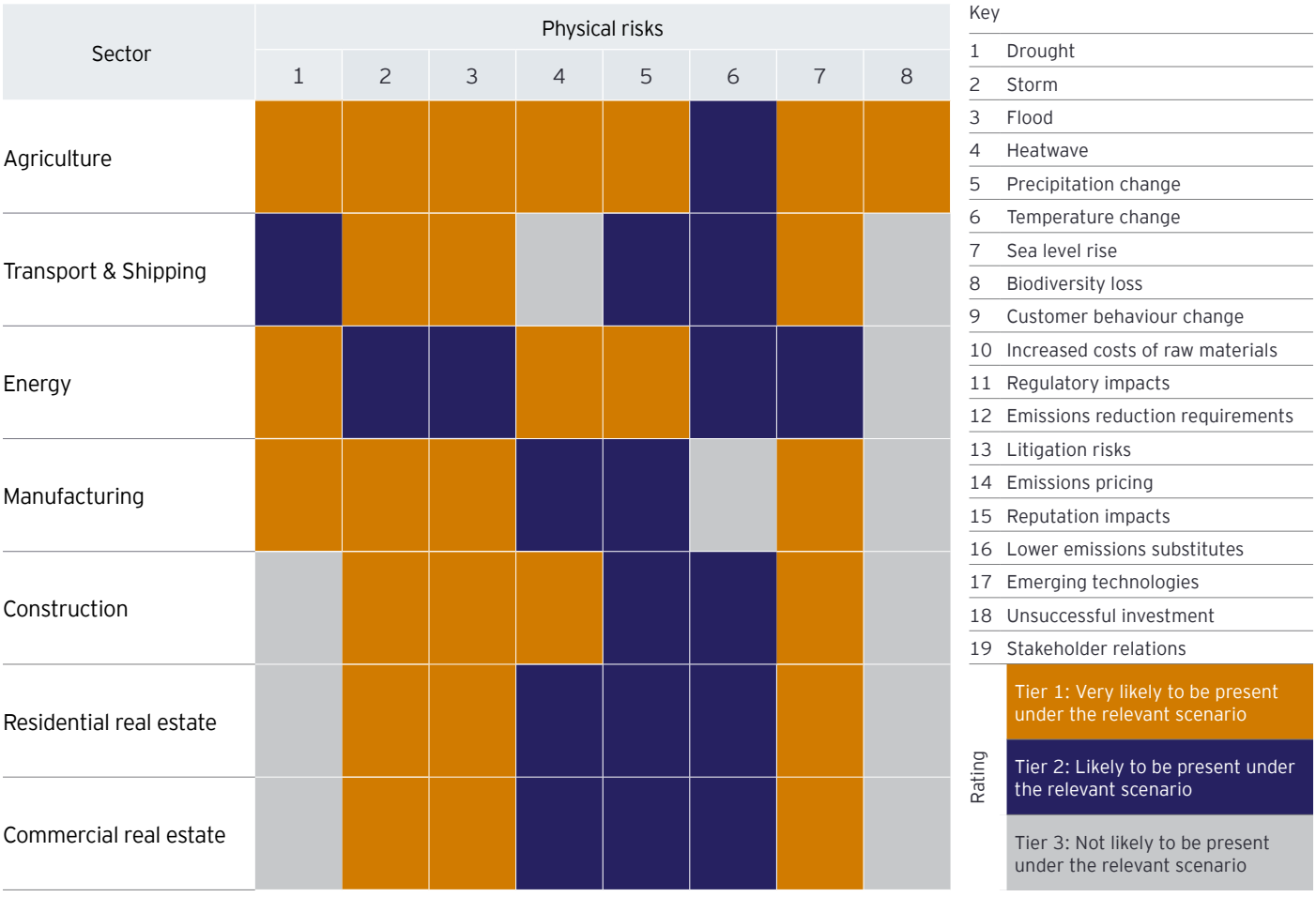


Table 21: Transition credit risks under a Hot House scenario

Sector	Transition risks										
	9	10	11	12	13	14	15	16	17	18	19
Agriculture	■	■	■	■	■	■	■	■	■		
Transport & Shipping	■			■	■	■	■				
Energy	■		■		■	■	■	■		■	
Manufacturing	■	■		■	■	■	■	■		■	
Construction	■		■	■	■	■	■	■			
Residential real estate	■		■	■	■	■	■	■			
Commercial real estate	■		■	■	■	■	■	■			

The persistent lack of action to address the impacts of climate change allow GHG emissions to continue rising unabated, leading to a high prevalence of physical risk. As with the Orderly and Too Little Too Late scenarios, agriculture again holds the greatest exposure to physical risks under a Hot House scenario. Due to the absence of emissions reform, no Tier 1 transition risks emerge within the priority sectors. In New Zealand, physical risks are likely to materialise in the medium to long term.

Agricultural sector

The agriculture sector is the most exposed to Tier 1 physical risks. These acute and chronic weather and environmental changes have the potential to significantly increase the costs of operation, while simultaneously reducing the amount of revenue businesses in the sector can generate. Seven Tier 1 risks have been identified for the sector; drought, storm, flooding, heatwave, precipitation change and biodiversity loss.

The compounded impact of severe events occurring simultaneously will amplify the financial implications of these risks for businesses operating in this sector. For example, if intense rainfall and flooding occur after a severe drought, runoff volumes are much higher due to the lack of ground cover, and erosion can be more severe, damaging what pasture and/or crops might have remained. This also strips topsoil, removing the nutrients required by plants to re-grow. Under a Hot House scenario, the occurrence of multiple severe weather events in succession is more likely, in conjunction with the underlying chronic changes to the environment. Lower agricultural productivity results in lower commodity prices, impacting the revenues of agribusiness companies and reducing their ability to repay loans.

Transport and shipping sector

The transport and shipping sector faces tier 1 physical risks from storms, floods and sea level rise, which all have the potential to disrupt transport routes. Recurring damage to transport infrastructure and assets may lead to significant increases in costs. Extreme storms may cause damage, disruption or closure of infrastructure such as roads, railways, and shipping routes. Flooding can cause widespread damage to assets and infrastructure and interrupt logistics, leading to negative impacts on supply chains. Storm surge and inundation from sea level rise may damage assets, in severe cases rendering them stranded.

Damage to infrastructure and assets may lead to reduced revenue and increased operational expenditure due to the need to find alternative transportation routes, impacting the ability of these companies to repay loans. Disruption to shipping routes impacts the ability of banks to finance shipping projects, leading to increased credit risk.

Energy sector

The energy sector faces tier 1 exposure risks from drought, precipitation change and heatwaves which all have the potential to impact lake levels given New Zealand's reliance on hydropower generation. Limited generation capacity combined with high electricity demand could increase degradation and reduce asset lifespan, with asset devaluation impacting the ability to repay loans.

Extended drought and/or heatwave conditions may lower lake levels over summer months, impacting hydropower generation. Droughts adversely affect hydropower generation and reduce water availability for cooling purposes to thermal power plants. Severe drought can cause water levels to drop below required design thresholds, causing plants to stop or reduce power production. Changing precipitation levels may further compound the impact of physical risks on hydropower generation. Higher temperatures reduce power generation efficiency and output as well as increase customers' cooling demands, stressing the capacity of generation and grid networks. This could impact the profitability of energy companies and increase the cost of financing for banks that provide loans to these companies.

Manufacturing sector

The manufacturing sector faces exposure to tier 1 risks through the impacts of drought, storm, flood and sea level rise on productivity. Repeated or prolonged experiences of these potential risks can reduce productivity for some manufacturing leading to a loss of revenue and increased operating costs which would undermine loan repayment abilities. Physical risks damage manufacturing infrastructure such as factories, warehouses, and supply chain facilities. This will disrupt manufacturing processes and impact the profitability of manufacturing companies. In addition, damage to infrastructure could lead to increased maintenance costs and the need for costly repairs, which could impact the ability of these companies to repay loans.

The manufacturing sector relies heavily on the transport and shipping and energy sectors to operate effectively and therefore is affected when these sectors are impacted by climate change. The impact of extended droughts on the energy sector may cause power disruptions that would slow down or stop manufacturing operations. The damage that extreme weather can cause to the transport and shipping sector may disrupt supply chains and limit access to raw manufacturing materials such as fuel. Repeated or long-term disruption may result in reduced operating hours or a complete shutdown of manufacturing if the required raw materials cannot be sourced.

Construction sector

The construction sector faces Tier 1 physical risks through the impact of storms, floods, heatwaves and sea level rise. These Tier 1 risks increase construction costs and delay project completion, impacting the profitability of construction companies. Damage to projects could lead to increased maintenance costs and the need for costly repairs, impacting the ability of these companies to repay loans particularly over periods of repeated disruption.

Acute climate events (such as severe storms) can have a large impact on rates of construction productivity as operations are temporarily shut down while the weather passes. The supply of construction material may also hinder construction activities should supply chains be cut off due to extreme weather. Heat stress, particularly during heatwaves, can have detrimental effects on the health and wellbeing of workers required to work outdoors. Working in extreme heat increases the risk of heat-related illness and injury. While this can be mitigated by shifting work hours outside of peak heat, there may be a period of adaptation that sees project delays and interruptions while new practices are established.

Residential property sector

The exposure of residential property to the elements increases their vulnerability to damage during intense storm and flood events. Damages can be costly to repair, and properties situated in disaster-prone areas can experience a drop in value as a result. Rental properties may also not be suitable for tenants to remain at the premises, and the owners may risk the loss of rental payment in the interim. Under a Hot House scenario, sea level rise inundates property located close to coastlines and low-lying areas. Property owners incur costs from climate change damage to assets, as well as declining land value which may impact their loan repayment abilities.

Where greenhouse gas emissions continue to rise, the frequency and severity of extreme weather events such as storms, flooding, and sea-level rise are very likely to increase, making managed retreat policies increasingly necessary. Properties located in high-risk areas such as coastal zones and floodplains would be most affected. As managed retreat policies move people and infrastructure away from these areas, properties in these zones may become unliveable, resulting in a decline in property values and increased risk of mortgage defaults.

Commercial property sector

Tier 1 risks such as storms, flooding, and sea level rise may damage commercial property such as office buildings, shopping centers, and hotels. This may lead to decreased property values and rental income, impacting the profitability of property owners and real estate companies. In addition, damage to commercial property may lead to increased maintenance costs and the need for costly repairs, impacting the ability of these companies to repay loans. There may be decreased demand for office buildings in coastal areas due to the risk of flooding and sea level rise, leading to decreased demand for financing from banks. These events disrupt operations of tenants, pushing people towards working from home. This further impacts revenue by placing pressure on occupation rates and rental costs.

Organisational Level Risks

The Hot House scenario generates the highest physical risk to bank operations, materialising from the medium term on due to the scenario's continued increase in emissions. Both acute and physical risks are expected to increase markedly in frequency and intensity over time under an increasing emissions pathway. On the other hand, the lack of action to curb emissions means that transition risks are not high in this scenario. The key operational risks under a Hot House scenario are presented in **Table 22** below.

Table 22: Key operational level risks under a Hot House scenario

Risk category	Risk Driver	Risk	Financial impact to the banks
Acute	Flood	Increase in physical sites impacted by flood, damaging equipment and ability to reach customers.	Operational costs may increase to cover repair costs and any potential increase in insurance premiums if bank assets are in a flood-prone zone.
Acute	Extreme weather	Severe weather impacts may see branches and corporate offices closed or inaccessible due to weather impacts. Travelling staff may be stranded away from home. Impacts on electricity supply may impact call and data centre reliability leading to digital business disruptions alongside physical business interruptions.	Revenue may decrease due to lower staff productivity and potential loss of customers if some banks are affected and others are not (in any given locality). Operational costs may increase due to increased costs for site repairs and increased costs due to travel disruption for stranded staff.
Acute	Heatwaves	Heatwaves may cause disruption to IT services provided by banks. Intense heat can damage data centres and other IT services or digital products and cause power outages due to overloaded power grids. An increase in hot days may impact staff through heat stress.	Increased energy demand for cooling leading to higher energy costs. This may result in an overall increase in operational expenditure. Increase possibility of lost revenue should data centres or IT systems fail, making it challenging for banks to serve customers and carry out transactions.

5

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