



Appendices —

Appendix A Description of domestic and international climate scenarios

Acronym	Description
Intergovernmental Panel on Climate Change (IPCC)	<p>IPCC scenarios are a combination of Representative Concentration Pathways (RCP) and Shared Socioeconomic Pathways (SSPs). Time horizon associated with these scenarios is 2100, and there is no carbon price explicitly given.</p> <p>The x-y combination accounts for the different socio-economic development assumptions. X represents the SSP scenario outlined, and Y is the radiative forcing level. IPCC use CMIP6 which runs 100 different climate models across the world.</p>
Network for Greening the Financial Systems (NFGS)	<p>NFGS scenarios use Integrated Assessment Models (IAMs) and do not have a detailed representation of economic sectors beyond energy and land use. Carbon price is an endogenous variable and has strong carbon dioxide technology assumptions to reduce emissions.</p> <p>As of September 2022, scenarios have been updated to incorporate a range of data on transition risks, physical risks and economic impacts at a higher sectoral and regional resolution. These have been included to reflect greater regional granularity and capture chronic physical risk in GDP projections for each scenario.</p>
International Energy Agency (IEA)	<p>The IEA has provided medium to long-term energy projections using the World Energy Model (WEM) which is a large-scale simulation model designed to replicate how energy market's function. The WEM is the principal tool used to generate detailed sector-by-sector and region-by-region projections for the WEO/IEA scenarios.</p>
National Institute of Water and Atmospheric Research (NIWA)	<p>Statistical' downscaling of IPCC RCP models was used to develop temperature and precipitation projections for New Zealand climate change for up to 41 different global climate models (GCMs)</p>
Climate Change Commission (CCC)	<p>The Climate Change Commission (CCC) modelled long-term scenarios to 2050 and beyond. This involved tailoring different assumptions under Transport, Energy, Industry and Buildings, Land and the Waste sectors specific to New Zealand and focuses on domestic emissions projections. They incorporated a range of technology, behaviour, and policy assumptions in each scenario.</p>

Appendix B Priority sector mapping to New Zealand Standard Industrial Output Classification industries – ANZSIC 2006

Sectors	ANZSIC L3	ANZSIC L3 Name	ANZSIC L4	ANZSIC L4 Name
Sheep and beef farming and manufacturing	014	Sheep, Beef Cattle and Grain Farming	0141	Sheep Farming (Specialised)
			0142	Beef Cattle Farming (Specialised)
			0143	Beef Cattle Feedlots (Specialised)
			0144	Sheep-Beef Cattle Farming
			0145	Grain-Sheep or Grain-Beef Cattle Farming
	111	Meat and Meat Product Manufacturing	1111	Meat Processing
1113			Cured Meat and Smallgoods Manufacturing	
Dairy farming and dairy product manufacturing	016	Dairy Cattle Farming	0160	Dairy Cattle Farming
	113	Dairy Product Manufacturing	1131	Milk and Cream Processing
			1132	Ice Cream Manufacturing
1133	Cheese and Other Dairy Product Manufacturing			
Horticulture	014	Sheep, Beef Cattle and Grain Farming	0146	Rice Growing
			0149	Other Grain Growing
	015	Other Crop Growing	0151	Sugar Cane Growing
			0152	Cotton Growing
			0159	Other Crop Growing n.e.c.
			0121	Mushroom Growing
			0122	Vegetable Growing (Under Cover)
			0123	Vegetable Growing (Outdoors)
			0131	Grape Growing
			0132	Kiwifruit Growing
			0133	Berry Fruit Growing
			0134	Apple and Pear Growing
			0135	Stone Fruit Growing
			0136	Citrus Fruit Growing
			0137	Olive Growing
	0139	Other Fruit and Tree Nut Growing		
	114	Fruit and Vegetable Processing	1140	Fruit and Vegetable Processing
	115	Oil and Fat Manufacturing	1150	Oil and Fat Manufacturing
	116	Grain Mill and Cereal Product Manufacturing	1161	Grain Mill Product Manufacturing
			1162	Cereal, Pasta and Baking Mix Manufacturing

Sectors	ANZSIC L3	ANZSIC L3 Name	ANZSIC L4	ANZSIC L4 Name
	117	Bakery Product Manufacturing	1171	Bread Manufacturing (Factory based)
			1172	Cake and Pastry Manufacturing (Factory based)
			1173	Biscuit Manufacturing (Factory based)
			1174	Bakery Product Manufacturing (Non-factory based)
	118	Sugar and Confectionery Manufacturing	1181	Sugar Manufacturing
			1182	Confectionery Manufacturing
	119	Other Food Product Manufacturing	1191	Potato, Corn and Other Crisp Manufacturing
			1192	Prepared Animal and Bird Feed Manufacturing
			1199	Other Food Product Manufacturing
	Forestry, logging, and wood product and paper manufacturing	030	Forestry and Logging	0301
0302				Logging
141		Log Sawmilling and Timber Dressing	1411	Log Sawmilling
			1412	Wood Chipping
			1413	Timber Resawing and Dressing
149		Other Wood Product Manufacturing	1491	Prefabricated Wooden Building Manufacturing
			1492	Wooden Structural Fitting and Component Manufacturing
			1493	Veneer and Plywood Manufacturing
			1494	Reconstituted Wood Product Manufacturing
			1499	Other Wood Product Manufacturing n.e.c.
151		Pulp, Paper and Converted Paper Product Manufacturing	1510	Pulp, Paper and Paperboard Manufacturing
152		Converted Paper Product Manufacturing	1521	Corrugated Paperboard and Paperboard Container Manufacturing
			1522	Paper Bag Manufacturing
			1523	Paper Stationery Manufacturing
	1524		Sanitary Paper Product Manufacturing	
	1529		Other Converted Paper Product Manufacturing	

Sectors	ANZSIC L3	ANZSIC L3 Name	ANZSIC L4	ANZSIC L4 Name
Transport and shipping	461	Road Freight Transport	4610	Road Freight Transport
	462	Road Passenger Transport	4621	Interurban and Rural Bus Transport
			4622	Urban Bus Transport (Including Tramway)
			4623	Taxi and Other Road Transport
	471	Rail Freight Transport	4710	Rail Freight Transport
	472	Rail Passenger Transport	4720	Rail Passenger Transport
	481	Water Freight Transport	4810	Water Freight Transport
	482	Water Passenger Transport	4820	Water Passenger Transport
	490	Air and Space Transport	4900	Air and Space Transport
	510	Postal and Courier Pick-up and Delivery Services	5101	Postal Services
			5102	Courier Pick-up and Delivery Services
	530	Warehousing and Storage Services	5301	Grain Storage Services
			5309	Other Warehousing and Storage Services
Energy	261	Electricity Generation	2611	Fossil Fuel Electricity Generation
			2612	Hydro-Electricity Generation
			2619	Other Electricity Generation
			2611	Fossil Fuel Electricity Generation
	262	Electricity Transmission	2620	Electricity Transmission
	263	Electricity Distribution	2630	Electricity Distribution
	264	On Selling Electricity and Electricity Market Operation	2640	On Selling Electricity and Electricity Market Operation
270	Gas Supply	2700	Gas Supply	
Petroleum, Chemical, Polymer, Rubber, Non-Metallic Mineral, and Metal Product Manufacturing	170	Petroleum and Coal Product Manufacturing	1701	Petroleum Refining and Petroleum Fuel Manufacturing
			1709	Other Petroleum and Coal Product Manufacturing
	181	Basic Chemical Manufacturing	1811	Industrial Gas Manufacturing
			1812	Basic Organic Chemical Manufacturing
			1813	Basic Inorganic Chemical Manufacturing
	182	Basic Polymer Manufacturing	1821	Synthetic Resin and Synthetic Rubber Manufacturing
			1829	Other Basic Polymer Manufacturing
			189	Other Basic Chemical Product Manufacturing
	183	Fertiliser and Pesticide Manufacturing	1831	Fertiliser Manufacturing
			1832	Pesticide Manufacturing

Sectors	ANZSIC L3	ANZSIC L3 Name	ANZSIC L4	ANZSIC L4 Name
	184	Pharmaceutical and Medicinal Product Manufacturing	1841	Human Pharmaceutical and Medicinal Product Manufacturing
			1842	Veterinary Pharmaceutical and Medicinal Product Manufacturing
	185	Cleaning Compound and Toiletry Preparation Manufacturing	1851	Cleaning Compound Manufacturing
			1852	Cosmetic and Toiletry Preparation Manufacturing
	189	Other Basic Chemical Product Manufacturing	1891	Photographic Chemical Product Manufacturing
			1892	Explosive Manufacturing
			1899	Other Basic Chemical Product Manufacturing n.e.c.
	191	Polymer Product Manufacturing	1911	Polymer Film and Sheet Packaging Material Manufacturing
			1912	Rigid and Semi-Rigid Polymer Product Manufacturing
			1913	Polymer Foam Product Manufacturing
			1914	Tyre Manufacturing
			1915	Adhesive Manufacturing
			1916	Paint and Coatings Manufacturing
			1919	Other Polymer Product Manufacturing
	192	Natural Rubber Product Manufacturing	1920	Natural Rubber Product Manufacturing
	201	Glass and Glass Product Manufacturing	2010	Glass and Glass Product Manufacturing
	202	Ceramic Product Manufacturing	2021	Clay Brick Manufacturing
			2029	Other Ceramic Product Manufacturing
	203	Cement, Lime, Plaster and Concrete Product Manufacturing	2031	Cement and Lime Manufacturing
			2032	Plaster Product Manufacturing
			2033	Ready-Mixed Concrete Manufacturing
			2034	Concrete Product Manufacturing
	209	Other Non-Metallic Mineral Product Manufacturing	2090	Other Non-Metallic Mineral Product Manufacturing
	211	Basic Ferrous Metal Manufacturing	2110	Iron Smelting and Steel Manufacturing
	212	Basic Ferrous Metal Product Manufacturing	2121	Iron and Steel Casting
			2122	Steel Pipe and Tube Manufacturing
	213	Basic Non-Ferrous Metal Manufacturing	2131	Alumina Production
2132			Aluminium Smelting	

Sectors	ANZSIC L3	ANZSIC L3 Name	ANZSIC L4	ANZSIC L4 Name
			2133	Copper, Silver, Lead and Zinc Smelting and Refining
			2139	Other Basic Non-Ferrous Metal Manufacturing
	214	Basic Non-Ferrous Metal Product Manufacturing	2141	Non-Ferrous Metal Casting
			2142	Aluminium Rolling, Drawing, Extruding
			2149	Other Basic Non-Ferrous Metal Product Manufacturing
	221	Iron and Steel Forging	2210	Iron and Steel Forging
	222	Structural Metal Product Manufacturing	2221	Structural Steel Fabricating
			2222	Prefabricated Metal Building Manufacturing
			2223	Architectural Aluminium Product Manufacturing
			2224	Metal Roof and Guttering Manufacturing (except Aluminium)
	223	Metal Container Manufacturing	2231	Boiler, Tank and Other Heavy Gauge Metal Container Manufacturing
			2239	Other Metal Container Manufacturing
	224	Sheet Metal Product Manufacturing (except Metal Structural and Container)	2240	Sheet Metal Product Manufacturing (except Metal Structural and Container)
	229	Other Fabricated Metal Product Manufacturing	2291	Spring and Wire Product Manufacturing
			2292	Nut, Bolt, Screw and Rivet Manufacturing
			2293	Metal Coating and Finishing
			2299	Other Fabricated Metal Product Manufacturing n.e.c.
Construction ¹	301	Residential Building Construction	3011	House Construction
			3019	Other Residential Building Construction
	302	Non-Residential Building Construction	3020	Non-Residential Building Construction
	310	Heavy and Civil Engineering Construction	3101	Road and Bridge Construction
			3109	Other Heavy and Civil Engineering Construction
	N/A	Residential Real Estate	N/A	Residential properties (as assets)
N/A	Commercial Real Estate	N/A	Commercial Properties (as assets)	

¹ Priority sector mapping for ANZSIC L3 and L4 is not available for property/real estate. Real estate sectors are only included to indicate where real estate resides in the overall sector composition.

Appendix C Detailed scenario and baseline data assumptions

The following tables lay out the data assumptions for key parameters as provided by the scenarios that make up each scenario narrative. For each parameter, data points from each scenario are provided where they are readily accessible from the scenario documentation. In addition, a set of baseline data has been provided for many of the same parameters. This baseline data is largely focused on New Zealand specific data for each parameter. In most cases, data has been sourced from New Zealand government agencies and statistics.

There are several climate models used by the NGFS and IPCC to calculate the various scenario parameters. To ensure consistency in calculation of parameters, all NGFS and IPCC data points below (apart from NGFS GDP datapoints) have been extracted from the data sets using the Global Change Assessment Model (GCAM). GCAM presents the interactions and behaviour of five systems: energy, water, agriculture and land use, the economy, and the climate to provide a set of global outcomes. GCAM is a dynamic recursive model, meaning it does not know the future state of the world when making decisions about the next period. After it solves each period (e.g., 2025-2030), the model then uses the resulting state of the world, including the consequences of decisions made in that period - such as resource depletion, capital stock retirements and installations, and changes to the landscape - and then moves to the next time step and performs the same exercise. Although both IPCC and NGFS parameter have been extracted using the GCAM model, variances in inputs and model version may still drive difference in the parameter outputs. For further information on GCAM, see the NGFS Technical Documentation². GDP datapoints from NGFS use an average of all models, to provide a more consistent measure for members.

The IEA and CCC do not provide the ability to use GCAM with their datasets, instead using their own climate models to produce the various parameters presented in the table below. For more information on the modelling used by each of these organisations see the Global and Climate Model³ documentation from the IEA and Modelling and Data information from the CCC⁴.

Baseline data assumptions (as at 2019)

	Category	Parameter	Summary of parameter	Cover age	Source
Baseline data (2019)	Climate	Total net emissions	54MtCO ₂ e	NZ	(Ministry for the Environment, 2019)
		Gross methane emissions	34MtCO ₂ e	NZ	(Ministry for the Environment, 2019)
		Average increase in temperature	0.95 °C ⁵	Global	(World Meteorological Organisation, 2019)
		Sea level rise	0.2m	NZ	(Ministry for the Environment, 2017)
	Socio-economic	GDP (2022 baseline)	US\$138 trillion ⁶	Global	(NGFS, 2022b)
			NZ\$279 billion ⁷	NZ	(NGFS, 2022b)
		Population growth	7.7 billion	Global	(World Bank, 2022)
			4.9 million	NZ	(Stats NZ, 2019)
		Forestry land area ⁸	1.6Mha	NZ	(Stats NZ, 2021)

² https://www.ngfs.net/sites/default/files/media/2022/09/15/technical_documentation-_ngfs_scenarios_phase_3.pdf

³ <https://iea.blob.core.windows.net/assets/3a51c827-2b4a-4251-87da-7f28d9c9549b/GlobalEnergyandClimateModel2022Documentation.pdf>

⁴ <https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/inaia-tonu-nei-a-low-emissions-future-for-aotearoa/modelling/>

⁵ Above 1981-2010 annual average

⁶ Provided in 2017 PPP

⁷ Provided in 2009 prices

⁸ No split in forestry land area available between native and exotic forestry

	Category	Parameter	Summary of parameter	Cover age	Source
		Dairy farming land area	2.2Mha	NZ	(Stats NZ, 2021)
		Sheep + Beef farming land area	6.8Mha	NZ	(Stats NZ, 2021)
		Horticulture farming land use area	0.13Mha	NZ	(Stats NZ, 2021)
	Policy	Carbon price (\$/tCO ₂ e)	NZ\$25	NZ	(Carbon News, 2019)
			US\$10	Global	(Network for Greening the Financial Sector, 2022b)
	Technology	Transport	0.28%	NZ	(Climate Change Commission, 2021a)
		Renewable electricity	81%	NZ	(Ministry of Business, Innovation and Employment, 2021)
		Renewable energy	40%	NZ	(Ministry of Business, Innovation and Employment, 2021)

Orderly scenario data assumptions

	Category	Parameter	Scenario	Summary of parameter			Source
				2030	2050	2100	
Orderly	Climate	Total net emissions (for all gases)	CCC Tailwinds	49MtCO ₂ e	5.9MtCO ₂ e		(Climate Change Commission, 2021a)
			NGFS Net Zero 2050	39BtCO ₂ e	9.6BtCO ₂ e		(Network for Greening the Financial System, 2022b)
			IEA NZE	21BtCO ₂ e	0MtCO ₂ e		(International Energy Agency, 2021a)
			IPCC SSP 1-1.9	42BtCO ₂ e	26BtCO ₂ e		(Riahi, et al., 2017)
	Climate	Gross methane emissions	CCC Tailwinds	26MtCO ₂ e	14MtCO ₂ e		(Climate Change Commission, 2021a)
			Average increase in temperature	NIWA 2.6		+0.7°C (0.2, 1.3)	
	IEA NZE			+1.5°C (1.4, 1.7)	+1.4°C (1.3, 1.5)	(International Energy Agency, 2021a)	
	IPCC SSP 1-1.9			+1.6°C (1.2, 2.0)	+1.4°C (1.0, 1.8)	(IPCC, 2021)	
	Climate	Precipitation change	NIWA 2.6		Increases in the west of the South Island, decreases north and east of the North Island		(Ministry for the Environment, 2018)
		Sea level rise	NIWA 2.6		0.23m	0.46m	(Ministry for the Environment, 2017)
Socio-economic	GDP	NGFS Net Zero 2050 ⁹	Global: US \$176 trillion (-1.2%)	Global: US\$ 289 trillion (-2.0%)		(Network for Greening the Financial System, 2022b)	

⁹ Data provided for GDP and GDP% due to chronic physical risk. Acute impacts are excluded from this figure and would further negatively impact GDP. Global GDP expressed in US\$ 2017 PPP; New Zealand GDP expressed in NZ\$ 2009 prices.

Category	Parameter	Scenario	Summary of parameter			Source
			2030	2050	2100	
			NZ: NZ\$ 330 billion (-0.5%)	NZ: NZ\$ 485 billion (-0.7%)		
		IPCC SSP 1-1.9 ¹⁰	US \$152 trillion	US \$284 trillion		(Riahi et al., 2017)
	Population growth	NGFS Net Zero 2050	8.3 billion	9.3 billion		(Network for Greening the Financial System, 2022b)
		IPCC SSP 1-1.9	8.0 billion	8.5 billion		(Riahi et al., 2017)
	Native forestry land area	CCC Tailwinds	0.27Mha	0.77Mha		(Climate Change Commission, 2021a)
	Exotic forestry land area	CCC Tailwinds	2.1Mha	2.5Mha		(Climate Change Commission, 2021a)
	Dairy farming land area	CCC Tailwinds	1.7Mha	1.6Mha		(Climate Change Commission, 2021a)
	Sheep + Beef farming land area	CCC Tailwinds	7.4Mha	7.0Mha		(Climate Change Commission, 2021a)
	Horticulture farming land use area	CCC Tailwinds	0.15Mha	0.22Mha		(Climate Change Commission, 2021a)
	Policy	Emissions outcome	CCC Tailwinds	Net zero long-lived greenhouse gases by 2040		
NGFS Net Zero 2050			Net zero CO ₂ by around 2050			(Network for Greening the Financial System, 2022b)
IEA NZE			Net zero CO ₂ by around 2050			(International Energy Agency, 2021a)
IPCC SSP 1-1.9			Net zero CO ₂ by around 2050			(IPCC, 2021)
Carbon price (\$/tCO ₂ e)		CCC Tailwinds ¹¹	NZ\$138	NZ\$250		(Climate Change Commission, 2021a)
		NGFS Net Zero 2050 ¹²	US\$104	US\$627	US\$1,471	(Network for Greening the Financial System, 2022b)
		IEA NZE ¹³	US\$130	US\$250		(International Energy Agency, 2021b)
		IPCC SSP 1-1.9 ¹⁴	US\$57	US\$153		(Riahi et al., 2017)

¹⁰ GDP expressed in US\$ 2005 PPP

¹¹ Carbon price expressed in real NZ\$

¹² Carbon price expressed in US\$ 2010

¹³ Carbon price expressed in US\$ 2020, for advanced economies

¹⁴ Carbon price expressed in US\$ 2005

Category	Parameter	Scenario	Summary of parameter			Source
			2030	2050	2100	
Technology	Transport	CCC Tailwinds ¹⁵	15% electrified	67% electrified		(Climate Change Commission, 2021a)
		NGFS Net Zero 2050		54% of the global energy supply for buildings, industry and transport is from electricity by 2050		(Network for Greening the Financial System, 2022b)
		IEA NZE		88% of all transport energy sourced from either electricity, hydrogen or bio energy by 2050		(International Energy Agency, 2021a)
	Renewable electricity	CCC Tailwinds	93%	98%		(Climate Change Commission, 2021a)
		IEA NZE	61%	88%		(International Energy Agency, 2021a)
	Renewable energy	CCC Tailwinds	55%	90%		(Climate Change Commission, 2021a)
		IEA NZE	30%	67%		(International Energy Agency, 2021a)

Too Little Too Late scenario data assumptions

Category	Parameter	Scenario	Summary of parameter			Source
			2030	2050	2100	
Too Little Too Late	Total net emissions (for all gases)	CCC Headwinds	58MtCO _{2e}	24MtCO _{2e}		(Climate Change Commission, 2021a)
		IEA APS ⁱ	34BtCO ₂	21BtCO ₂		(International Energy Agency, 2021b)
		NGFS Nationally Determined Contributions (NDCs)	51BtCO _{2e}	42BtCO _{2e}		(Network for Greening the Financial System, 2022b)
		IPCC SSP2-4.5 ⁱⁱ	63BtCO _{2e}	53BtCO _{2e}		(Riahi, et al., 2017)
	Gross methane emissions	CCC Headwinds	30MtCO _{2e}	25MtCO _{2e}		(Climate Change Commission, 2021a)

¹⁵ Road transport only

Category	Parameter	Scenario	Summary of parameter			Source
			2030	2050	2100	
	Average increase in temperature	NIWA RCP4.5		+0.8°C (0.4, 1.3)	+1.4°C (0.7, 2.2)	(Ministry for the Environment, 2018)
		IEA APS		+1.8°C (1.7, 2.0)	+2.1°C (1.9, 2.3)	(International Energy Agency, 2021b)
		IPCC SSP2-4.5		+1.7°C (1.6, 2.5)	+2.7°C (2.1, 3.5)	(IPCC, 2021)
	Precipitation change	NIWA RCP4.5		Increases west and south, decreases north and east with moderate magnitude.		(Ministry for the Environment, 2018)
	Sea level rise	NIWA RCP4.5		0.24m	0.55m	(Ministry for the Environment, 2017)
Socio-economic	GDP	NGFS Nationally Determined Contributions (NDCs) ¹⁶	Global: US\$ 175 trillion (-1.6%) NZ: NZ\$ 329 billion (-0.7%)	Global: US\$ 274 trillion (-5.1%) NZ: NZ\$ 477 billion (-2.3%)		(Network for Greening the Financial System, 2022b)
		IPCC SSP2-4.5 ¹⁷	US\$142 trillion	US\$230 trillion		(Riahi, et al., 2017)
	Population growth	NGFS Nationally Determined Contributions (NDCs)	8.4 billion	9.3 billion		(Network for Greening the Financial System, 2022b)
		IPCC SSP2-4.5	8.3 billion	9.2 billion		(Riahi, et al., 2017)
	Native forestry land area	CCC Headwinds	0.20Mha	0.50Mha		(Climate Change Commission, 2021a)
	Exotic forestry land area	CCC Headwinds	2.2Mha	2.6Mha		(Climate Change Commission, 2021a)
	Dairy farming land area	CCC Headwinds	1.7Mha	1.7Mha		(Climate Change Commission, 2021a)
	Sheep + Beef farming land area	CCC Headwinds	7.4Mha	6.9Mha		(Climate Change Commission, 2021a)
	Horticulture farming land use area	CCC Headwinds	0.11Mha	0.13Mha		(Climate Change Commission, 2021a)

¹⁶ Data provided for GDP and GDP% due to chronic physical risk. Acute impacts are excluded from this figure and would further negatively impact GDP. Global GDP expressed in US\$ 2017 PPP; New Zealand GDP expressed in NZ\$ 2009 prices.

¹⁷ GDP expressed in US\$ 2005 PPP

Category	Parameter	Scenario	Summary of parameter			Source	
			2030	2050	2100		
Policy	Emissions outcome	CCC Headwinds	Net zero by 2048			(Climate Change Commission, 2021a)	
		NGFS Nationally Determined Contributions (NDCs)	Emissions are reduced but net zero is not achieved			(Network for Greening the Financial System 2022b)	
		IEA APS	Emissions are reduced but net zero is not achieved			(International Energy Agency, 2021b)	
		IPCC SSP2-4.5	Does not reach net zero by 2100			(Riahi, et al., 2017)	
	Carbon price (\$/tCO _{2e})	CCC Headwinds ¹⁸	NZ\$138	NZ\$250		(Climate Change Commission, 2021a)	
		NGFS Nationally Determined Contributions (NDCs) ¹⁹	US\$53	US\$103	US\$174	(Network for Greening the Financial System 2022b)	
		IEA APS ²⁰	US\$120	US\$200		(International Energy Agency, 2021b)	
		IPCC SSP2-4.5 ²¹	US\$0	US\$54		(Riahi, et al., 2017)	
	Technology	Transport	CCC Headwinds	6% electrified	59% electrified		(Climate Change Commission, 2021a)
			NGFS Nationally Determined Contributions (NDCs)			40% of all energy sourced from electricity	(Network for Greening the Financial System 2022b)
Renewable electricity		CCC Headwinds	92%	96%		(Climate Change Commission, 2021a)	
		IEA APS	46%	71%		(International Energy Agency, 2021b)	
Renewable primary energy		CCC Headwinds	49%	78%		(Climate Change Commission, 2021a)	
		IEA APS	19%	37%		(International Energy Agency, 2021b)	

¹⁸ Carbon price expressed in real NZ\$

¹⁹ Carbon price expressed in US\$ 2010

²⁰ Carbon price expressed in US\$ 2020, for advanced economies with net zero pledges

²¹ Carbon price expressed in US\$ 2005

Hot House scenario data assumptions

Category	Parameter	Scenario	Summary of parameter			Source
			2030	2050	2100	
Climate	Total net emissions (for all gases)	CCC Current Policy Reference	64MtCO _{2e}	40MtCO _{2e}		(Climate Change Commission, 2021a)
		NGFS Current Policies	56BtCO _{2e}	54BtCO _{2e}		(Network for Greening the Financial System, 2022b)
		IEA STEPS ⁱⁱⁱ	36BtCO ₂	34BtCO ₂		(International Energy Agency, 2021b)
		IPCC SSP5-8.5 ^{iv}	70BtCO _{2e}	83BtCO _{2e}		(Riahi, et al., 2017)
	Gross methane emissions	CCC Current Policy Reference	31MtCO _{2e}	30MtCO _{2e}		(Climate Change Commission, 2021a)
	Average increase in temperature	NIWA RCP8.5		+1.0°C (0.5, 1.7)	+3.0°C (2.0, 4.6)	(Ministry for the Environment, 2018)
		IEA STEPS		+2.0°C (1.8,2.1)	+2.6°C (2.4,2.8)	(International Energy Agency, 2021b)
		IPCC SSP5-8.5		+2.4°C (1.9, 3.0)	+4.4°C (3.3, 5.7)	(IPCC, 2021)
	Precipitation change	NIWA RCP8.5		Increases in west and south of the South Island, decreases in north and east of the North Island.		(Ministry for the Environment, 2018)
	Sea level rise	NIWA RCP8.5		0.28m	0.79m	(Ministry for the Environment, 2018)
Socio-economic	GDP	NGFS Current Policies ²²	Global: US\$ 175 trillion (-1.6%) NZ: NZ\$ 329 billion (-0.7%)	Global: US\$ 273 trillion (-5.7%) NZ: NZ\$ 475 billion (-2.6%)		(Network for Greening the Financial System, 2022b)
		IPCC SSP5-8.5 ²³	US\$166 trillion	US\$361 trillion		(Riahi, et al., 2017)
	Population growth	NGFS Current Policies	8.4 billion	9.3 billion		(Network for Greening the Financial System, 2022b)

²² Data provided for GDP and GDP% due to chronic physical risk. Acute impacts are excluded from this figure and would further negatively impact GDP. Global GDP expressed in US\$ 2017 PPP; New Zealand GDP expressed in NZ\$ 2009 prices.

²³ GDP expressed in US\$ 2005 PPP

Category	Parameter	Scenario	Summary of parameter			Source
			2030	2050	2100	
		IPCC SSP5-8.5 ^{vi}	8.1 billion	8.6 billion		(Riahi, et al., 2017)
	Native forestry land area	CCC Current Policy Reference	0.15Mha	0.22Mha		(Climate Change Commission, 2021a)
	Exotic forestry land area	CCC Current Policy Reference	2.1Mha	2.8Mha		(Climate Change Commission, 2021a)
	Dairy farming land area	CCC Current Policy Reference	1.7Mha	1.7Mha		(Climate Change Commission, 2021a)
	Sheep + Beef farming land area	CCC Current Policy Reference	7.4Mha	6.8Mha		(Climate Change Commission, 2021a)
	Horticulture farming land use area	CCC Current Policy Reference	0.12Mha	0.13Mha		(Climate Change Commission, 2021a)
Policy	Emissions outcome	CCC Current Policy Reference	Net zero not achieved, emissions decrease slightly by 2050			(Climate Change Commission, 2021a)
		NGFS Current Policies	Net zero not achieved, emissions continue to rise by 2050			(Network for Greening the Financial System, 2022b)
		IEA STEPS	Net zero no achieved, emissions decrease slightly by 2050			(International Energy Agency, 2021b)
		IPCC SSP5-8.5 ^{vii}	Net zero not achieved, significant increase in emissions by 2050			(Riahi, et al., 2017)
	Carbon price (\$/tCO _{2e})	CCC Current Policy Reference ²⁴	NZ\$35	NZ\$35		(Climate Change Commission, 2021a)
		NGFS Current Policies ²⁵	US\$6	US\$6	US\$14	(Network for Greening the Financial System, 2022b)
		IEA STEPS ²⁶	US\$65	US\$90		(International Energy Agency, 2021b)

²⁴ Carbon price expressed in real NZ\$

²⁵ Carbon price expressed in US\$ 2010

²⁶ Carbon price expressed in US\$ 2020, for European Union

Category	Parameter	Scenario	Summary of parameter			Source
			2030	2050	2100	
		IPCC SSP5-8.5 ^{viii27}	US\$0	US\$22	US\$253	(Riahi, et al., 2017)
Technology	Transport	CCC Current Policy Reference ²⁸	3% electrified	39% electrified		(Climate Change Commission, 2021a)
		NGFS Current Policies		37% of all energy sourced from electricity		(Network for Greening the Financial System, 2022b)
	Renewable electricity	CCC Current Policy Reference	90%	92%		(Climate Change Commission, 2021a)
		IEA STEPS	42%	60%		(International Energy Agency, 2021b)
	Renewable primary energy	CCC Current Policy Reference	45%	58%		(Climate Change Commission, 2021a)
		IEA STEPS	16%	26%		(International Energy Agency, 2021b)

ⁱ No reported CO₂e figures available, CO₂ used instead

ⁱⁱ Assume Kyoto Gases as proxy for total global CO₂e

ⁱⁱⁱ No reported CO₂e figures available, CO₂ used instead

^{iv} Assume Kyoto Gases as proxy for total global CO₂e

^v Data for SSP5-8.5 unavailable, SSP5-6.0 used instead

^{vi} Data for SSP5-8.5 unavailable, SSP5-6.0 used instead

^{vii} Data for SSP5-8.5 unavailable, SSP5-6.0 used instead

^{viii} Data for SSP5-8.5 unavailable, SSP5-6.0 used instead

²⁷ Carbon price expressed in US\$ 2005

²⁸ Road transport only

Appendix D Detailed description of risks at an organisational level

Category	Risk category	Risk Driver	Risk
Physical	Acute	Flood	Increase in physical sites impacted by flood, damaging equipment and ability to reach customers.
		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 to electricity supply may impact call and data centre reliability leading to digital business disruptions alongside physical business interruptions.
		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. Increase in hot days may impact staff through heat stress.
	Chronic	Increased temperature	Increased temperatures may impact the health of staff through heat stress, rise in infectious diseases, poorer water quality, timing of events (i.e. large rainfall event post drought = increase surface water runoff).
		Sea level rise	Storm surges due to weather events exacerbated by high sea levels may threaten bank properties located in vulnerable areas.
		Increased temperature, extreme weather, drought	Chronic changes to climatic conditions may impact foundations and structural integrity of buildings.
		Sea level rise	The inundation of coastal land around coastal towns and cities may reduce housing options for staff that are in appropriate proximity to the workplace.
Transition	Reputation	Consumer preference	The focus on decarbonisation may increase stakeholder expectation of banks to be proactive in reducing emissions and disclosing progress.
		Investor preference	Investor confidence may be lost if a bank is not seen to be adapting quickly enough to changing risks and opportunities.
		Investor preference	A divergence in stakeholder expectations may drive a difference in operational practices between New Zealand and home/other markets.
		Consumer preference	If transition plans are too ambitious (relative to peers), borrowers (i.e. agriculture) may be concerned about future changes to their borrowing and switch banks.

Category	Risk category	Risk Driver	Risk
Transition	Market	Governance	The rapid shift towards decarbonisation may make it difficult to meet market expectations to decarbonise, causing some banks to fall behind their competitors.
		Governance	A slow reaction to decarbonisation may lead to a bank falling behind competitors in identifying and capturing opportunities relating to the transition.
		Governance	Employee attrition may occur due to change of preference regarding climate resilient and purpose-led organisations.
	Technology	Cost	With a number of potential future technologies, there is the potential for unsuccessful investment in lower emissions (virtual) technologies.
		Changes to technology	Customers unable to interact with bank effectively based on technology change to transition to low emissions economy such as moving more things online and reducing physical presence.
		Changes to technology	Uncertainty around the feasibility of new technologies may make it difficult to decide on new investment pathways.
		Changes to technology	Technological solutions to help banks analyse climate risks from a credit perspective may not be either available or fit for purpose.
	Policy and legal	Regulation	Sudden regulation changes at mid-century may lead to rapid industry collapse/change creating stranded assets in the process.
		Climate policy	Increasing disclosure requirements may occur, including obligations to align with Aotearoa New Zealand Climate Disclosures.
		Climate policy	A lack of compliance with regulation or legislation may result in fines or sanctions from regulators.
		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 to new climate policy.
		Litigation	Shareholder/stakeholder litigation may result in banks being financially responsible for their share of existing emissions.
Stakeholder activism	Allegations of climate change inaction and/or greenwashing may be directed towards banks that are perceived as falling behind market expectations.		

Appendix E Detailed description of sector-based credit level risks

Agriculture

Risk information				Operational impact to sector			Flow on impact
Category	Risk category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
Physical	Acute	Drought	Prolonged periods of drought may create resource pressure on farms and plantations and disrupt upstream and downstream supply chains.	Sheep & Beef	Sheep and beef livestock rely heavily on water availability and pasture growth, which are diminished under drought conditions. Nutritional quality of pastures may also decrease due to the impacts of drought in soil quality, increasing costs for farmers to supplement livestock feed and decreasing animal wellbeing, increasing reputational risk. Consecutive seasons of drought create significant cumulative financial impacts for farms and added pressure on mental health for farmers.	Increased operational costs in order to bring in extra feed and water to cover drought shortages. Decreases in revenue due to loss of stock or crops and increases in raw material supply as well as change in farmer behaviour due to increased pressure on mental health.	Increased operating costs and decreased revenue may lead to an inability to repay loans for the farms in the affected areas.
				Dairy	Dairy livestock rely heavily on water availability and pasture growth, which are diminished under drought conditions. Nutritional quality of pastures may also decrease due to the impacts of drought in soil quality, increasing costs for farmers to supplement livestock feed and decreased animal wellbeing, increasing reputational risk. Consecutive seasons of drought create significant cumulative financial impacts for farms and added pressure on mental health for farmers.		
				Horticulture and cropping	Crops are heavily reliant on water-resources, so yields can be reduced or lost entirely in prolonged periods of drought. Drought also increases stress factors in plants, making them more susceptible to pests. Consecutive seasons of drought can have significant cumulative impacts for farms and added pressure on mental health for farmers.		

Risk information				Operational impact to sector			Flow on impact
Category	Risk category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
				Forestry, wood and paper	90% of New Zealand plantations are Radiata Pine, which is typically drought-tolerant. However, soil quality might be affected in droughts leading to erosion and impacts in the stability and viability of plantations. Water supply is also often crucial in wood and paper processing, so if water restrictions are applied during droughts, sector production might be affected.		
Physical	Acute	Extreme weather	Extreme wind and rain may cause damage to farm and plantation facilities and disrupt upstream and downstream supply chains.	Sheep & Beef	On-farm and processing facilities and operations can be damaged and disrupted during storms. Large land tracts can be lost and require re-development. This creates employee and animal wellbeing issues as well as flow-on effects down the supply chain. Reduced council support and increased rates including insurance may impact farm productivity.	Increase in operational costs to cover storm damage and insurance premium increases. Resulting decreases in revenue due to loss of stock, crops or processing assets and increased costs from raw materials and redevelopment of damaged land may be incurred.	Increased operating costs, decreases in revenue and insurance access issues may lead to an inability to repay loans.
				Dairy	On-farm and processing facilities and operations can be damaged and disrupted. This creates employee and animal wellbeing issues. If domestic transport networks are disrupted during milking season, this can create significant impact for scheduled milk pick-ups and deliveries. Land damage may require re-development and reduced council support along with increased rates may impact productivity.		
				Horticulture	Storms can destroy standing crops and food stores, and also create safety risks for farmers and their homes and families. On-farm facilities may also be damaged, and upstream and downstream supply chains disrupted. Crops may be spoiled if they cannot be distributed.		

Risk information				Operational impact to sector			Flow on impact
Category	Risk category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
				Forestry, wood and paper	Trees can be sensitive to high winds, either developing a lean, toppling during storms or dying after extreme winds. Toppling risk increases when soils are saturated. Storms can also damage and/or disrupt activities at paper mills and other processing facilities, including through disruption of electricity supply.		
Physical	Acute	Flood	Surface water and river flooding may damage farm facilities, cause loss of road access, disrupting operations and the supply chain.	Sheep & Beef	Immediate impacts include worker safety, threats to livestock, damage to farm facilities and disrupted operations. Lingering floodwaters can cause feed & water contamination, disease risk, reduced soil quality, soil erosion, nutrient runoff and pasture die-off. Supply chains can also be disrupted.	Increased operational costs to cover flood damage and any insurance related costs including increased premiums due to a high flood risk. Decreases in revenue due to loss of stock, crops or physical assets that supported processing.	Increased operating costs and decreases in revenue, and insurance access issues may lead to an inability to repay loans.
				Dairy	Immediate impacts include worker safety, threats to livestock, damage to farm facilities and disrupted operations. Lingering floodwaters can cause feed & water contamination, disease risk, reduced soil quality, soil erosion, nutrient runoff and pasture die-off. If domestic transport networks are disrupted during milking season, this can create significant impact for scheduled milk pick-ups and deliveries.		
				Horticulture	Immediate impacts include safety risks for farmers, damage to crops and farm equipment. Lingering floodwaters can contaminate water suppliers, erode fertile topsoil, and kill crops. Long-term reductions in crop quality due to reduced soil quality after flooding is a risk.		
				Forestry, wood and paper	Topsoil is washed away causing root damage and slowing growth, reducing product quality and quantity of forestry.		

Risk information				Operational impact to sector			Flow on impact
Category	Risk category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
					Safety risks associated with forest debris being swept away during flooding.		
Physical	Acute	Heatwave	Extreme heat may cause heat stress in animals, increased risk of wildfires and added pressure on cooling systems.	Sheep & Beef	The impacts of heat stress on livestock include reduced feed consumption, slowed development, reduced fertility, and changes to the quantity and quality of meat. Animal welfare and productivity will therefore be an increasing concern. Wildfires also create safety risks for farmers and their animals.	Decreased revenue throughout the supply chain due to stock and crop loss through either heat exhaustion, wildfire alongside decreased availability of raw materials due to lower levels of productivity. Increased operational costs due to increased energy demand to keep food products chilled e.g., milk.	Increased operating costs, decreases in revenue and insurance access issues may lead to an inability to repay loans.
				Dairy	The impacts of heat stress on livestock include reduced feed consumption, slowed development, reduced fertility, and changes to the quantity and quality of milk. Animal welfare and productivity will therefore be an increasing concern. Wildfires also create safety risks for farmers and their animals. Fires can also disrupt transport networks and are more likely to happen during summer when the milking season is at its peak.		
				Horticulture	Extreme heat can affect crop development and growth, and therefore product quality and quantity. Extreme heat is also a risk to farmers wellbeing. Wildfires pose a risk to farmers and crop yields.		
				Forestry, wood and paper	Extreme heat can weaken trees and dry out the forest, making it more susceptible to wildfires. Wildfires can occasionally have extreme consequences on forestry plantations and result in total loss of plantations.		
Physical	Chronic	Precipitation change	Changes to precipitation patterns may disrupt	Sheep & Beef	Pasture growth may be affected. Animal health may be impacted during persistently rainy conditions due to fungal	Decreases in revenue throughout the supply chain due	Increased operating costs and decreases in revenue may lead

Risk information				Operational impact to sector			Flow on impact
Category	Risk category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
			pasture and crop growth and availability of water resources.		infections and spread of disease. Precipitation changes will vary significantly across and within regions, introducing added challenge of managing volatile water availability.	to losses of farm productivity leading to reduced availability of products from farms. Increased on farm operating costs to support animal or crop welfare.	to an inability to repay loans - particularly in those areas where the changes are most pronounced
				Dairy	Pasture growth may be affected. Animal health may be impacted during persistently rainy conditions due to fungal infections and spread of disease. Precipitation changes will vary significantly across regions introducing the added challenge of managing volatile water availability.		
				Horticulture	Plant growth might be impacted by changes in precipitation. Slightly increased rainfall may improve crop growth in some regions. However, excessive rainfall can damage crops and restrict root growth. Changing precipitation patterns may change the annual timing for planting and harvesting. Persistently rainy conditions may also encourage the spread of fungal diseases or pests.		
				Forestry, wood and paper	Volatile precipitation patterns can lead to long-term declines in tree growth. Some species show strong negative growth responses to precipitation extremes, causing the harvested wood to be of lower quality. Persistently rainy conditions may also encourage the spread of fungal diseases or pests.		
Physical	Chronic	Temperature change	Increasing temperature may increase pests and reduce plant growth on farms and	Sheep & Beef	Warming temperatures increase risks of disease which can affect wellbeing and reproduction. Pests & pathogens may spread more easily, further increasing the risk of disease. Supply chain impacts may be felt in refrigeration facilities as	Decreases in revenue throughout the supply chain due to losses of farm productivity leading to reduced	Increased operating costs and decreases in revenue may lead to an inability to repay loans - particularly in those areas where the

Risk information				Operational impact to sector			Flow on impact
Category	Risk category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
			reduce wood quality on plantations.		increased energy is required to keep facilities at appropriate temperatures.	availability of products from farms. Increased on farm operating costs to support animal or crop welfare.	changes are most pronounced.
				Dairy	Warming temperatures increase risks of disease which can affect wellbeing and reproduction. Pests & pathogens may spread more easily, further increasing the risk of disease. Supply chain impacts may be felt in refrigeration facilities as increased energy is required to keep facilities at appropriate temperatures.		
				Horticulture	Plant growth might be impacted by changes in precipitations and changes in temperature. Additionally, the timing of growing seasons may change and the regions where certain crops can grow may shift. Pest species may spread and grow in population more easily, creating increased costs for pest control. Supply chain impacts may be felt in refrigeration facilities as increased energy is required to keep facilities at appropriate temperatures.		
				Forestry, wood and paper	Impacts will vary significantly by region; increased average temperatures may result in higher forest productivity in some regions, while in others, growth may be stunted. Wood obtained from stunted trees will be of lower quality.		
Physical	Chronic	Sea level rise	Rising sea levels may reduce arable land area, damage assets and disrupt logistics.	Sheep & Beef	Coastal farms may lose land area over time due to rising seas. More frequent and severe coastal inundation can also damage farm facilities, reduce soil quality through salination, and threaten livestock and farm workers. Port activities may be reduced during coastal inundation events, reducing the ability for product to be	Decreases in revenue throughout the supply chain due to a loss of productive land to sea level reducing the supply of raw materials. Increased	Increased operating costs and decreases in revenue may lead to an inability to repay loans - particularly in low lying coastal areas.

Risk information				Operational impact to sector			Flow on impact
Category	Risk category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
					transported and exported, interrupting the supply chain.	operational costs to repair damage to assets and protect against rising seas.	
				Dairy	Coastal farms may lose land area over time due to rising seas. More frequent and severe coastal inundation can also damage farm facilities, reduce soil quality through salination, and threaten livestock and farm workers. Port activities may be reduced during coastal inundation events, reducing the ability for product to be transported and exported, disrupting the supply chain.		
				Horticulture	Coastal farms may lose land area over time due to rising seas. More frequent and severe coastal inundation can also damage farm facilities, reduce soil quality through salination, and threaten livestock and farm workers. Soil salinity may lead to poor plant growth and reduce crop yield. Port activities may be reduced during coastal inundation events, reducing the ability for product to be transported and exported.		
				Forestry, wood and paper	Coastal plantations may be submerged over time or experience increased soil salination. Additional costs may be incurred to protect trees through flood-prevention or adaptation measures. Port activities may be reduced during coastal inundation events, reducing the ability for product to be transported and exported.		
Physical	Chronic	Biodiversity loss	Biodiversity loss may reduce product quality and production rates.	Sheep & Beef	Healthy biodiversity provides essential ecosystem services that support livestock farming, including improved soil quality and pasture growth. Loss of biodiversity can reduce these services and reduce pasture quality or quantity.	Decreases in revenue throughout the supply chain due to losses of farm productivity leading to reduced	Increased operating costs and decreases in revenue may lead to an inability to repay loans.

Risk information				Operational impact to sector			Flow on impact
Category	Risk category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
				Dairy	Healthy biodiversity provides essential ecosystem services that support livestock farming, including improved soil quality and pasture growth. Loss of biodiversity can reduce these services and reduce pasture quality or quantity.	availability of products from farms. Increased on farm operating costs to supplement land where biodiversity support has been lost.	
				Horticulture	Healthy biodiversity provides essential ecosystem services that support crop growth, such as pollination, soil aeration and water filtration. Loss of biodiversity can reduce these services and reduce crop productivity or quality.		
				Forestry, wood and paper	Healthy biodiversity provides essential ecosystem services that support tree growth as well as soil health and structure. Loss of biodiversity can reduce these services and reduce plantation productivity. Plantation pine species also presents risks to biodiversity as they are invasive species that spread easily via wind pollination.		
Transition	Market	Customer behaviour change	Customer consumption trends may be influenced by environmental awareness	Sheep & Beef	Growing awareness among consumers regarding agricultural practices may influence the demand for sheep & beef products. For example, preferences for low-emissions, local, cruelty-free and environmentally friendly products have contributed to reduced meat consumption.	Decreases in revenue throughout the supply chain due to demand reduction through product substitution, particularly for animal products. Potential increases in revenue for alternative protein producers and recycled paper products due to increased demand.	Decreased revenues may limit the ability of some farms to repay their loans if they are unable to pivot to more environmentally friendly products.
				Dairy	Growing awareness among consumers regarding agricultural practices may influence the demand for dairy products. For example, preferences for low-emissions, local, cruelty-free and environmentally friendly products have contributed to reduced dairy consumption.		
				Horticulture	Growing demand for organic, local and in-season crops may create opportunities in		

Risk information				Operational impact to sector			Flow on impact
Category	Risk category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
					the domestic market but negatively impact the export market. Reduced meat consumption may create higher demand for vegetable and legume crops.		
				Forestry, wood and paper	Growing awareness of the impacts of paper and forest products to the environment, as well as deforestation and its impacts on climate change and biodiversity may drive consumer demand away from wood-based products. On the other hand, wood as an organic, biodegradable product may increase in demand to replace non-biodegradable materials.		
Transition	Market	Increased costs of raw materials	Raw materials, resources and transport/distribution may increase in cost due to carbon price.	Sheep & Beef	Production costs related to electricity, vehicle fuel, fertilizers and pesticides, transport and logistics will increase. The distance between New Zealand and many of the largest sheep and beef markets means increased transport costs could disproportionately affect the sector and reduce competitiveness and demand.	Increased operational costs throughout the supply chain to cover the increase in raw material costs leading to reduced competitiveness in overseas markets.	Increased operational costs may lead to an inability to repay loans and discourage new market entrants thereby reducing demand for new loans. Reduced profitability will also decrease on farm asset value.
				Dairy	Production costs related to electricity, vehicle fuel, fertilizers and pesticides will increase. Domestic and international transport networks are crucial to the dairy sector, so increase transport and logistics costs due to fuel prices will have a large impact.		
				Horticulture	Production costs related to electricity, vehicle fuel, fertilizers and pesticides, transport and logistics will increase. Fertiliser cost impacts may be particularly significant during planting season.		
				Forestry, wood and paper	Forestry input materials are often carbon-intensive, such as steel, chemicals, or		

Risk information				Operational impact to sector			Flow on impact
Category	Risk category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
					fuels. As a result, input costs will increase as carbon prices rise.		
Transition	Policy & legal	Regulatory impacts	Increasingly stringent climate change regulations may create additional processes and costs.	Sheep & Beef	Climate change regulation may increase production costs. Most significantly, pricing of GHG emissions may create large costs for farms to reduce or offset emissions. Other regulatory costs may relate to water-use, fertiliser-use and equipment upgrades at processing plants.	Increased operational costs throughout the supply chain to cover the costs of climate change regulations leading to reduced competitiveness in overseas markets.	Increased operational costs may lead to an inability to repay loans and discourage new market entrants thereby reducing demand for new loans.
				Dairy	Climate change regulation may increase production costs. Most significantly, pricing of GHG emissions may create large costs for farms to reduce or offset emissions. Other regulatory costs may relate to water-use, fertiliser-use and equipment upgrades at processing plants.		
				Horticulture	Climate change regulation may increase production costs. Regulations such as pricing of GHG emissions, water-use, fertiliser-use and equipment upgrades at processing plants may all have cost impacts. Costs relating to water and fertiliser regulations may impact crop farmers most significantly.		
				Forestry, wood and paper	Climate regulations that affect input materials such as steel, timber, chemicals, or fuels and workers may create resource input constraints. Processing facilities may face increasing compliance requirements and costs around equipment upgrades.		
Transition	Policy & legal	Emissions reduction requirements	Requirements to reduce emissions may alter agricultural	Sheep & Beef	GHG mitigation requirements will increase operating costs for farm operations as emissions-intensive practices or resource inputs need to be reduced or replaced. GHG reduction efforts may also cause the	Increased operational costs associated with emissions pricing, particularly in for	Increased operational costs may lead to an inability to repay loans. Potential

Risk information				Operational impact to sector			Flow on impact
Category	Risk category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
			practices and land-use.		diversion of land towards less emissions-intensive agricultural commodities.	animal product supply chain and especially at the on-farm level. Potential for increased revenues for forestry due to carbon sequestration opportunities	increase in demand for forestry loans.
				Dairy	GHG mitigation requirements will increase operating costs for farm operations as emissions-intensive practices or resource inputs need to be reduced or replaced. GHG reduction efforts may also cause the diversion of land towards less emissions-intensive agricultural commodities.		
				Horticulture	GHG mitigation requirements will increase regulatory requirements and operating costs for farm operations as emissions-intensive practices or resource inputs need to be reduced or replaced. For crop farmers this may relate mostly to fertiliser use and supply chain emissions from transport.		
				Forestry, wood and paper	The pulp and paper industry is a high energy consuming sector, so GHG mitigation requirements will affect energy use. On-site renewable energy generation may be an opportunity to reduce emissions from utilising grid electricity or fossil fuel boilers. Forestry as a climate-solution may increase in demand.		
Transition	Policy & legal	GMO regulations	Use of genetically modified animals or crops with climate-resilient traits may be supported or hindered by regulations.	Sheep & Beef	Policy measures introduced around GM products may impact farmers ability to adapt to climate impacts through producing climate-resilient livestock breeds or feed crops.	Reduced revenue and operational costs throughout the supply chain from a loss of productivity due to GMO regulations restricting the ability for farms to adapt to climate change	Increased operational costs and reduced revenue may lead to an inability to repay loans and discourage new market entrants thereby reducing demand for new loans.
				Dairy	Policy measures introduced around GM products may impact farmers ability to adapt to climate impacts through producing climate-resilient livestock breeds or feed crops.		

Risk information				Operational impact to sector			Flow on impact
Category	Risk category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
				Horticulture	Policy measures introduced around GM products may impact farmers ability to adapt to climate impacts through producing climate-resilient plant varieties. Costs of seeds may also be affected due to patents over certain plant varieties.	using GMO products.	
				Forestry, wood and paper	Policy measures introduced around GM products may impact foresters' ability to adapt to climate impacts through producing climate-resilient tree varieties.		
Transition	Policy & legal	Litigation risk	Lawsuits may be raised against companies failing to meet climate expectations and requirements	Sheep & Beef	Sheep & beef companies may face increased legal risk related to their contribution to GHG emissions and environmental degradation.	Increased operational costs to cover legal costs, especially for animal product and forestry companies. Decreased revenue due to reputation loss leading to reduced demand.	Increased operational costs and reduced revenue may lead to an inability to repay loans. Potential reputational risks for banks that are associated with companies facing litigation
				Dairy	Dairy companies may face increased legal risk related to their contribution to GHG emissions and environmental degradation.		
				Horticulture	Crop farming companies are unlikely to face high legal risks relating to climate change.		
				Forestry, wood and paper	Deforestation may become a source of litigation resulting in lost business opportunities, brand damage and extensive legal costs.		
Transition	Reputation	Reputation impacts	Negative reputational impacts as a result of environmental or social impacts may affect stakeholder and consumer perspectives.	Sheep & Beef	The association of the sheep & beef sector with high emissions, water pollution and animal welfare issues may lead to boycotting of certain products and negative reputational impacts on the sector.	Decreased revenue through the supply chain due to reputation losses leading to reduced demand, especially for animal and forestry companies.	Increased operational costs and reduced revenue may lead to an inability to repay loans. Potential reputational risks for banks that are associated with companies facing negative
				Dairy	The association of the dairy sector with high emissions, water pollution and animal welfare issues may lead to boycotting of certain products and		

Risk information				Operational impact to sector			Flow on impact
Category	Risk category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
					negative reputational impacts on the sector.		consumer/stakeholder perspectives.
				Horticulture	Crop farming, particularly smaller and less intensive farms, may receive positive reputation impacts compared to other more intensive forms of farming. However, negative impacts on climate, water and biodiversity may create reputational impacts.		
				Forestry, wood and paper	The forestry sector could face challenges to public relations and risk reputational damages due to backlash against deforestation. Exposure to climate risks may worsen investor confidence and cause reductions in company valuation where investors do not see mitigating action by the company.		
Transition	Technology	Lower emissions substitutes	Emerging low-emissions technologies may displace traditional farm practices and products.	Sheep & Beef	"Sustainable" alternatives to meat may emerge as technology develops. For example, synthetic and lab-grown meat as well as meat-alternatives. This may displace demand for sheep & beef products.	Decrease in revenue throughout the supply chain due to loss of demand for traditional high emissions products, especially for animal farming.	Decreases in revenue may lead to an inability to repay loans and may reduce demand for new loans in the animal farming sectors
				Dairy	"Sustainable" alternatives to dairy milk may continue to grow as technology develops. Greater levels of alternative milk consumption will impact the demand for dairy products and undermine the profitability of the sector.		
				Horticulture	GM technology may enhance crop farming efficiency. If New Zealand policy does not support the use of GM, then New Zealand crop products may lose competitiveness internationally.		

Risk information				Operational impact to sector			Flow on impact
Category	Risk category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
				Forestry, wood and paper	Evolving technology is digitising the format of traditionally paper-based products such as books and newspapers, which may disrupt some of the sector's core revenue streams.		

Risk information				Operational impact to sector			Flow on impact
Category	Risk category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
Transition	Technology	Emerging technologies	Emerging technologies may increase efficiency on-farm.	Sheep & Beef	Some emerging technologies such as methane vaccines and 'smart-farming' systems will create on-farm efficiencies, improve farming practices and reduce emissions. However, unsuccessful investments in unproven technologies may negatively impact farm revenue and ability to meet emissions reduction requirements.	Reduced operational costs throughout the supply chain due to long term impacts of productivity improvements and lower emissions due to better technologies. However, investment risks associated with untrials technologies may leave assets stranded.	Reduced operational costs may improve loan repayments for those using successful emerging technologies.
				Dairy	Some emerging technologies such as methane vaccines and 'smart-farming' systems will create on-farm efficiencies, improve farming practices and reduce emissions. However, unsuccessful investments in unproven technologies may negatively impact farm revenue and ability to meet emissions reduction requirements.		
				Horticulture	Some emerging technologies such as "smart-farming" systems and electric vehicles will create on-farm efficiencies, improve farming practices and reducing emissions. However, unsuccessful investments in unproven technologies may negatively impact farm revenue and ability to meet emissions reduction requirements.		
				Forestry, wood and paper	New technologies such as remote sensing and utilisation of artificial intelligence for better forest management and protection of the supply of wood pulp may help to reduce emissions and improve productivity. However, these technologies will require high upfront investment, which creates a risk around investing in unproven technologies.		

Transport and Shipping

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
Physical	Acute	Drought	Drought conditions may degrade transport infrastructure, increasing safety risk and cost of maintenance.	Transport & Shipping	The drying of land during a drought result in cracking, slumping, rutting and settling of road surfaces. Increased risk of damage, higher maintenance, health and safety risks may result in the occurrence of major drought. Road and rail closures could also impact transport logistics.	Significant operational costs to repair. Damage to infrastructure and assets may lead to reduced revenue and/or increase operational expenditure due to need for alternative route.	Added costs from asset degradation and logistics disruption may impact loan repayment.
Physical	Acute	Extreme weather	Extreme weather during storms may damage assets and increase safety risk.	Transport & Shipping	Storm may cause damage, disruption or closure of infrastructure such as roads, railways, shipping routes and general operation. This may lead to significant costs required to repair damages and respond to infrastructure closure.	Significant operational costs to repair. Damage to infrastructure and assets may lead to reduced revenue and/or increase operational expenditure due to need for alternative route.	Increased costs and corresponding reduced revenues may impact loan repayments.
Physical	Acute	Flood	Surface water and river flooding may disrupt transport infrastructure and damages assets.	Transport & Shipping	Flooding can cause widespread damage to assets and infrastructure, and interrupt logistics leading to impacts in supply chains. This slows production rates and increases costs from damage repair. Additionally, damage to airports on reclaimed land could also disrupt air travel and freight.	Increased repair and inspection costs due to infrastructure and asset damage. Floods may also damage airport infrastructure, disrupting air and ground travel.	Repeated occurrence of damage to infrastructure and assets may lead to significant increase in costs and borrowers' inability to repay loans.

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
Physical	Chronic	Precipitation change	Increased precipitation may degrade transport infrastructure	Transport & Shipping	Increased precipitation may lead to roads and railways being washed away by erosion and instability, which may lead to significant costs and supply chain disruptions to all sectors.	Significant operational costs to repair. Damage to infrastructure and assets may lead to reduced revenue and/or increase operational expenditure due to repair costs and need for alternative route.	Ongoing occurrence of damage to infrastructure and assets may lead to significant increase in costs and borrowers' inability to repay loans.
Physical	Chronic	Temperature change	Rise in temperature may increase degradation rates, increasing costs.	Transport & Shipping	Increase in temperatures may lead to an increase in maintenance costs of infrastructure. Long-term temperature increase may lead to increased requirements of rail infrastructure design and maintenance and cause permanent rail damage in extreme cases.	Increase in temperatures may lead to an increase in maintenance costs of infrastructure. Long-term increase in temperatures may increase damages to infrastructure, and lead to increase cost to repair and maintain assets.	Ongoing occurrence of damage may lead to borrowers' inability to repay loans.
Physical	Chronic	Sea level rise	Storm surge and inundation from sea level rise may damage and/or strand assets.	Transport & Shipping	Risk of damage to roads near water and infrastructure on reclaimed land may occur due to sea level rise. Ports may be rendered unusable if not prepared and significant capital expenditure will be required. Coastal airports may also be at risk of damage.	Ports may be rendered unusable if not prepared and significant capital expenditure will be required. Coastal airports may also be at risk of damage. Significant operational costs to repair erosion of coastal infrastructure, including costs of more frequent inspection.	Significant costs to repair damages to coastal infrastructure, and stranded assets, may hinder loan repayment in the long run.
Transition	Market	Customer behaviour change	Decreasing consumer demand for travel by road or air may impact sales revenue	Transport & Shipping	Increase in climate action, fuel taxes and carbon price may lead to increase in sharing modes of transport, active transport, and therefore decrease in consumers demand for individual road and air travel.	The drop in demand for emissions reliant (e.g., Air travel) or intensive (e.g., kerosene) products reduces their market value, in turn increasing asset risk for transport	Change in consumer behaviour may lead to reduced demand for fossil fuelled transport vehicles.

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
						and fossil fuel providers and resulting in reduced revenues.	
Transition	Policy and legal	Emissions reduction requirements	Emissions reporting may increase costs and can damage reputation	Transport & Shipping	Corporate carbon reporting and the disclosure of GHG emissions has become increasingly common. Additional mandatory disclosures may result in additional cost as companies create and maintain processes for carbon emission monitoring. Reports where performance does not meet stakeholder expectations could worsen investor confidence and cause reductions in company valuations.	Additional mandatory disclosures may result in additional cost as companies create and maintain processes for carbon emission monitoring. Reports where performance does not meet stakeholder expectations could worsen investor confidence and cause reductions in company valuations.	Restructuring to accommodate reporting requirements may reduce productivity and add costs, leading to potential disruption in their ability to repay loans.
Transition	Policy and legal	Litigation risk	Failing to meet reporting obligations may expose companies to litigation	Transport & Shipping	Borrowers may face increased legal risk related to their contribution to GHG emissions and environmental degradation.	Increased costs and/or reduced demand for products and services resulting from fines and judgments	Increased litigation risk may create reputational impacts for lenders. Legal costs may affect loan repayments.
Transition	Policy and legal	Emissions pricing	Increased cost of high emissions assets may decrease affordability and demand.	Transport & Shipping	Increased cost due to scarcity may occur, carbon pricing and higher demand for finite materials. Costs likely passed on to consumers. Increasing the costs of fossil-fuel based transport.	Carbon pricing may increase costs to borrowers who may lose competitive advantage resulting in higher product prices and reduced demand.	Higher costs may reduce competitiveness and demand, affecting loan repayments and potentially discouraging new market entrants and therefore demand for new loans.

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
Transition	Technology	Lower emissions substitutes	Higher costs may occur due to restructuring needed to employ low emissions alternatives.	Transport & Shipping	Significant cost required to research alternatives where they don't exist, such as low-emission aviation and maritime fuel. Technology may not be proven and can be high risk	Significant cost required to research and trial low emissions alternatives may be required. Upgrading infrastructure to shift towards electrified transport and upgrading infrastructure such as rail networks will also require significant capital expenditure. Unsuccessful investment in low emission technologies may also lead to sunk costs	Significant increase in these costs and potential sunk costs due to unsuccessful investment in technologies may impact borrowers' ability to repay loans.

Energy

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
Physical	Acute	Drought	High demand for water during drought periods may increase cost of power usage.	Energy Generation	Droughts adversely impact 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.	Slower production rates decrease revenue across the energy sector. During extended drought periods entities may be forced to abandon assets increasing capital cost. Early retirement or temporary shut-down of hydropower plants results in rapid and total loss of revenue.	Added costs and reduced revenue may impact ability to repay loan.
				Oil & Gas	The oil and gas industry is heavily reliant on access to water. Droughts and greater water scarcity will lead to greater competition for water, increasing supply costs. If well levels get too low, this can slow production of oil and gas during exceptional conditions.		
Physical	Acute	Flood	Surface water and river flooding may disrupt energy transmission and damage assets.	Energy Generation	Hydropower plants are typically located near rivers or lakes putting them at risk during a flood event. Overflow from floods can damage plant infrastructure, interrupting supply and increasing reliance on oil/gas. Damage can also occur through eroding transmission and distribution lines and tower structures.	Increased operational cost and delays in production. Reduced lifespan of assets due to more rapid degradation as well as added maintenance and repair costs during the asset's lifespan.	Increased asset risk exposure and reduced revenues impact loan repayment.
				Oil & Gas	Increased flooding will cause damage to oil and gas operations, including ruptured flow lines and storage tanks. Flooding of wells may interrupt operations, leading to increased operational costs and delays in production work.		
Physical	Acute	Heatwave	Heatwaves may impair energy	Energy Generation	Heatwaves reduce plant efficiency or causing blackouts due to equipment	Catastrophic failure leading to complete	Reduction in revenue is felt across the

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
			production or risk of failure due to extreme heat.		design thresholds. For transmission and distribution infrastructure, high temperatures may cause conductor sagging, possibly causing fires. Large fires can cause widespread damage, including damage to towers and poles leading to potential collapse of power lines.	plant shutdown would incur extensive losses to the entity. Damages will increase maintenance and repair costs, and interrupt energy production/supply, decreasing overall revenue.	energy sector, impacting loan repayment
				Oil & Gas	Failure of oil and gas infrastructure during extreme heat conditions may cause catastrophic explosions and loss of supply. This may also increase risk of wildfire occurrence, causing additional damage. Health and wellbeing of workers is also reduced under extreme conditions increasing possibility of heat stroke and other heat related illnesses.		
Physical	Chronic	Temperature change	Increasing temperatures may decrease energy production efficiency	Energy Generation	Higher temperatures reduce power generation efficiency and output as well as increase customers' cooling demands, stressing the capacity of generation and grid networks. Added pressure for generation during periods of high demand could increase degradation and reduce asset lifespan.	Continued power generation at capacity results in higher depreciation costs, higher repair and maintenance costs and earlier asset write off. This contributes to an overall reduction in revenue.	Reduced revenue and rapid asset devaluation impact ability to repay loan.
				Oil & Gas	Rising temperatures will affect efficiency and performance of plant and equipment such as compressors, gas turbines, pumps, generators. Consequences include increasing energy consumption, decreased output, more maintenance, reduction in asset performance and life.		

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
Physical	Chronic	Sea Level Rise	Impact to coastal infrastructure may occur due to inundation and storm surge from sea level rise	Energy Generation	Sea level rise and associated increased exposure to storm surge poses risks to onshore infrastructure through flood erosion and degradation. This may interrupt and reduce power supply and could lead to asset stranding if appropriate measures are not taken to adapt to encroaching sea level.	Increased exposure to asset damage increasing maintenance and repair costs as well as reduced productivity if operations are interrupted during design upgrades or temporary shutdowns due to the asset being deemed unsafe. Sea level rise will increase operating costs and reduce revenue across the energy sector.	Decreased revenue and possible stranding of assets impacts loan repayments.
				Oil & Gas	Changes due to sea level rise will affect offshore facility operation and design. Existing flood management and drainage systems may be compromised and assets with outdated design standards are likely to be evacuated more frequently.		
Transition	Market	Customer behaviour change	Changing consumer behaviour may increase preference for low emissions alternatives.	Energy Generation	Rise in consumer awareness will 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.	Restructuring to accommodate shift in demand will incur added cost.	Reduced demand for loans and financial assets. Increased financial risk incurred due to divestment may impact loan repayment.
				Oil & Gas	The global consensus on decarbonisation has increased pressure for diversification and emissions cuts. Growing movement supporting divestment from fossil fuels poses risks to traditional oil and gas business models as consumers seek low emissions alternatives.		

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
Transition	Policy and legal	Regulatory impacts	Failing to adhere to changing regulation may impact revenue and reputation.	Energy Generation	Failing to meet regulation results in stranded assets resulting in unanticipated or premature write-downs, devaluations or conversion to liabilities by not considering changes in climate change policy.	Asset devaluation and plant shutdowns and falling investment due to entity failure to meet regulation will significantly affect revenue.	Significant and rapid reduction in revenue impacts loan repayment and damages reputation
				Oil & Gas	Risk of stranded assets due to shifts in demand towards renewables further enhanced by their increased affordability. The shifting market will force oil and gas companies to move away from traditional fossil fuels or risk losing investors.		
Transition	Policy and legal	Litigation risk	Failing to meet reporting obligations may lead to increased litigation	Energy Generation	Managing and reporting the carbon emissions associated with electric utilities is important to meet reporting obligations. New Zealand has set ambitious targets which, if not met, may incur legal action, provided the targets aren't changed.	Increased operating costs incurred from re-structuring required to measure and report on emissions in alignment with government obligations. If obligations are not met litigation may decrease investor interest.	Reduced revenue due to increased operational costs and/or decreased investment impacts loan repayment.
				Oil & Gas	Litigation against companies and/or directors on climate grounds (claiming causation or seeking greater action to mitigate effects) could have reputational, development and operating cost impacts.		
Transition	Policy and legal	Emissions pricing	Higher costs of emissions intensive processes may impact affordability.	Energy Generation	Increased cost of fossil fuel-based energy will reduce affordability and demand. Increased risk exposure for entities relying on carbon intensive process will negatively impact revenue and reputation.	Carbon pricing increases operating costs for entities with high emissions profiles. This together with decreased stakeholder investment impacts revenue and capital value. Added costs may be passed onto	The electricity sector in New Zealand is mostly reliant on Hydropower which reduces carbon pricing costs. Oil and gas however will incur added revenue losses and decreased demand which may
				Oil & Gas	Regulation of oil and gas companies' is intensifying; refineries are amongst the industry groups already included in carbon price/emissions trading schemes. High carbon prices result in		

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
					higher direct energy costs as well as within the supply chain including higher construction material costs and higher transportation costs, for oil and gas companies.	the consumer however this will decrease demand, again affecting revenue.	impact loan repayments.
Transition	Reputation	Reputation impacts	Sector stigmatization may be increased by engaging in unethical or unsustainable practices.	Energy Generation	Environmental groups have targeted major firms and asset managers to end fossil fuel investment, including coal in a bid to help combat global warming. Although New Zealand's electricity is sourced largely from renewables, fossil fuels are still relied upon in winter when lakes aren't full.	Loss of reputation due to increasing public awareness and climate activism resulting in reduced demand.	Inability to repay loan if drastic decarbonisation and reduction occurs and increased asset risk due to reputation changes.
				Oil & Gas	Key stakeholders whose sentiments impact the viability of operations. If a divestment campaign from traditional fossil fuels is successful in stigmatising oil and gas players who continue to invest and expand in fossil fuels, the company will experience a reduction in capital availability and demand for their products.		
Transition	Technology	Lower emissions substitutes	Transition to alternative low emissions technology increase capital cost.	Energy Generation	Carbon capture, utilisation and storage (CCUS) technologies are critical for reducing carbon emissions however capture technologies have not yet proven widely feasible and rate of uptake is slow due to high-cost barriers.	Significant capital cost required to implement new technology such as hydrogen and carbon capture and storage methods, reducing total revenue.	Investment in alternative technology might lead to an increased uptake in loans, however these may be accompanied by added risk due to uncertainty with technology alternatives.
				Oil & Gas	CCUS is particularly important for oil and gas to reduce emissions. Slow uptake means the sector needs to maintain a balance between production of emissions and compensating with added investment		

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
					in carbon credits to remain within legal limit.		
Transition	Technology	Unsuccessful investment	Added losses may be incurred by investment in new alternative technologies	Energy Generation	Investments in new, clean technologies may not generate returns. High-risk, high-cost CCUS investments looked potentially viable a decade ago but are being eclipsed today by less-costly ways to produce electricity while curbing carbon emissions.	Added risk of investment in alternative technology without certainty on viability. Increased costs incurred if financed projects fail to make returns.	Loan repayment may be impacted if borrowers' investments are unsuccessful.
				Oil & Gas	While CCUS technology should continue being developed, its viability in terms of efficiency and ability to deploy at scale remains unproven, and reliance on such technologies is risky. The capital that has been channelled towards R&D may go waste if the benefits of the technologies do not materialise as intended.		

Manufacturing

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
Physical	Acute	Drought	Droughts may reduce water availability required in manufacturing processes, reducing productivity.	Manufacturing	Reduced water supply caused by drought would impact manufacturing as many manufacturing industries use water during production processes including fabricating, washing, diluting, cooling or transporting. In particular large amounts of water are used to produce food, paper and chemicals. Therefore, a reduction in supply could cause operational delays and disruption.	Increased operational costs due to increased water costs. Reduced revenue as water availability limits productivity.	Increased operational costs and reduced revenue may lead to an inability to repay loans, particularly periods of extended drought.
Physical	Acute	Extreme weather	Storms may interrupt manufacturing operations through power outage and damage to capital.	Manufacturing	Storms may result in increased power outages at manufacturing sites. This will result in disruption and slowdown in production and damage to equipment and products.	Increased operational costs to cover storm damage and insurance premium increases. Reduced revenue due to a loss of production activity.	Increased operational costs and reduced revenue may lead to an inability to repay loans.
Physical	Acute	Flood	Flooding from high intensity rainfall may damage assets and disrupt supply chains.	Manufacturing	Flash flooding caused by high intensity rainfall is the leading cause of weather-related disruption to the transport sector. Flooding may cause logistical delays, disrupting delivery and supply of goods as well as damaging materials, products and machinery.	Decreased revenue to due disruption in transport networks and getting products to market. Increased operational costs to cover the cost of repair to assets.	Increased operational costs and reduced revenue may lead to an inability to repay loans, particularly over periods of repeated disruption.
Physical	Acute	Heatwave	Heatwaves may lower productivity and damage equipment.	Manufacturing	Unsafe working conditions due to extreme heat during heatwaves can result in delays to maintenance of manufacturing products. Manufacturing machinery can also be disrupted under extreme temperatures, slowing overall production rate.	Increased operational costs to cover greater worker welfare needs. Reduced revenue due to lost productivity from high heat days.	Increased operational costs and reduced revenue may lead to an inability to repay loans, particularly over long heatwave periods.

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
Physical	Chronic	Precipitation change	Increased precipitation may disrupt supply chains and lead to delays in operations due to flooding.	Manufacturing	Increased precipitation may increase the risk of landslides, slope failures, and floods, causing road washouts and closures. This may lead to logistical problems for manufacturing firms including delivery delays and disrupted supplies.	Increased operational costs due to cover storm damage and insurance premium increases. Reduced revenues due to disrupted supply chains	Increased operational costs and reduced revenue may lead to an inability to repay loans.
Physical	Chronic	Sea level rise	Sea-level rise may increase frequency of coastal flooding and jeopardise coastal manufacturing operations.	Manufacturing	Manufacturing plants located on or near coasts or waterways might be exposed to sea level rise. Increased exposure to coastal flooding interrupts operations and damages machinery, slowing productivity rates and increasing capital expenditure.	Increased operational costs to repair damage to assets and protect against rising seas. Decreases in revenue throughout the supply chain due to a loss of factories in coastal areas and coastal transport routes, reducing the availability of raw materials.	Increased operating costs and decreases in revenue may lead to an inability to repay loans - particularly those organisations that are heavily reliant on factories and transport infrastructure located in low lying coastal areas.
Transition	Market	Customer behaviour change	Customer awareness may shift consumer preference away from emissions intensive products.	Manufacturing	Changes in customer behaviour may result in a reduction of demand for carbon-intensive products and services and a corresponding increase in demand for low-carbon goods, as well as for services.	Increased operational costs due to significant restructuring of manufacturing companies required to meet changing consumer demand.	Increased operating costs may lead to an inability to repay loans
Transition	Market	Increased costs of raw materials	Raw materials, resources and transport/distribution may increase in cost due to carbon price.	Manufacturing	Manufacturers may face increased prices in raw materials. Added cost of carbon intensive transport/distribution methods will	Increased operational costs due to increases in raw material costs and a higher cost of carbon. Reduced	Increased operational costs and reduced revenue may lead to an inability to repay loans and discourage new market entrants

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
					contribute to added cost of raw materials supply.	revenue due to loss of competitiveness on international markets.	thereby reducing demand for new loans.
Transition	Policy and legal	Emissions reduction requirements	Requirements to reduce emissions may alter manufacturing practices.	Manufacturing	Corporate carbon reporting and the disclosure of GHG emissions has become increasingly common. Additional mandatory disclosures may result in additional cost as companies create and maintain processes for carbon emission monitoring. Reports where performance does not meet stakeholder expectations could worsen investor confidence and cause reductions in company valuations.	Increased operational costs to reduce and report emissions. Reduced revenues due to a loss of competitiveness with overseas producers.	Increased operational costs and reduced revenue may lead to an inability to repay loans and discourage new market entrants thereby reducing demand for new loans.
Transition	Policy and legal	Litigation risk	Lawsuits may be raised against companies failing to meet climate expectations and requirements.	Manufacturing	The threat of litigation will increasingly undermine the future liability of laggard companies and their shareholder value, and lawsuits are increasingly targeting the highest greenhouse-gas-emitting companies - many of which are manufacturing. This exposes entities to increased litigation costs and reputational damage.	Increased operational costs to cover legal costs. Decreased revenue due to reputation loss leading to reduced demand.	Increased operational costs and reduced revenue may lead to an inability to repay loans. Potential reputational risks for banks that are associated with companies facing litigation.
Transition	Policy and legal	Emissions pricing	Rising carbon price may increase cost of carbon intensive manufacturing processes.	Manufacturing	The manufacturing sector is a major source of CO2 emissions, generated through on-site fuel combustion and the manufacturing processes. Carbon pricing on carbon intensive materials such as steel and plastic will increase the cost of the raw components in manufacturing.	Increased operational costs to cover the higher cost of carbon. Reduced revenue due to loss of competitiveness with overseas producers	Increased operational costs and reduced revenue may lead to an inability to repay loans and discourage new market entrants thereby reducing demand for new loans.

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
Transition	Technology	Lower emissions substitutes	Emerging low-emissions technologies may displace older manufacturing equipment.	Manufacturing	Many manufacturing sites still use old, 'leaky', high emissions intensive equipment. Manufacturing companies need to invest in more energy efficient new technologies. This will increase capital expenditure costs and also research and development costs. The sector will continue to change structurally, including in the direction of 'servitisation'. This is a significant change in business model for many manufacturing companies which would result in significant additional costs.	Increased capital investment to adapt and improve factories with new energy efficient technology.	Upfront costs of upgrading factories may lead to increased demand for new loans. Increasing operational costs for those factories that do not replace older technologies may lead to an inability to repay loans
Transition	Technology	Unsuccessful investment	Unsuccessful investment in new technologies during adaptation phase may increase exposure to unnecessary additional cost.	Manufacturing	Manufacturing industries face the risk of unsuccessful investment due to the complexity of prices and supply chains that need to be managed, as well as maintaining production whilst they are adapting to low-carbon technology. Unsuccessful technology could result in disruption to the supply chain and production.	Increased operational costs to invest in new technologies whilst maintain current production.	Upfront costs of upgrading factories may lead to increased demand for new loans. Repayment of loans for those companies that invest in unsuccessful technologies may be affected.
Transition	Reputation	Stakeholder relations	Delayed action on climate risk mitigation and adaptation may harm stakeholder relations.	Manufacturing	Exposure to climate risks may worsen investor confidence and cause reductions in company valuation where investors do not see appropriate action being taken by the company.	Increased operational costs due to lower levels of investment from stakeholders.	Increased operational costs may lead to an inability to repay loans.

Construction, Residential and Commercial Property

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
Physical	Acute	Extreme weather	Storms may damage property and disrupt rate of construction.	Construction	Extreme weather accompanying storms may damage unprotected and exposed infrastructure and disrupt communications and/or block access to site locations.	Increase in operational expenditure may result from repairing damage from storms. Write-offs and early retirement of existing assets through damage to property and assets in high-risk locations	Storms can be highly costly, and assets may incur permanent damage which can drastically reduce their value. Major delays in the construction timeline or property damage beyond repair in severe cases may impact loan repayment.
				Residential Real Estate	Increasing intensity and frequency of storms can damage properties in high-risk areas, particularly those along coastal areas which may be exposed to storm surge and associated erosion destabilising property foundations. Repairing damage and rebuilding is costly and highly exposed properties may become less insurable or become stranded. This also negatively affects residential property value significantly in these areas.		
				Commercial Real Estate	As above, damage to commercial properties in high-risk areas. Repairing damage and rebuilding is costly and highly exposed properties may become less insurable or become stranded. This also severely affects commercial property value in these areas.		
Physical	Acute	Flood	Surface water and river flooding may disrupt operations and damage assets.	Construction	Flooding due to extreme rainfall can interrupt construction operations, causing delays to project timelines. Flooding can also damage materials and disrupt logistics for delivery of supplies and removal of waste. Floods also might risk leakage of toxic substances resulting in spills and subsequent compliance and legal risk.	Increase in operational expenditure may result from repairing flood damage to assets and costs associated with delayed project timelines. Write-offs and early retirement	Impact on loan repayments if flood preparation does not take place, and operations are interrupted for prolonged periods.

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
				Residential Real Estate	Damage to property from flooding is costly to repair and can reduce the value to properties in flood prone areas. Rental properties also may not be suitable for tenants to remain at the premises, and owners may therefore lose rental payment in the interim. This might jeopardise mortgage loan repayment. Managed retreat may lead to stranded properties.	of existing assets through damage to property and assets in high-risk locations	
				Commercial Real Estate	Damage to commercial property from flooding could cause disruption to business, including lack of essential services and loss of profit. Higher repair, replacement and reinstatement costs may jeopardise loan repayments. Managed retreat may lead to stranded properties.		
Physical	Acute	Heatwave	Heat stress may have negative health implications and increase probability of wildfire occurrence.	Construction	Severe heat may impact the quality of working conditions for workers, slowing or halting construction operations. This may impact workers wellbeing, delay timeline for project completion and increase costs.	Increase in operational expenditure may result from costs associated with delayed project timelines. Write-offs and early retirement of existing assets through damage to property and assets from wildfires in high-risk locations	Added costs across both sectors reduce overall revenue which may impact loan repayment in the long run.
				Residential Real Estate	Heat stress have negative impacts on occupants' health, particularly for the very young, elderly and the sick. Increased likelihood of wildfire occurrence which can be highly destructive to property and surrounding natural environment.		
				Commercial Real Estate	Extreme heat can cause damage to the building's exterior and interior, including the roof, walls, and windows. High temperatures can		

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
					also cause mechanical systems to malfunction, such as elevators and cooling systems, leading to costly repairs.		
Physical	Chronic	Precipitation change	Change in rainfall patterns may increase asset degradation rates and increases costs	Construction	Increased precipitation may interrupt operations on construction sites. Prolonged periods of rain may have larger impacts on project timeline, and additional costs may be incurred. Under prolonged dry conditions water scarcity may affect water intensive processes during construction, also delaying project completion.	Increase in operational expenditure may result from maintenance because of asset degradation. Write-offs and early retirement of existing assets through damage to property and assets in high-risk locations	Higher costs incurred due to increased asset degradation and interruption during construction may decrease property value and project revenue, impacting loan repayment.
				Residential Real Estate	Property exposure to harsher weathering from rainfall may lead to premature degradation. Maintenance costs and the reduced lifespan of the building will create additional costs incurred by the owner.		
				Commercial Real Estate	Property exposure to harsher weathering from rainfall may lead to premature degradation. Maintenance costs and the reduced lifespan of the building will create additional costs incurred by the owner.		
Physical	Chronic	Temperature change	Increased average temperature may slow operations and increase wildfire exposure.	Construction	Higher temperatures will increase the likelihood of thermal discomfort in workers which has been shown to reduce productivity. Consistently high temperatures will slow output rates, resulting in delays and costs associated with extending the project timeline. This will reduce profit earnings overall.	Write-offs and early retirement of existing assets through damage to property from wildfires in high-risk locations	Higher average temperatures slow construction rates and increases probability of wildfire in high-risk areas. Associated costs due to delays and decreased land

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
				Residential Real Estate	Higher average temperatures and lower rainfall increases the risk of wildfire occurrence. This may decrease demand in high-risk areas accompanied by a drop in land prices. Real estate agencies invested in these areas risk a decrease in the value of their property portfolio. Added costs to future proof exposed properties will also be incurred.		value may impact loan repayment.
				Commercial Real Estate	Higher temperatures can cause materials to expand and contract, which can result in damage to building materials such as roofing, siding, and windows. This can lead to the need for repairs and replacements, which can be costly for building owners. The impacts of increased temperatures on commercial real estate, including health and safety concerns and damage to building materials, can potentially lead to lower property values.		
Physical	Chronic	Sea level rise	Increased inundation and exposure to storm surge interrupts operations, damages assets and devalues land.	Construction	Construction sites located in low lying coastal areas may be at risk of inundation and/or damage by storm surge. Flood occurrence can interrupt construction operations and logistics due to difficulty in delivering materials or removing waste from the site. Associated delays in the project timeline and associated costs should be considered.	Write-offs and early retirement of existing assets through damage to property and assets in coastal locations	Costs incurred from damage to assets and materials and logistical interruption as well as declining land value may impact loan repayment.
				Residential Real Estate	Properties in low lying coastal areas may be exposed to an increase in		

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
					the frequency and severity of flooding. Repeated inundation and flood events may damage the property, resulting in costly repairs, as well as decrease in marketability and valuation of properties where their resilience SLR varies. Managed retreat may lead to stranded properties.		
				Commercial Real Estate	Properties in low lying coastal areas may be exposed to flooding due to sea level rise. Repeated inundation and flood events may damage the property, resulting in costly repairs, as well as decrease in marketability and valuation of properties where their resilience SLR varies. Managed retreat may lead to stranded properties.		
Transition	Market	Customer behaviour change	Shifting preference for high quality sustainable building standards may impact property value.	Construction	Studies show a shift in consumer preference towards buildings which exceed standards in New Zealand. These buildings often include low energy consumption and the incorporation of renewable energy, low GHG emissions and incorporation of sustainable design features. Adapting to changing consumer demand is necessary to remain competitive.	Re-pricing of assets and land valuations. Construction losses may be incurred if projects remain traditional in their design.	Higher costs associated with higher standard design along with declining land value in high-risk areas impact loan repayment.
				Residential Real Estate	Growing awareness of the risks associated with climate change are increasing property owner preference for resilient, efficient buildings that are not situated in high-risk areas, such as flood prone coastal areas or near bushland with the risk of wildfire. These factors		

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
					may decrease valuation of properties in previously high value areas.		
				Commercial Real Estate	Increased demand for sustainable buildings (e.g., LEED certification) and higher expectations for energy efficiency as a response to changing customer behaviours. 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.		
Transition	Policy & legal	Regulatory impacts	Changing regulation may introduce added costs associated with transition to low emissions alternatives.	Construction	Regulation supporting the reduction of carbon in construction materials and promoting a shift towards low-emissions buildings will incentivise investment in alternative energy efficient, sustainable building designs. Failing to engage in new alternative low emissions materials may place construction companies at a disadvantage in the changing regulatory environment.	Changing regulations may result in added costs associated with operational changes and building standards. Mandated changes to product specifications, limits on certain materials and other regulatory changes may impact profitability.	Significant increase in operational costs might impact borrowers' ability to repay loans
				Residential Real Estate	Governments may introduce new regulations to mitigate the impacts of climate change, such as requiring buildings to meet higher energy efficiency standards or imposing restrictions on where buildings can be located. These regulations may impact property values and make it more difficult for property owners to realise a return on their investment.		

Risk information				Operational impact to sector			Flow on impact
Category	Sub-category	Risk driver	Risk	Sub-sector	Operational Impact	Financial Risk	Flow on impacts to the banking sector
					Moreover, zoning regulations may significantly alter the areas available for development, potentially reducing the scope for future developments.		
				Commercial Real Estate	There is a global trend towards higher building standards regarding environmental management and energy efficiency. Commercial properties that do not accommodate to this changing policy and fail to meet standards over the next decade may face a loss of competitiveness and increased cost. Moreover, zoning regulations may significantly alter the areas available for development, potentially reducing the scope for future developments.		
Transition	Reputation	Reputation impacts	Delayed action on climate risk mitigation and adaptation may harm stakeholder relations.	Construction	Exposure to climate risks may worsen investor confidence and cause reductions in company valuation where investors do not see appropriate action being taken by the company.	Increased operational costs due to lower levels of investment from stakeholders.	Increased operational costs may lead to an inability to repay loans.
				Residential Real Estate	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.		
				Commercial Real Estate	Commercial property developers/owners/investors with a poor reputation for environmental		

Risk information				Operational impact to sector			Flow on impact
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					stewardship or sustainability may see a negative impact on the value of their commercial properties. 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.		
Transition	Market	Increased costs of raw materials	Raw materials, resources and transport/distribution may increase in cost due to carbon price.	Construction	Extraction of building materials, such as concrete and steel, will increase costs within the supply chain as they are typically carbon-intensive and are currently few substitutes available.	Higher operational costs and capital expenditure as the price of carbon-intensive raw materials increases.	Significant increase in operational costs might impact borrowers' ability to repay loans.
				Residential Real Estate	As the cost of raw materials like steel, cement, and lumber rise due to climate-related disruptions, the cost of building new residential property may increase. This could make it more difficult for residential property developers to build new properties, or make the cost of new construction more expensive, which could ultimately impact property prices.		
				Commercial Real Estate	As the cost of raw materials like steel, cement, and lumber rise due to climate-related disruptions, the cost of building new commercial property may increase. This could make it more difficult for developers to build new properties, or make the cost of new construction more expensive, which could ultimately impact property prices.		

Risk information				Operational impact to sector			Flow on impact
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Transition	Policy & legal	Emissions reduction requirements	Increasingly stringent climate change regulations may create additional processes and costs.	Construction	Corporate carbon reporting and the disclosure of GHG emissions has become increasingly common in construction.	Increase in operational expenditure may result from costs of reporting activities and carbon emission monitoring.	Restructuring to accommodate reporting requirements may reduce productivity and add costs, leading to potential disruption in their ability to repay loans.
				Residential Real Estate	Homes that do not meet emissions reduction requirements may become less desirable to homebuyers and renters, potentially resulting in lower property values.		
				Commercial Real Estate	Corporate carbon reporting and the disclosure of greenhouse gas emissions has become increasingly common in commercial real estate.		
Transition	Policy & legal	Litigation risk	Failing to meet reporting obligations may expose companies to litigation.	Construction	Climate change litigation risks include exposure to damages claims, financial and reputational costs of defending litigation, disruption to operations and enforcement of financial disclosure requirements. Failing to meet reporting obligations and building standards once introduced may place companies at risk of exposure to litigation.	Reputational damage caused by legal action against a company may limit inward investment. Client exposure to litigation may interrupt operations and reduce project or property value.	Decreases to property values may impact the lenders reputation as well as loan repayment from the client.
				Residential Real Estate	Climate litigation can lead to increased insurance costs for homeowners, particularly those who live in areas prone to climate-related events. Climate litigation may lead to new disclosure requirements for homeowners, requiring them to disclose information about the risks of climate-related events or the energy efficiency of their homes.		

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				Commercial Real Estate	Climate change litigation risks include exposure to damages claims, financial and reputational costs of defending litigation, disruption to operations and enforcement of financial disclosure requirements. Failing to appropriately consider the impact of climate change and related weather events to properties might expose borrowers to litigation.		
Transition	Policy & legal	Emissions pricing	Emissions intensive operations and materials may become increasingly costly.	Construction	Increased carbon pricing increases the cost of emissions intensive materials such as concrete. Concrete is widely used within the construction industry and would be a substantial added cost.	Higher materials costs where carbon taxes are passed through the value chain. Costs incurred from high emissions materials may reduce revenue.	Costs associated with increased pricing of GHG emissions may decrease revenue, and effect property value, in turn affecting loan repayment.
				Residential Real Estate	Emissions pricing can lead to higher energy costs for homeowners, particularly those who rely on fossil fuels for heating or electricity. Building homes that meet emissions pricing requirements, such as higher energy efficiency standards or the use of renewable energy sources, can increase the cost of construction.		
				Commercial Real Estate	Borrowers may be burdened by additional cost associated with heating and/or cooling cost for their buildings. The additional operating expenses will reduce affordability for current carbon-intensive technologies, potentially forcing them into earlier than expected decommission.		

Risk information				Operational impact to sector			Flow on impact
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Transition	Technology	Lower emissions substitutes	Added costs may be introduced through increased demand to adopt alternative low emissions technologies.	Construction	Alternative methods are being explored to manage concrete emissions. Thus far these have been expensive and involve restructuring of production processes. This interrupts rate of concrete production which may lead to incurred revenue losses.	Increase in operational expenditure may result from the introduction of new technologies. Loss of competitiveness if low-carbon technologies are operationally less profitable and/or if customers continue to use high-emissions technologies. Increase in capital investment may be required to deploy low-emissions technologies in operations.	Impact on borrowers' ability to repay loans due to increased operational expenditure and revenue losses.
				Residential Real Estate	Building homes that use lower emissions substitutes can impact the cost of construction, potentially making it more expensive to build sustainable homes. The use of lower emissions substitutes can impact the rental market by incentivising landlords to invest in sustainable upgrades or to prioritize sustainable properties.		
				Commercial Real Estate	Increasing energy efficiency should be prioritised when designing new buildings as well as retrofitting older properties. There may be added cost associated with optimising for efficiency however these costs would be saved in the long run as energy price increases.		
Transition	Policy and legal	Stakeholder relations	Stakeholders may increasingly focus on climate related matters due to a better understanding of climate risks and increased political and activist positioning.	Construction	Where stakeholder relations are not prioritised, this may impact the ability to attract talent, particularly younger generations who place a higher value on corporate social responsibility and sustainability practices.	Increasing costs of capital, more frequent and more successful litigation, policy change increasing the cost of doing business, a reduction in customers or difficulty in sourcing suppliers who can	Significant increase in operational costs might impact borrowers' ability to repay loans.
				Residential Real Estate	Stakeholder relations can impact access to funding for residential real estate projects. Investors and lenders are increasingly looking for		

Risk information				Operational impact to sector			Flow on impact
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					companies that are taking proactive steps to mitigate climate change risks and improve sustainability.	comply with emissions targets.	
				Commercial Real Estate	Impact on access to funding for commercial real estate projects. Investors and lenders are increasingly looking for companies that are taking proactive steps to mitigate climate change risks and improve sustainability. Companies that do not prioritise stakeholder relations will not be positioned to attract environmentally conscious buyers and investors, potentially leading to decreased property values.		