

APPENDIX 1

The three scenarios at a glance– socio-economic

Requirement	NZCS Reference	Page in this document
Scenario narrative description	NZCS 3, Section 51(a)(i)	11, 14, 17
Reduction pathway and assumption description	NZCS 3, Section 51(a)(iii)	10 - 19

	1.5° Scenario	2.5° Scenario	3.5° Scenario
Summary	Narrow but achievable path towards sustainability	Socio-economic path does not shift from historical trends. Increasing inequality	Increasing competition and regional conflicts put countries on a path towards national and regional security
International cooperation	Effective at national and international levels	Uneven, modest effectiveness	Weak global institutions; national governments dominate societal decision making
Market access and trade	Moderate international trade; connected markets; regional production	Moderate international trade; semi-open globalised economy	Strongly constrained trade; deglobalizing regional security
Policy orientation	Towards sustainable development	Weak focus on sustainability	Towards security
Technology development and transfer	Rapid development and transfer	Medium, uneven development and slow transfer	Slow development and transfer
Environment	Improving conditions over time	Continued degradation	Serious degradation
Climate change	Humanity avoids disruptive climate change	Global climate continues to heat up, with growing direct and secondary impacts	More significant direct and secondary impacts of rising temperatures and sea level
Gross electricity demand (now ~41.5TWh)	70TWh in 2050 (Accelerated Electrification)	63.1TWh in 2050 (Measured Action)	55.6TWh in 2050 (Business as Usual)
Installed generation (now ~9.2GW)	21.8GW in 2050	18.9GW in 2050	14.7GW in 2050

1.5° Scenario Narrative

Global narrative

The world shifts gradually, but pervasively, toward a more sustainable path, emphasizing more inclusive development that respects perceived environmental boundaries. Management of the global commons slowly improves, educational and health investments accelerate the demographic transition, and the emphasis on economic growth shifts toward a broader emphasis on human well-being.

Driven by an increasing commitment to achieving development goals, inequality is reduced both across and within countries. Consumption is oriented toward low material growth and lower resource and energy intensity. Technology is rapidly advancing and shared around the globe. Energy technology is moving away from fossil fuels, towards renewables in combination with higher energy efficiency. Environmental conditions are improving over time, and strong regulations avoid making environmental trade-offs.

Despite these efforts, global temperatures rise by on average 1.7 degrees by mid-century, then slowly dropping to end at 1.4 degrees above the global benchmark of 1900. Direct and second order impacts of climate change grow accordingly, but humanity avoids disruptive climate change.

New Zealand narrative

NZ's Climate Change Response (Zero Carbon) Amendment Act 2019 provided a critical platform for change. Delivering on this promise became a guiding principle of post-COVID 19 economic recovery, as the Government employed the greatest fiscal stimulus package in the nation's history to kick-start a zero-carbon transition.

Though challenging for many sectors, the transformation resulted in one of the world's most sustainable economies with high levels of energy efficiency across industries, robust trade in innovative environmental goods and services, and primary products sought by customers around the world as a direct result of NZ's 'clean and green' reputation.

Because of its location in a temperate zone, NZ's climate is warming up by 0.6 to 0.7 degrees, significantly less than the global average. Still, this increase is paired with a rapid rise in the number of hot days around the country (between 20% and 70%) compared to the 2018 benchmark.

New Zealand sector narrative

Higher demand for electricity is driven by significant and rapid efforts to integrate climate change after years of limited action.

Gross demand is forecast to rise to around 70TWh by mid-century, significantly up from ~42TWh in 2019.

The level of investment associated with this steep growth puts challenges on the electricity sector, exacerbated by enduring global resource shortages and ongoing supply chain issues. It is estimated that by around 2035 the sector needs to fill around 7,500 additional roles to enable the level of change required, on top of another 6,000 roles required to replace workers who are about to retire.

1.5° Scenario

Global perspective

Global Socio-Economic	Shared Socio-economic Pathway	SSP1 – Sustainability (Taking the green road)		
	Global population	~ 8.5 billion		
	Global GDP/Capita	High growth (US\$36k/capita)		
	International cooperation	Effective		
	Institutions	Effective at national and international levels		
	Market access & trade settings	Moderate international trade, connected markets, regional production		
	Policy orientation	Towards sustainable development		
	Technology development & transfer	Rapid development & transfer		
	Energy technology change	Directed away from fossil fuels, towards efficiency and renewables		
	Energy demand	Low, efficiencies diminish demand side		
	Environment	Improving conditions over time		
	Land use	Strong regulations to avoid environmental trade-offs		
Global Climate	Relative Concentration Pathway 2.6	Near-term (2021-2040)	Mid-term (2041-2060)	Long-term (2081-2100)
	Best estimate (°C)	1.5	1.7	1.4
	Very likely range (°C)	1.2 to 1.8	1.3 to 2.2	1.0 to 1.8
	Hot temperature extremes (land)	10-year event: ~4 times as often	10-year event: ~4.5 times as often	10-year event: ~4 times as often
		50-year event: ~ 8.5 times as often	50-year event: ~9 times as often	50-year event: ~8.5 times as often
	Heavy precipitation (land)	10-year event: ~ 1.5 times as often	10-year event: 1.6 times as often	10-year event: ~1.5 times as often
	Sea level rise (global mean)	0.24m (0.17m to 0.32m)		0.44m (0.28m to 0.61m)

1.5° Scenario

New Zealand perspective

New Zealand Socio-Economic	NZ Pathway	Near-term (2021-2040)	Mid-term (2041-2060)	Long-term (2081-2100)
	NZ Population	~5.5 million	~5.9 million	n/a
	NZ GDP	395 billion (+52%)	561 billion (+42% vs 2035)	n/a
	NZ GDP/Capita (NZ\$)	NZ\$71,800 (+41%)	NZ\$95,100 (+32%)	n/a
	NZ GDP/Capita (US\$)	US\$47,800	US\$63,400	n/a
	Gross electricity demand	59.9TWh	70TWh	n/a
	Installed generation capacity	17.4GW	21.8GW	n/a
New Zealand Climate	Relative Concentration Pathway 2.6	Near-term (2021-2040)	Mid-term (2041-2060)	Long-term (2081-2100)
	Best estimate (°C)	n/a	0.6	0.6
	Very likely range (°C)	n/a	0.6 to 0.7	0.6 to 0.7
	Average number of hot days:			
	Auckland (2018: 19.5)	n/a	32 (+64%)	30.7 (+57% vs 2018)
	Waikato (2018: 23.6)	n/a	34.9 (+48%)	33.3 (+41% vs 2018)
	Taranaki (2018: 6.5)	n/a	12 (+85%)	11.1 (+71% vs 2018)
	Wellington (2018: 20.1)	n/a	26.8 (33%)	26.3 +31% vs 2018)
	Marlborough (2018: 14)	n/a	19.7 (+41%)	19.3 (+38% vs 2018)
	Canterbury (2018: 27.3)	n/a	33.5 (+23%)	33.1 (+21% vs 2018)
	Otago (2018: 17.8)	n/a	21.9 (+23%)	21.4 (+20% vs 2018)
	Sea level rise (NZ)	n/a	0.25m	0.5m

2.5° Scenario Narrative

Global narrative

The world follows a path in which social, economic, and technological trends do not shift markedly from historical patterns. Development and income growth proceeds unevenly, with some countries making relatively good progress while others fall short of expectations. Global and national institutions work toward but make slow progress in achieving sustainable development goals.

Environmental systems experience degradation, although there are some improvements and overall the intensity of resource and energy use declines. Global population growth is moderate and levels off in the second half of the century. Income inequality persists or improves only slowly and challenges to reducing vulnerability to societal and environmental changes remain.

The global climate continues to heat up, with mid-century global temperatures increasing by around 2 degrees, resulting in an approximately 2.7 degree increase by 2100 (compared to 1900 global average). Global mean sea level rise likely to exceed 0.5m, causing frequent flooding of low-lying areas in particular in South-East Asia.

New Zealand narrative

NZ's economy continues to grow as the country takes a strong pathway to mitigate climate risk by electrifying transport and industrial heat.

Industry development is less coordinated. Climate change threats motivate stronger policies to reduce climate-changing activities.

NZ's climate is warming up by approximately 0.8 degrees by 2050 and 1.3 to 1.4 degrees by the turn of the century. Sea levels gradually rise to reach just about half a meter above the 1900 benchmark by 2100. The average number of hot days double within that timeframe, with some areas in the country heating up at a significantly higher rate.

New Zealand sector narrative

Higher demand for electricity driven by efforts to reduce reliance on fossil fuels.

Gross demand is forecast to rise to 54.5TWh by 2035/40 and around 65TWh by 2050, up from ~42TWh in 2019.

Rising demand will require an equivalent rise in generation capacity, which in turn will see a level of investment the nation is likely to struggle with.

2.5° Scenario

Global perspective

Global Socio-Economic	Shared Socio-economic Pathway	SSP2 – Middle of the Road		
	Global population	~ 9.2 billion		
	Global GDP/Capita	Medium growth (US\$28k/capita), uneven		
	International cooperation	Relatively weak		
	Institutions	Uneven, modest effectiveness		
	Market access & trade settings	Moderate international trade, semi-open globalised economy		
	Policy orientation	Weak focus on sustainability		
	Technology development & transfer	Medium, uneven development and slow transfer		
	Energy technology change	Some investments in renewables but continued reliance on fossil fuels		
	Energy demand	Grows, but is met by fossil fuel		
	Environment	Continued degradation		
	Land use	Medium regulations lead to slow decline in the rate of deforestation		
Global Climate	Relative Concentration Pathway 4.5	Near-term (2021-2040)	Mid-term (2041-2060)	Long-term (2081-2100)
	Best estimate (°C)	1.5	2.0	2.7
	Very likely range (°C)	1.2 to 1.8	1.6 to 2.5	2.1 to 3.5
	Hot temperature extremes (land)	10-year event: ~4 times as often	10-year event: ~5.5 times as often	10-year event: ~7 times as often
		50-year event: ~ 8.5 times as often	50-year event: ~13.9 times as often	50-year event: ~22 times as often
	Heavy precipitation (land)	10-year event: ~ 1.5 times as often	10-year event: 1.7 times as often	10-year event: ~2.1 times as often
	Sea level rise (global mean)	0.26m (0.19m to 0.33m)		0.53m (0.36m to 0.71m)

2.5° Scenario

New Zealand perspective

New Zealand Socio-Economic	NZ Pathway	Near-term (2021-2040)	Mid-term (2041-2060)	Long-term (2081-2100)
	NZ Population	~5.5 million	~5.9 million	n/a
	NZ GDP	366 billion (+41%)	490 billion (+34% vs 2035)	n/a
	NZ GDP/Capita (NZ\$)	NZ\$66,500 (+30%)	NZ\$83,100 (+25%)	n/a
	NZ GDP/Capita (US\$)	US\$44,300	US\$55,400	n/a
	Gross electricity demand	55.9TWh	63.1TWh	n/a
	Installed generation capacity	15.6GW	18.9GW	n/a
New Zealand Climate	Relative Concentration Pathway 4.5	Near-term (2021-2040)	Mid-term (2041-2060)	Long-term (2081-2100)
	Best estimate (°C)	n/a	0.8	1.0
	Very likely range (°C)	n/a	0.7 to 0.9	0.1 to 1.1
	Average number of hot days:			
	Auckland (2018: 19.5)	n/a	35.5 (+82%)	47.6 (+144% vs 2018)
	Waikato (2018: 23.6)	n/a	37.8 (+60%)	47.8 (+103% vs 2018)
	Taranaki (2018: 6.5)	n/a	13.5 (+108%)	19.7 (+203% vs 2018)
	Wellington (2018: 20.1)	n/a	28.6 (42%)	35.2 (+75% vs 2018)
	Marlborough (2018: 14)	n/a	21.2 (+51%)	27.3 (+95% vs 2018)
	Canterbury (2018: 27.3)	n/a	34.8 (+27%)	40.9 (+50% vs 2018)
	Otago (2018: 17.8)	n/a	22.6 (+27%)	26.8 (+51% vs 2018)
	Sea level rise (NZ)		0.28m	0.55m

3.5° Scenario Narrative

Global narrative

A resurgent nationalism, concerns about competitiveness and security, and regional conflicts push countries to increasingly focus on domestic or, at most, regional issues. Policies shift over time to become increasingly oriented toward national and regional security issues. Countries focus on achieving energy and food security goals within their own regions at the expense of broader-based development. Investments in education and technological development decline.

Economic development is slow, consumption is material-intensive, and inequalities persist or worsen over time. Population growth is low in industrialized and high in developing countries. A low international priority for addressing environmental concerns leads to strong environmental degradation in some regions.

Global temperatures are predicted to rise by up to 2.5 degrees by mid-century and 3.5 by 2100. Global mean sea level rises by approximately 27cm by 2050 and 60cm by the end of the century. The expected impacts of sea level rise on coastal ecosystems over the course of the century include habitat contraction, loss of functionality and biodiversity, and lateral and inland migration. Areas most affected are China, Bangladesh, India, Vietnam, Indonesia, Thailand and Japan.

New Zealand narrative

NZ has been less hard hit by climate change than its neighbours, but it is still ill-prepared for what lies ahead. With short-term thinking continuing to dominate, both public and private sector adaptation is predominantly reactive and predicated on short-term benefit calculations.

Average temperature in NZ rises by around one degree by 2050, compared to 1900 levels. By the end of the century average temperatures could rise to between 2.8 and 3.1 degrees. Significant regional and seasonal differences could lead to average temperatures in regions like Auckland, Bay of Plenty, Taranaki and Nelson/Tasman about 4 degrees higher than in 1900. NZ sea level is predicted to rise by around 0.3m by 2050 and 0.7m by 2100, which is between 5 and 10% more than the global average. This will require alternative strategies rather than incremental ones to mitigate the impact on the land and its people.

New Zealand sector narrative

Demand for electricity is expected to rise steadily until 2050 by around 20%. Peak demand is largely following a similar trajectory. This level of growth is similar to growth levels over the past 20 years (about 1% per year), when total demand increased from around 35TWh to around 42TWh. Installed capacity grew at a slightly lower rate, reaching 14.7GW by 2050.

3.5° Scenario

Global perspective

Global Socio-Economic	Shared Socio-economic Pathway	SSP3 – Regional Rivalry (Rocky Road)		
	Global population	~ 10 billion		
	Global GDP/Capita	Low growth (US\$17k/capita)		
	International cooperation	Weak and uneven		
	Institutions	Weak global institutions, national governments dominate societal decision making		
	Market access & trade settings	Strongly contained international trade; de-globalisation of regional security		
	Policy orientation	Towards security		
	Technology development & transfer	Slow development & transfer		
	Energy technology change	Slow technology change, directed towards domestic energy sources		
	Energy demand	Remains steady. Efficiencies arise via innovation to avoid growing costs		
	Environment	Serious degradation		
	Land use	Hardly any regulation; continued deforestation due to competition over land and rapid expansion of agriculture		
Global Climate	Relative Concentration Pathway 7.0	Near-term (2021-2040)	Mid-term (2041-2060)	Long-term (2081-2100)
	Best estimate (°C)	1.5	2.1	3.6
	Very likely range (°C)	1.2 to 1.8	1.6 to 2.5	2.8 to 4.6
	Hot temperature extremes (land)	10-year event: ~4 times as often	10-year event: ~5.5 times as often	10-year event: ~9 times as often
		50-year event: ~ 8.5 times as often	50-year event: ~13.9 times as often	50-year event: ~38 times as often
	Heavy precipitation (land)	10-year event: ~ 1.5 times as often	10-year event: 1.7 times as often	10-year event: ~2.5 times as often
	Sea level rise (global mean)	~0.27 (0.20 to 0.34)		~0.60 (0.40 to 0.80)

3.5° Scenario

New Zealand perspective

New Zealand Socio-Economic	NZ Pathway	Near-term (2021-2040)	Mid-term (2041-2060)	Long-term (2081-2100)
	NZ Population	~5.6 million (+10%)	~5.9 million (+5% vs 2035)	n/a
	NZ GDP	339 billion (+30%)	428 billion (+26% vs 2035)	n/a
	NZ GDP/Capita (NZ\$)	NZ\$60,500 (+19%)	NZ\$72,500 (+20% vs 2035)	n/a
	NZ GDP/Capita (US\$)	US\$40,400	US\$48,400	n/a
	Gross electricity demand	50.9TW	55.6TWh	n/a
	Installed generation capacity	12.8GW	14.7GW	n/a
New Zealand Climate	Relative Concentration Pathway 8.5	Near-term (2021-2040)	Mid-term (2041-2060)	Long-term (2081-2100)
	Best estimate (°C)	n/a	1.0	2.9
	Very likely range (°C)	n/a	1.1 to 1.1	2.8 to 3.1
	Average number of hot days:			
	Auckland (2018: 19.5)	n/a	39.1 (+101%)	89.7 (+360% vs 2018)
	Waikato (2018: 23.6)	n/a	40.9 (+73%)	84 (+256% vs 2018)
	Taranaki (2018: 6.5)	n/a	15.3 (+135%)	47.7 (+634% vs 2018)
	Wellington (2018: 20.1)	n/a	30.6 (52%)	60.1 +199% vs 2018)
	Marlborough (2018: 14)	n/a	23 (+64%)	51.8 (+270% vs 2018)
	Canterbury (2018: 27.3)	n/a	36.8 (+35%)	62.3 (+128% vs 2018)
	Otago (2018: 17.8)	n/a	23.9 (+34%)	42.3 (+138% vs 2018)
	Sea level rise (NZ)		0.45m	1.1m