Prototype Socio-Economic Scenarios for Climate change Strategic Management

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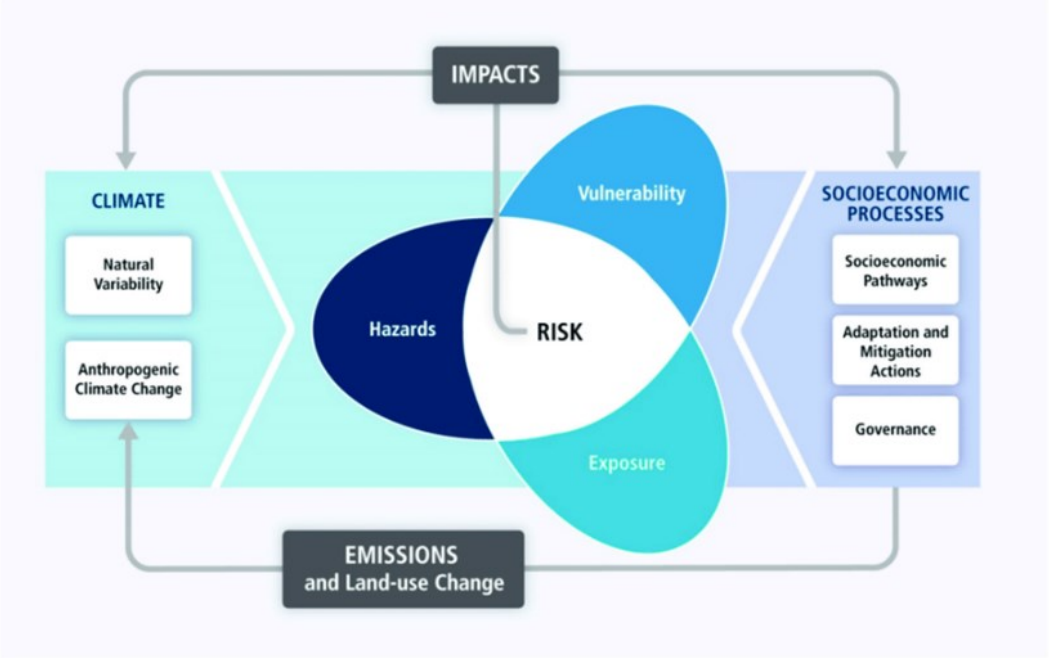

Date: November 2021

Report No: RFP-T016

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1 SUMMARY

Social, economic, and environmental drivers and their interactions are at the root cause of climate change. The interdependencies between drivers create additional impacts, including reinforcing climate change challenges and creating greater uncertainty in the decision-making context surrounding climate change responses. The socio-economic environment is also impacted by climate change, creating feedback loops that reinforce and or balance out impacts – furthermore creating, enhancing, or reducing the harm from climate change. (IPCC, 2012).

This study adapts existing shared socio-economic pathways (SSPs) that provide a global set of five scenarios of how the world, including New Zealand, could respond to climate change mitigation and adaptation challenges.

This research develops a framework for regionalising the global SSPs to the New Zealand context and develops a first draft of prototype scenarios with some specific implications for the forestry sector.

This report provides a set of prototype scenarios that companies, and the sector can use in their strategic management processes and serve as a start point for further scenario development and refinement. The report provides an understanding of external drivers and sources of uncertainties that will be useful in guiding the development of company internal dialogues.

The socio-economic scenarios will be useful to the sector and individual businesses for supporting their medium to longer-term strategic thinking, planning and addressing business and sector needs with respect to adaptability and transformation pathways. As such, scenarios inform strategic management in structured, systematic, and analytical ways, contributing to resilience strategies, and providing the continual exploration of alternative strategies (Task Force on Climate-Related Financial Disclosures, 2017).

A summary of the SSP talking points are given in the following table.

Table E1: SSP interpretations and the implications for the primary sectors

SSPs	Interpretation	Implications for Primary Sector
SSP 1	• The SSP 1 marker scenario is a coherent storyline for sustainable development, with ambitious improvement in resource efficiency, human development, and preferences regarding consumption and production systems within energy- and land-system (van Vuuren, Stehfest, et al., 2017).	• SSP 1 is a utopian vision, with an expectation of increasing prosperity driven by strong demand for agricultural products increasing GDP, allowing social and economic life improvements. • SSP1 is a prosperous and highly technology-led rural sector that focuses on sustainability and efficiencies.
SSP 3	• SSP 3 describes a dystopian world of fragmentation, resulting in low economic growth and low technology development, so when combined with an increasing population, mitigation and adaptation are difficult (van Vuuren, Stehfest, et al., 2017). • SSP 3 leads to high emissions as there is an absence of climate policy that mitigates climate change. SSP 3 is a word of regional rivalry (Fujimori et al., 2017). • SSP 3 is a high fossil fuel dependant world.	• The emphasis is on production in a world with high CO_2 concentrations with resultant high temperatures. • Production systems, water quality and land use will be significantly impacted, and some production systems may not be viable. • Land use in agriculture expands to address the increasing demand for food and overcome lower production efficiencies, hence competing with other land uses, e.g. forestry. • Social, environmental, and cultural consultation is limited to those immediately affected and benefits those with economic resources.
SSP 4: Inequality – A Road Divided	• The SSP4 world has global and within nations inequality and stratification between haves and have-nots. I • Society splits into those who are: well educated, internationally connected, and	• New Zealand is a high-income earning country. Hence impacts will be lessened when compared to poorer countries.

	who drive and develop knowledge and have access to capital or those who are: low income, poorly educated working in labour-intensive and low technology economies.	• NZ role as a primary producer is emphasised. Two opposing national scenarios can be developed based on the distribution of wealth and land. • Farms, forests, and other primary enterprises part of the agri-industrialised sector will prosper, along with their owners/investors and potentially their workers, due to investment, access to technology, assistance with necessary and costly adaptations such as water supply and access to trade and overseas markets. • Extreme events will impact production and profitability, and resilience and adaptive capacity could be low, especially for extreme events that are close together.
SSP 5	• SSP 5 has very high fossil fuel usage, high food usage, a tripling of energy requirements. • CO_2 will increase with a resultant challenge to decrease it. • This world has some international collaborations, trade-dominated economies with a growing focus on sustainable development. • To some degree, adaptation and mitigation are driven by technological solutions or afforestation and policy–emission payments.	• Pursuing a low CO_2 emphasising production, but not at the expense of the environment. • Agriculture still dominates with policy options to manage down agriculture emissions as part of NZ international commitments. • Primary production will prosper, land-based export sectors are protected and valued, and enjoy good returns. • Exporting opportunities and the effects of climate change on primary production supply chains are managed to ensure production. • Climate could limit some land-use practises, either requiring a refocus or some transformational changes. • Environmental and ecological protection is still a component of NZ but can be exploited. • Marginal lands are used for production; irrigation has priority.

2 INTRODUCTION

There is an increased and intensifying societal requirement to understand current and future challenges across economic, social, cultural and environmental domains. The World Economic Forum identifies climate action failure as the number two risk by likelihood and impact, naming climate change a catastrophic risk (World Economic Forum, 2021). Making a case for addressing climate change as a part of a prudent and longer-term risk assessment and management best practice.

Environmental, social, health, economic or cultural shocks impact the socio-economic system over and above direct impacts to forests. For example, the effects of the covid-19 pandemic depressed the global economy by 4.4% (as a reference, the GFC caused a 0.1% contraction) (World Economic Forum, 2021). Snow et al. (2021) found that the forestry sector was significantly exposed to the global impacts of COVID-19. The COVID-19 impact was exacerbated by being compounded with other socio-economic risks, such as the increased log supply from Europe, the Chinese New Year shutdown and lockdown, and the COVID-19 responses made by New Zealand and other countries.

Climate change will have significant impacts on the socio-economic system. Social, economic, and environmental drivers over time and interactions between these drivers are at the root cause of climate change risk and impact, and their interactions will ultimately create further impacts in these domains, reinforcing climate change risk, impact and challenges, and creating additional uncertainty in the risk management context (Figure 1) (IPCC, 2012).

The impact of climate events and threats compound and propagate through socio-economic systems, affecting returns, policy, behaviours, and perceptions, which creates the potential for additional loss and damage beyond the scope of an initiating event. For example, protectionist trade policies can adversely affect business and sector returns through restricted access to products or higher tariffs (e.g. a carbon border adjustment tax).

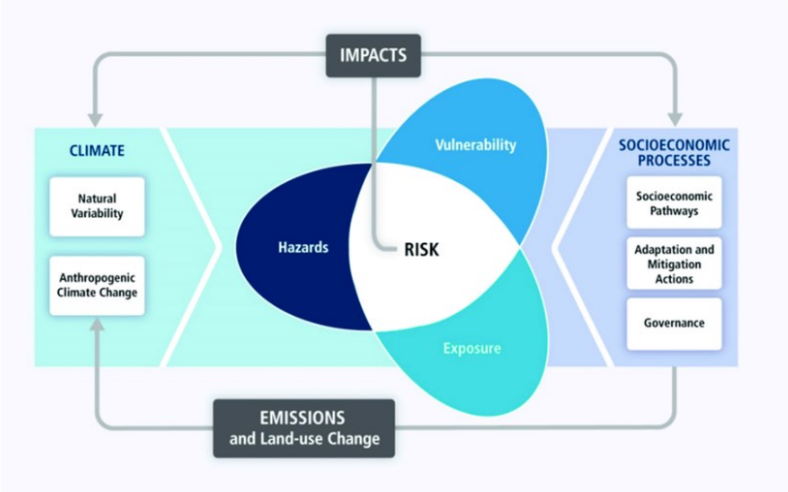

Figure 1:IPCC Assessment Report 5 Conceptual model (IPCC, 2014)

Climate change scenarios can be both narrative and quantitative assessments of future worlds based on various impacts from climate change drivers. Scenarios allow the exploration of the implications of climate change, policy and decision-making contexts, conceptualising what may happen in the future (Pedde et al., 2021).

Scenarios are projections of the future, not predictions (Figure 2). Nevertheless, scenarios help understand sources of risk, the impacts that may occur and provide the basis for developing risk responses: mitigation and adaptation options (B. O'Neill et al., 2017). In addition, they help explore the interactions between human societies and the natural environment (Fujimori et al., 2017).

As an evaluative matrix, three scenario systems are used to understand climate change impacts, adaptation and vulnerabilities assessment (van Vuuren et al., 2013). First, the Representative Concentration Pathways (RCP) are scenarios of global warming (van Vuuren et al., 2011); the Shared Socioeconomic Pathways address social-economic drivers (van Vuuren, Riahi, et al., 2017), and the Shared Policy Assumptions (SPA) address policy (Kriegler et al., 2014).

Different combinations of the RCP, SSPs and SPAs identify outcomes based on the underlying assumptions and projections of climate, socio-economic conditions and policy. A range of analyses can determine the breadth and depth of impacts and the degree of uncertainty. This report focuses on the SSPs and develops an understanding on how future socio-economic scenarios can inform strategic and long-term planning and risk assessment for businesses and the NZ forestry sector.

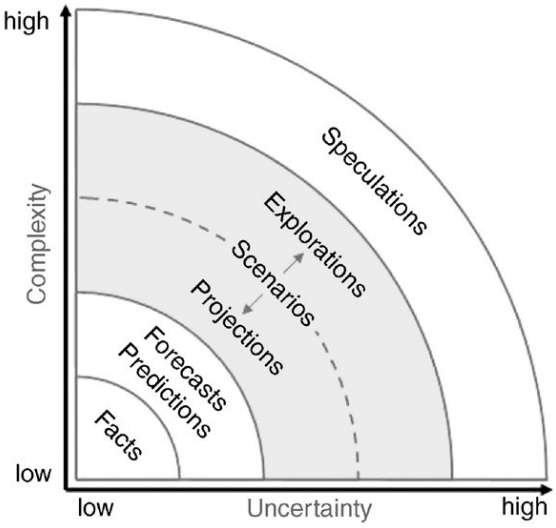

Figure 2: Scenarios can help address uncertainty in complex systems—note that scenarios differ from facts, forecasts, predictions (Zurek & Henrichs, 2007).

2.1 Rationale

This report develops a framework for developing scenarios and undertakes the first steps of framing medium- to long-term scenarios that describe a range of futures for the external environment that forestry systems may encounter.

The changes in the socio-economic elements could impact the policy and operating environment that the sector operates under. For example, land use and water policy, regulations on environmental impacts and protection, the role of forests in mitigation, including carbon pricing and allowable activities, the demand for wood and timber products based on consumer sustainability preferences, and any barriers to trade in logs or forest products may all be impacted by policy or operating conditions, or changes thereto.

Scenarios are a widely used business planning tool for strategic and risk management under complex and uncertain future conditions, allowing companies to understand their performance under different and hypothetical futures. Scenario analysis contributes to developing robust business and sector strategy resilience by:

- Evaluating strategy options against a set of scenarios;
- identifying potential threats or opportunities;
- identifying trigger points to set contingency plans in motion; and
- serving as a basis for continuous monitoring and strategy adjustment

(Task Force on Climate-Related Financial Disclosures, 2017)

3 INTRODUCTION TO THE SOCIO-ECONOMIC PATHWAYS

Socio-economic pathways (SSP) scenarios used in this study are a set of widely different and plausible futures that provide pictures of societal changes that could influence future potential risks and impacts of climate change based on mitigation and adaptation challenges.

Scenarios are quantitative and qualitative storylines that provide data and assumptions. They are trajectories of social development based on the current understanding of drivers that impact the ability to mitigate and adapt. The storylines explain changes to institutions, political stability, changes in understanding – political awareness and environmental awareness.

Four of the SSPs (B. O'Neill et al., 2017; van Vuuren, Riahi, et al., 2017) (Figure 3) describe worlds where societal trends make it either easier or harder to mitigate climate change and easier or harder to adapt to climate change. The fifth SSP is in the middle of the two axes.

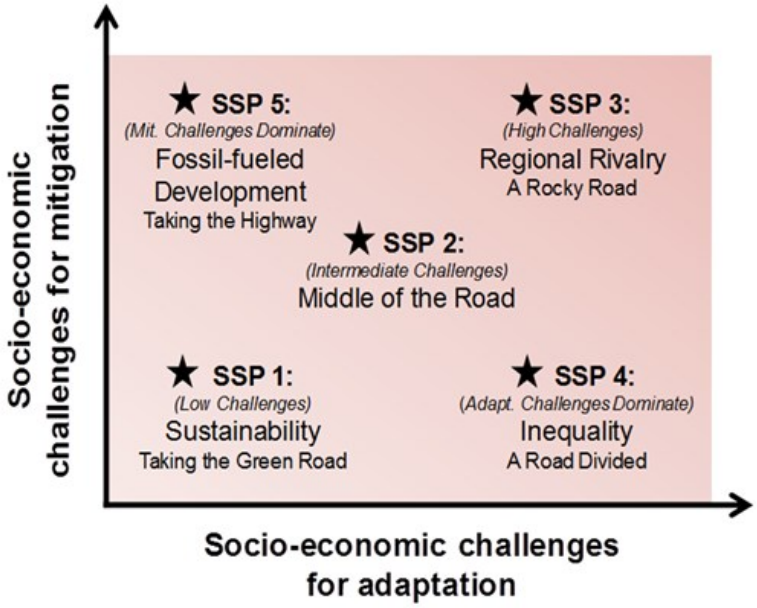

Figure 3: Global SSPs (O'Neil et al, 2012)

3.1 Interpretations of Global and NZ SSPs

The global descriptions of the SSPs have been developed internationally, with narratives in B. O'Neill et al. (2017) which have then been tested with different models to develop marker scenarios (e.g. SSP3. Fujimori et al., 2017) that illustrate a particular SSP.

SSPs are constructed from various socio-economic elements hypotheses as important determinants of climate change mitigation and adaptation challenges. The list of elements and how they vary for SSP 1,3,4,5 are given in Table 2 (SSP2 is an average scenario and is not considered at this stage).

Table 2: Summary of assumptions for elements of the boundary SSPs (1 and 3-5)

Element	SSP 1	SSP 3	SSP 4	SSP 5
Economy and lifestyles				
Economic growth	High in HIC and MIC. Reduced in LIC.	Slow	Low in LICs. Medium in other.	High
Inequality	Reduced across and within countries.	High, especially across countries	High, Esp. within countries.	Strongly reduced, especially across counties.
Globalisation	Connected markets, regional production.	De-globalising, regional security.	Globally connected elites.	Strong globalised, increasingly connected.
Consumption and Diet	Low growth in material consumption, low meat diets, first in HICs.	Material-intensive consumption	Elites: High consumption diets. Rest: Low consumption, low mobility.	Materialism, status consumption, tourism, mobility, meat rich diets.
Population growth	Low	High and medium fertility countries: High Other: Low	High and medium fertility. countries: relatively High Other: Low	Relatively Low
Fertility	OECD: Med	OECD: Low	OECD: Low	OECD: High
Mortality	Low	High	OECD: Medium	Low
Migration	Medium		Medium	Low
Urbanisation Level	High	Low	OECD: Medium	High
Urbanisation type	Well managed.	Poorly managed.	Mixed across and within cities.	Better management over time, some sprawl.
Policy and Institutions				
Env. Policy	Improved management of local and global issues. Tighter regulation of pollutants.	Low priority for environmental issues.	Focus of local environment in MICs and HICs. Little attentions to vulnerable areas or global issues.	Focus of local environment with obvious benefits to well-being. Little concern for global problems.
International Cooperation	Effective	Weak, uneven	Effective for global connected economy, not for vulnerable populations.	Effective in pursuit of development goals. More limited for environmental goals.
Policy orientation	Towards sustainable development.	Oriented towards security.	Toward the benefit of the political and business elite.	Towards development, free markets, human capital.
Institutions	Effective at global and national levels	Weak global institutions/ National government dominate societal decision making.	Effective for political and business elite, not for rest of society.	Increasingly effective, oriented towards fostering competitive markets.
Technology				

Technology development	Rapid	Slow	Rapid in high tech economies and sectors; Slow in others	Rapid
Technology transfer	Rapid	Slow	Little transfer within countries with poorer populations.	Rapid
Energy tech change	Directed away from fossil fuels toward efficiency and renewables.	Slow tech change. Directed towards domestic energy sources.	Diversified investments including efficiency and low-carbon sources.	Directed towards fossil fuels. Alternative sources are not actively pursued.
Carbon intensity	Low	High in regions with large domestic fossil fuel resources.	Low / Medium	High
Energy intensity	Low	High	Low/medium	High
Transport	Lower % spend on transport. Preference for public transport, car-sharing and increases in transport energy efficiency.	Slower reduction in cost. Slower efficiency increases due to slow technological developments. More income is spent on transport. Saturation of transport demand.		
		Slower improvement in efficient technologies. Low access to modern energy.		
Buildings	Lower energy demand. Using more efficient technologies. Rapid phase out of traditional fuels.	High intensity for cement and steel Fuel preference driven by price. Preference for standard technologies.		
Non-energy	Low intensity	High intensity		
Environment and Natural resources				
Fossil fuels / Fossil constraints	Global trade in fossil fuels; median tech development for extraction technologies. Preference to shift away from fossil fuels	Unconventional resources for domestic supply.	Anticipation of constraints drives up prices with high volatility.	None
Environment	Improving conditions over time.	Serious degradation.	Highly managed and improved near high or middle incomes living.	Highly engineered approaches. Successful management of local issues.
Bio-energy	Traditional biofuels are gone by 2030. Biofuel has a biodiversity tax. High yields. Improved efficiencies and costs of production technology.	Traditional biofuels phase-out slower. Lack of reserves increased potential land. Lower yields.		

		Low efficiencies and high costs of biofuel production technologies.		
Renewables		Slow technology development.	High cost.	
Land use change regulation	Strong Protected areas growth. c. 30% unavailable for agricultural production. Strong regulations to avoid environmental trade-offs.			
Crop Productivity	Strong, crop yield increases as a function of GDP, big increased irrigation efficiencies.	Low - crop yield increases as a function of GDP. Irrigation efficiencies low.	HIC: Technology improvements drive productivity.	
Livestock productivity	Efficiencies up from (SSP 2) by 50%.	No efficiency gains over 2017.	HIC: Technology improvements drive productivity.	
Environment impact of food production	Low. Consumption of animal products 30% lower. Food waste reduction (33%).	High consumption of animal product increases. Food waste increase (33%)		
Trade in agricultural commodities	Limited to no tariffs and export subsidies. Focus on regional trade.	Import tax by 2050 to protect self-sufficiency.		
Human Development				
Education	High	Low	OECD: Medium / unequal	high
Health investment	High	Low	Medium in HICs	High
Access to health, water, sanitation	High	Low	Medium in HICs	High
Gender equality	High	Low	Medium in HICs	High
Equity	High	Low	Medium	High
Social cohesion	High	Low	Low, stratified	High
Societal Participation	High	Low	Low	High

(Country groupings are World Bank definition for High-Income Countries (HIC), Medium Income Countries (MIC), and Low-Income Countries (LIC)) (Calvin et al., 2017; Fricko et al., 2017; Fujimori et al., 2017; Kriegler et al., 2017; B. C. O'Neill et al., 2017). (NB: not all SSP marker scenarios provided descriptions of elements)

4 REVIEW OF THREE REGIONAL / SECTORAL SCENARIOS

The SSPs are global in nature, but elements will have different proprieties and impacts for regions, countries, and sub-national areas and sectors. This section reviews three examples of downscaling SSPs to country, downscaling to the EU region focusing on implications for agriculture, and assessing specific drivers for the global forestry sector. The aim is to document the different drivers that the three processes identified, stimulate critical thinking on key drivers for forestry companies and the sector and provide examples of how the drivers change under different scenarios.

4.1 UK-SSPs

The UK Climate Resilience Strategic Priority Fund (Met Office, UK) funded an 18-month project to develop UK socio-economic scenarios for climate vulnerability, impact, adaptation and services research and policy[1] based on the Shared Socioeconomic Pathways (SSPs) and Representative Concentration Pathways (RCPs). The programme produced:

- narratives for all five SSPs for the UK and its countries;
- tables of semi-quantitative trends for a wide range of socio-economic indicators;
- quantifications for specific indicators at the appropriate temporal and spatial resolution depending on user needs; and
- a set of interactive visualisations that show the interrelationships between the key drivers represented in the scenarios and ensure internal consistency in their future projections. (UK-SSP Consortium, 2020)

The key drivers that were determined as important and central to creating the uncertainty used for defining the socio-economic development of the UK over this century are shown in Table 3.

Table 3: UK-SSP Socio-economic drivers of climate risk (Harrison, Harmáčková., & Pedde, 2020).

UK-SSP Driver	Range from	
Driver 1: UK/Devolved Administration Policy & Governance	Devolved	Centralised
Driver 2: International relations	Protectionist	Globalised
Driver 3: Response to global shocks	Persistence	Transformative change
Driver 4: Public attitudes	Disillusioned, disempowered	Engaged, empowered
Driver 5: Social structure	Privileged (few)	Egalitarian (many)
Driver 6: Natural resources	Resource friendly, sustainable use	Over-exploitative, unsustainable use
Driver 7: Technology	Slow	Rapid
Driver 8: Education	Low investment	High investment
Driver 9: Demography	Lower proportion of people >65	Higher proportion of people >65
Driver 10: Energy	Low-carbon	High-carbon
Driver 11: Food	Low-meat diet	High-meat diet
Driver 12: Economic development	Traditional market-based systems	Novel economic systems
Driver 13: Health	Low investment	High investment
Driver 14: Transport & mobility	Low mobility	High mobility

[1] https://www.ukclimateresilience.org/news-events/introducing-socio-economic-scenarios/

4.2 Agri-SSP (EU)

The Eur-Agri-SSPs[2] summarise how the agricultural and related sectors may evolve until 2050 in Europe, given the inherent uncertainties about the future. The storylines support scientific (e.g. quantitative modelling, qualitative scenario studies) and applied (e.g. policy planning) applications that consider future agricultural sector conditions[2].

The storyline elements and how they change for each SSP are given in Table 4.

Table 4: Socio-economic climate change drivers for European Agriculture

	SSP 1 Sustainability	SSP 2 Middle of the road	SSP 3 Regional rivalry	SSP 4 Inequality	SSP 5 Fossil-fuelled development
	Social and environmental awareness rise continuously, environmental policies are strengthened, and consumption patterns are gradually adjusted to European agricultural production potentials which benefit from green technology innovations.	The agriculture and food systems develop on established paths. The slowly growing domestic demand for agricultural and food products can be satisfied because resource-efficient technologies and environmental protection are developed at a moderate pace.	A climate of mistrust and rivalry prevails and results in a renationalisation process of policies, more severe trade restrictions, slow technological progress and, overall, increasing pressure on land resources.	A business-oriented, wealthy upper class, dominates agricultural and food supply chains determine technology development and uptake, and pushes policy development to support economic growth, whereas a large group of people are socioeconomically deprived	Material-intensive lifestyles and large private investments in technological progress and education boost economic growth, also in the agricultural and food sectors, while public payments are cut back to conform with liberalised markets.
Demand for meat in EU	Low	Medium	High	Elites: high; Rest: low	High
International Trade	Moderate	Moderate	Strongly constrained	Moderate	High, with regional specialization in production
Land productivity growth	High improvements in agricultural productivity; rapid diffusion of best practices	Medium pace of technological change	Low technology development	Productivity is high for large scale industrial farming, low for small-scale farming	Highly managed, resource-intensive; rapid increase in productivity
Feed import	Low	Moderate	Low	High	Moderate
Meat production	Low	Moderate	High	Moderate	High
Feed production	Moderate	Moderate	High	Moderate	Moderate
Agricultural prices	Relatively high	Moderate	High	Relatively low	Low

[2] https://eur-agri-ssps.boku.ac.at/

Price volatility	Moderate	Moderate	Low in EU	High	High
Land availability	Low	Moderate	Low	High	High
Labour availability	Moderate	Moderate	Low	High	High
Food industry structure	Mixed	Mixed	SMEs	Multinationals	Multinationals
Vertical coordination	High	Moderate	Low	Mixed	Low
Food waste	Low	Moderate	High	High	High
Consumption trends	Healthy, natural and sustainable	Mix	Origin	Slenderness	Diversity

4.3 Forest Sector Pathways

Daigneault (2019) and (Daigneault et al., 2019) extended the global SSPs with five Forest Sector Pathways (FSP), providing details on forest management, regional forest area, ecological sustainability, technological change, forest carbon, forest bioenergy expansion, and forest product consumption. Daigneault (2019) suggested the following drivers affect the *global* forestry sector:

1. Land-use regulation.
2. Forest productivity growth
3. Environmental impact of forestry activities.
4. International trade of forest products.
5. Forest-specific mitigation policies.
6. The efficiency of timber processing and wood use.
7. Consumption of primary and secondary forest products.
8. Forest carbon pricing and mitigation.

Table 5: Overview of key elements of FSPs for each corresponding Shared Socio economic Pathways (SSPs) (Daigneault et al., 2019), with some 'straw person' implications for NZ forestry.

Element	FSP 1	FSP 2	FSP 3	FSP 4	FSP 5
Land-use change regulation	Strong regulation to avoid damages to the environment	Medium regulation; focused on reducing of deforestation	Limited regulation; continued deforestation	Highly regulated in MICs and HICs; lack of regulation in LICs lead to high deforestation rates	Medium regulation; slow decline in the rate of deforestation
NZ Forestry	Strong regulation		Some regulation, production priority Competition for land		
Forest productivity growth	High improvements in forest plantation productivity and forest management; rapid diffusion of best practices	Medium increase of productivity in managed forests and plantations	Very low productivity development	Forest productivity is high in HICs, low in LICs	Highly managed, resource intensive; rapid increase in productivity
NZ Forestry	High improvement		Productivity reduces, lack of investment	High improvement	High improvement
Environmental impact of forestry activities	Reduced harvest intensity in non-plantation forests, emphasis on conservation of environmental values. Increased areas set aside from forestry activities	Medium environmental impacts from forestry activities	Intensive harvests increase the stress on biodiversity and other environmental values	HICs: strong regulation ensures adequate set-asides and environmental considerations; MICs and LICs: negative impacts on the environment through poor control	Intensive harvests cause more stress to the environment, but moderate level of regulation and set-asides reduces the harmful impacts
NZ Forestry	RMA limits areas for clear cut forests		Production focus, some environmental protections removed FSC/PEFC depreciated		
International Trade	Moderate	Moderate	Strongly constrained	Moderate	High, with regional specialisation in production
NZ Forestry	As is now		High degree of protectionism, trade is a pollical tool		
Globalisation	Connected markets, regional production	Semi-open globalised economy	De-globalizing, regional security	Globally connected elites	Strongly globalised
NZ Forestry			Largely impacts on trade, fine balancing line between		

			trading partners and traditional allies The impact is dependent on country exposure		
Land-based mitigation policies*	No delay in international cooperation for climate change mitigation. Full participation of the land-use sector	Delayed international cooperation for climate change mitigation. Partial participation of the land-use sector	Heavily delayed international cooperation for climate change mitigation. Limited participation of the land-use sector	No delay in international cooperation for climate change mitigation. Partial participation of the land-use sector	Delayed international cooperation for climate change mitigation. Full participation of the land use sector
NZ Forestry	Forests are the core component of mitigation Agriculture is in ETS or equivalent		The role of carbon forests is dependent on local policies only (no international pressures on e.g., NDC)		
Efficiency of wood use (cascading, recycling, new materials, technical development)	High, with rapid development of new technologies for bio-based materials	Medium	Low, with a primary focus on local technology	Medium-high in HICs; Low in LICs	High, with rapid development of new technologies, and regional specialisation. Medium cascading and recycling
NZ Forestry	New technologies provide additional value chains Competition for wood/timber products May drive local processing May drive export wood product value add		The trading environment still forces a commodity product and pricing		
Forest Product Consumption	Decreased overall consumption, with a high share of wood-based materials	Medium, following historical trends	High total consumption, emphasis on conventional products	Medium, following historical trends with LICs relying heavily on firewood as an energy source	High overall consumption, with moderate share of wood-based materials and fuel
	Wood is the sustainable material Consumption is variable across the world as HIC populations age, housing demand reduces				

5 FRAMEWORK TO DEVELOP FORESTRY FOCUSED SSPS

The framework developed in this study is based on the EU Impressions programme (Kok & Pedde, 2016). Only Step 1 was undertaken in this research reported here.

1. Develop baseline narratives based on the global scenarios and informed by methods used in the development of other national and sector-based scenarios. This step has no stakeholder participation, and expert input is limited to published material.

The next stages expand engagement based on the drafted storylines and interpretations and could be completed at a later date:

2. Workshop 1 (Domain and SSP Experts)

    a. Build legitimacy,
    b. Refinement of narratives,
    c. Identify other key uncertainties,
    d. Develop qualitative trends for variables.

3. Intersessional

    a. Questionnaires confirming understanding and trends
    b. Narrative iteration
    c. Optional – mini-workshops

4. Impacts analysis

    a. Quantitative modelling of impacts. e.g., productivity or land use.

5. Workshop 2 – Stakeholders

    a. Link with Climate change scenarios (RCPs)
    b. Revise elements
    c. Contextualise adaptation and mitigation pathways

6. Impacts analysis updates

6 CASE STUDY: NZ PROTOTYPE BASELINE SHARED SOCIO-ECONOMIC PATHWAYS

This section unpacks the SSP narratives and other expert guidance to understand potential scenarios for New Zealand. The following narratives [3](italics) (B. O'Neill et al., 2017) for each SSP are the baseline global narratives that have been interpreted for New Zealand and the forestry sector.

6.1 SSP 1

6.1.1 Narrative

> *The world shifts gradually, but pervasively, toward a more sustainable path, emphasising more inclusive development that respects perceived environmental boundaries. Increasing evidence of and accounting for the social, cultural, and economic costs of environmental degradation and inequality drive this shift.*
>
> *The combination of directed development of environmentally friendly technologies, a favourable outlook for renewable energy, institutions that can facilitate international cooperation, and relatively low energy demand results in relatively low challenges to mitigation. At the same time, the improvements in human well-being, along with strong and flexible global, regional, and national institutions imply low challenges to adaptation. (O'Neil et al 2015, supporting information)*

6.1.2 Interpretation for NZ

The SSP 1 marker scenario is a coherent storyline for sustainable development, addressing reasonably ambitious improvement in resource efficiency, human development, and preferences regarding consumption and production systems within energy- and land-system (van Vuuren, Stehfest, et al., 2017).

The scenario assumes that there are no or limited barriers to effective mitigation and adaptation due to the developments in technology and governance. SSP 1 emphasises the use of environmentally friendly technologies, a transition to less resource-intensive lifestyles, an increasing global GDP coupled with a decline in population post-2050. Technology improvement and efficacies drive down the cost of technologies such as PV and electric batteries.

This scenario arises out of public awareness of the importance of sustainability and the environment and the impact of re-occurring and increasing natural and environmental disasters on well-being. As a result, the public is empowered, and with increased authority (e.g., wellness mandate), local and regional councils develop and act on demands for sustainable futures. Furthermore, the public awareness and expectation empowers public engagement of societal and environmental impacts of natural capital-based businesses and having real involvement in reputational capital and social licence to operate, including analyses and understanding of the role of foreign capital in land sector businesses.

GDP growth is increasing with overall higher income levels; hence, the public can choose sustainable products, processes, and businesses.

New Zealand is still a major trading nation, where success builds on its real environmental credentials. Water, sensitive land, biodiversity is highly protected, and production practices are regulated to ensure high sustainable credentials. While exports are still largely animal, plant and fibre based, and where meat and dairy are marketed

[3] The narratives are located in the extra material associated with the published paper (B. O'Neill et al., 2017)

as high-end and high welfare sustainable niche products, there is also growing diversity of products including plant-based protein, and diversification of land-use, including novel land use to remediate and protect land and water. NZ will have opportunities to export as other nations (e.g. central America, Africa, India) grow their middle and elite classes.

Internationally, agricultural land use will reduce. In New Zealand, the slow transition to high-end niche meat and dairy products will either neutralise or increase agricultural land use. Land use in horticulture and crops will increase to demand for local produce and more healthy diets. GMO technology is adopted as other countries gain a competitive advantage, drive increases in agriculture, horticulture, and forest productivity, address direct climate impacts (e.g. disease resistance), and reduce fertiliser use.

Water use fundamentally changes with less reliance on irrigation systems, and iwi prioritises river and lake health.

Housing and building are redesigned, building on the nascent energy-efficient programmes, retrofitting of older houses, and reducing the use of concrete in construction. In addition, the emission treatment of harvested wood products means that CO_2 capture is recognised.

Transport continues as now envisaged, with reliance on electric or alternative fuelled vehicles. Densification of larger urban centres incentives public transport, but the long-thin nature of New Zealand geography still requires an efficient highway system for the transport of freight, with an enhanced rail system.

There is an increased demand for electricity, which is somewhat offset by energy efficiencies and changes in lifestyles. The electricity increase will be generated from renewables and local house systems. In addition, there are options for bio-energy, especially for high point-based energy demand businesses and where feedstock can be co-located.

Climate policies (i.e., those that are focused on reducing CO_2) are implemented by a carbon price, which is an indicator of how hard it is to meet specific forcing levels. SSP 1 means that both RCP 2.4 and 4.5 are relatively easily met with either a low or modest carbon price. The caveats are that there is a strong international collaboration and favourable technology development and lifestyle changes.

SSP1, when coupled with the lower emission targets, especially targeting a maximum 1.5C increase, requires negative emissions, so there will be a large investment and returns for carbon capture technologies.

6.1.3 Interpretation for NZ Forestry

The major storylines are

- Competition for productive land
- Strong public environment ethos increases the requirement for robust social license / reputational capital programmes
- Sustainability drivers could develop policy that limits log exports towards higher-value products
- Opportunities in the local market will arise from sustainable construction (i.e. limited concrete) and biofuels and other bio-products (e.g. bio-plastics)
- Demand for marketed sustainable wood products internationally will grow,

6.2 SSP 3

6.2.1 Narrative

> *A resurgent nationalism, concerns about competitiveness and security, and regional conflicts push countries to increasingly focus on domestic or, at most, regional issues. This trend is reinforced by the limited number of comparatively weak global institutions, with uneven coordination and cooperation for addressing environmental and other global concerns.*

*Growing resource intensity and fossil fuel dependency along with difficulty in achieving international cooperation and slow technological change imply **high challenges to mitigation**. The limited progress on human development, slow income growth, and lack of effective institutions, especially those that can act across regions, implies **high challenges to adaptation** for many groups in all regions.*

6.2.2 Interpretation for NZ

SSP 3 describes a world of fragmentation, resulting in low economic growth and low technology development so when combined with an increasing population, mitigation and adaptation are difficult (van Vuuren, 2017). SSP 3 has a high degree of challenge that consists of factors that lead to high emissions in the absence of climate policy and factors that tend to reduce society's ability to mitigate climate change (Fujimori 2017). SSP 3 is a word of regional rivalry with high trade barriers (O'Neil, 2017).

Countries develop policies that are identity based and focused on national (physical and economic) security. The lack of international collaboration on climate change and weakened international organisations limit economic growth, especially in developing countries; The SSP provides for low investment in education and low technological development. Hence, economic growth is resource-intensive with low increases in energy efficiency and agricultural production efficiencies, or growth can be pursued through increasing land in production, increasing deforestation.

Government is responsive to the needs of export earners. Hence the drive for more growth relaxes environment policies and protection and limits investment in resource efficiencies. Trade barriers are strengthened, relying on in-country resources; government budgets are focused on production, local manufacturing and building trading relationships, reducing or putting the social welfare system at risk, and health and retirement protections. There is a relaxation of some externally imposed food safety standards, e.g. chemical use. ACC is reduced in scope and benefits. There are inequities, especially for rural settlements and Maori and service cuts. There is an emphasis on the exploitation of mineral resources.

With the relaxation of environmental protections, water quality declines to the extent that potable water quality is reduced, and river systems flow, and quality are impacted. There is tension between larger water takers (e.g., agriculture, electricity generation, and large industrial uses). Recreational and iwi interests are depreciated to the national interest.

Internal migration will increase to the 3-5 larger cities but not to the extent of other countries, but still increasing peri-urban land and housing demand.

Trading relationships dominate foreign policy, including inward investment, protections, immigration, and labour standards.

As in SSP 1, land use is driven by food demand, with the trends in population and welfare increasing food demand. Yield improvements are limited due to low technology developments, increased competition for land increased yield improvement but through low technology improvements. Local food demand increases due to limited imports (as other countries treat food products strategically, or as NZ protects local industry). Agriculture demand increases to feed NZ placing pressure in land use and with an additive effect of requiring more land for feed (lack of imports) and low productivity.

SSP 3 emissions increase over the 21st century, mostly driven by energy-related CO_2 emissions. Marker scenario shows a warming of 4C by 2100(Fujimori et al., 2017; van Vuuren, Stehfest, et al., 2017).

6.2.3 Interpretation for NZ forestry

This scenario is dystopian, with potential negative impacts for the whole primary sector. The emphasis is on production in a world that could have a high CO_2 concentration (RCP 7.0[4]) with resultant high warming. Impacts from increased atmospheric CO_2 and temperature will significantly impact production systems, water quality and land use. Some production systems may not be viable.

Prosperity in NZ is uneven. It is expected that regions will suffer. Forestry technology improvements are limited, leading to low growth in production efficiencies, and there is a lack of access to new technologies due to rigorous and enforced IP. Land use in forestry is highly competitive, with strong completion for increasing demand for food. Though, this can be offset by the local albeit small ongoing demand for timber and fibre products. There could be an investment in local processing of core building material, e.g. EWP, pulp and paper, to reduce import demand and protect supply chains. These industries will see some degree of trade protection.

Those people that have land in food production will be well off compared to others. New Zealand is a trade food producer, though competing against producers with significant state support in a more cut-throat world. This will lead to policies those offer subsidies, remove environmental constraints to production, and increase productive land use.

Decision making is expected to serve the privileged address their largely business and wider economic interests.

Consultation for social, environmental and cultural aspirations and values is limited to those immediately affected and is inequitable, benefiting those with economic resources. In addition, Treaty of Waitangi institutions roles are limited and depreciated under the national [economic] security focus.

There is limited investment in people, in health and education and opportunities.

6.3 SSP 4: Inequality – A Road Divided – Low challenges to mitigation and High challenges to adaptation

6.3.1 Narrative

> *Highly unequal investments in human capital, combined with increasing disparities in economic opportunity and political power, lead to increasing inequalities and stratification both across and within countries. Over time, a gap widens between an internationally-connected society that is well educated and contributes to knowledge-and capital-intensive sectors of the global economy, and a fragmented collection of lower-income, poorly educated societies that work in a labour intensive, low-tech economy.*
>
> *Environmental policies focus on local issues around middle and high-income areas. The combination of some development of low carbon supply options and expertise, and a well-integrated international political and business class capable of acting quickly and decisively, implies **low challenges to mitigation**. Challenges to **adaptation are high** for the substantial proportions of populations at low levels of development and with limited access to effective institutions for coping with economic or environmental stresses.*

[4] RCP7.0 is a new forcing level scenario that will be used in the next IPCC report. There are no New Zealand data for this scenario.

6.3.2 Interpretations for NZ

Mitigation challenges are low, due to the technology and expertise that is the forefront of this world. But, the drive to reduce emissions will arise from business and only when it is in their interests to develop and apply climate policies.

Adaptation challenges are high due to the inequities that are present in this world. For example, wealthy people can insulate themselves from climate impact, but the poorer populations have less access to effective institutions that could ameliorate economic and environmental stress.

The SSP world is one characterised by global and within nations inequality. It arose from a class of future scenarios called barbarisation. From the global narrative (B. C. O'Neill et al., 2017), there is inequality and stratification between haves and have-nots, entrenched through high levels of unequal investment in human capital, increased economic opportunities, and political power disparities.

Society resolves into those who are: well educated, internationally connected, and who drive and develop knowledge and have access to capital or those who are: low income, poorly educated working in labour-intensive and low technology economies.

As expected, power is held by the elite even in democratic societies where the 'poor' have limited representation or the capacity to achieve it. Globally, 'extreme poverty, income inequality, and lack of opportunity lead to environment ills especially for the poor' (Calvin et al., 2017). As there is wealth and power in the elite segment, they can invest in mitigation, and technologies 'should the will to do so materialise' (Calvin et al., 2017, p. 285). Hence, poverty and lack of access to technologies make it hard for the poor to adapt to climate change.

The marker scenario shows that the population decreases for high- and middle-income regions (HIR, MIR). As a result, HIR's become more prosperous. The opposite is for low-income regions. This with population growth, but with no means for increasing income. These differences between the different strata will drive different demands for food, energy and how demand is met.

How this plays out for NZ depends on whether the regions benefit from a world that requires food, provides economic returns to agriculture, or whether cities dominate economic growth and trade.

6.3.3 Interpretation for forestry

New Zealand is a high income earning country; hence impacts will be lessened compared to poorer countries. NZ role as a food producer is emphasised. This is a scenario where two opposing national scenarios can be developed based on the distribution of wealth and land.

Farms, forests and other primary enterprises that are part of the agri-industrialised sector will prosper, along with their owners/investors and potentially their workers. This is due to investment, access to technology, assistance with necessary and costly adaptations such as water supply and access to trade and overseas markets. However, whether the towns benefit will depend on where large companies purchase goods and services.

Forestry companies that are not part of the elite will struggle as they will have to face the severe impacts of climate change in an environment of inequality, limited access to technology and information, and probably poorer returns. In addition, extreme events will impact production and profitability and resilience, and adaptive capacity could be low, especially for extreme events that are close together.

Inequality rules this world. Hence the impacts of climate change, especially at high RCPs will have detrimental effects on local communities.

6.4 SSP 5: Fossil Fuelled Development

6.4.1 Narrative

> *Driven by the economic success of industrialised and emerging economies, this world places increasing faith in competitive markets, innovation and participatory societies to produce rapid technological progress and development of human capital as the path to sustainable development. Global markets are increasingly integrated, with interventions focused on maintaining competition and removing institutional barriers to the participation of disadvantaged population groups.*
>
> *The strong reliance on fossil fuels and the lack of global environmental concern result in potentially **high challenges to mitigation**. The attainment of human development goals, robust economic growth, and highly engineered infrastructure results in relatively **low challenges to adaptation** to any potential climate change for all but a few.*

6.4.2 Interpretation for NZ

SSP 5 is a world that is energy and resource-intensive, derived from very high fossil fuel usage, high food usage, a tripling of energy requirements. Under this scenario, CO_2 will increase with a resultant challenge to decrease them. The population will increase then decline, and there is rapid human development and growth in income convergence, coupled with an inclusive and globalised economy. The high challenge to adaptation means that adaptive capacity is high and grows (Kriegler et al., 2017).

This world is somewhat like the world over the last 30-50 years, with international collaborations and trade dominated economies focusing on sustainable development.

Depending on attitudes to climate change mitigation and appropriate technologies, there could be limited CO_2 increases. To some degree, adaptation and mitigation are driven by technological solutions or afforestation and policy–emission payments.

SSP 5 is the opposite of SSP 4. This is a world that is driven by the intensive use of fossil fuels.

6.4.3 Interpretation for the forestry

Pursuing a low CO_2 would mean that the focus is like the current emphasis on production, but not at the expense of the environment. Agriculture still dominates in the medium CO_2 world but with policy options to manage down agriculture emissions as part of NZ international commitments.

Primary production will prosper, land-based export sectors are protected and valued and enjoy good returns.

Agriculture, forestry and other major export earners are protected and enhanced.

Exporting opportunities and the effects of climate change on primary production supply chains are managed to ensure production

Changes in climate-related risks, such as increases in pest and disease outbreaks, increases in flooding/storms, etc all would require adaptive measures to prevent or react to, requiring capital and cash. Impacts can affect infrastructure, e.g. roads, or land and community and private assets, e.g. sea-level rise. Where there are economic benefit adaptation measures are well funded, though land-use is market-driven.

Over time (decadal), the climate could limit some land-use practises, either requiring a refocus or some transformational changes. On the other hand, climate change may increase opportunities for other production systems to thrive.

Water supply is expected to be a valuable commodity, with limitations on supply and restricted access.

There is no restriction for using mitigative energy sources. However, sector inclusion in any ETS is driven by trade requirements and limited competitive disadvantages with trade competitors.

Institutions and governance are focused on both production and strong investments in health, education, and institutions to enhance human and social capital.

Adaptation funding is oriented to protect production and include welfare issues, especially for more wealthy neighbourhoods/communities.

Economic activity rules. Environmental and ecological protection is still a component of NZ but can be exploited. Marginal lands are used for production, and irrigation has priority.

7 DISCUSSION: USING SCENARIOS IN STRATEGIC MANAGEMENT

Scenario analysis is commonly used as a risk management tool in strategic thinking, planning, and risk management by companies (and the sector). However, climate change challenges strategic risk assessment largely due to uncertainties in how economic, ecological, social systems are impacted over time and space and how impacts propagate, amplify or suppress effects. Hence, methods are required that are more forward-looking and can cope with uncertainty.

The scenarios story points and the implications identified are not predictions but are starting points for companies to evaluate, sift, modify or reject to suit their purposes.

Scenarios:

1) Allow a focus on key uncertainties that the company deem, through analysis, that are relevant to their strategic decision making,
2) Avoid the impossible task of trying to predict the future,
3) Through company analysis and consideration, develop new perspectives and change mental models based on a range of plausible but hypothetical worlds. Determining how risks and opportunities can develop under different circumstances and understanding the longer-term business impacts.

Strategic thinking "seeks innovation and to imagine new and very different futures that may lead a company to redefine its core strategies" (Task Force on Climate-Related Financial Disclosures, 2017). Scenarios provide thought pieces on changes in external drivers and uncertainties, particularly in the socio-economic environment. Some questions that scenarios help answer include:

- Do the companies value chains still provide value under each scenario? What are the trends that could reduce the value proposition?
- How do you see drivers changing the market, bottlenecks that appear, or new opportunities? How are you placed compared to competitors?
- Do the current strategy and value propositions, policies, products and capabilities prepare the company for the different possible futures described in each scenario? What is more at risk?
- Does the current strategy look sound across the different scenarios? Why?

In the strategic planning phase, scenarios can be used to build resilience by evaluating options against scenarios:

- Do the proposed strategies address impacts and risks that occur across multiple scenarios or just one?
- What options generate the moist value by scenarios?
- Are there options to capitalise on high return options but have resilience for any scenario where the opportunity has higher risks of failure?
- Are there options that create value across all scenarios?

Scenarios can be enhanced by including other drivers or elements. For example, STEEP driving forces (

Table 6) analysis can identify more company-specific drivers.

Table 6: STEEP components (Task Force on Climate-Related Financial Disclosures, 2017)

Driving forces	Components
Social	• Social/Lifestyle Factors • Demographic Patterns • Health & Education Trends • Civil Stability & Tensions
Technology	• Research Trends • Emerging Technologies • Technology Diffusion
Economic	• Macroeconomic Trends • Microeconomic Trends • Regional/National Variations • Financial Capital Trends • Trade Rules/Protectionism
Environment	• Ecosystem Trends • Energy • Climate/Weather Trends • Waste Disposal • Pollution • Land Use
Political	• Policies • Laws/Regulations • Court Decisions • Political Attitudes

8 CONCLUSIONS

Climate change has far-reaching implications for businesses and the sector, beyond just the direct physical impacts of a changing climate and extreme events. The uncertainty of degree, spatial and temporal distribution of climate change impacts and implications, along with cascading risk (that cause impacts beyond forestry) and compound risks (new risks that develop when multiple risks interact), the nonlinear behaviour of people and systems, delayed feedbacks (e.g., the large time delay between mitigation actions and changes in atmospheric CO_2 concentrations), means that traditional business planning methods are not suitable.

The baseline SSP scenarios presented here are the first steps in assisting companies and the sector to use scenarios as part of their risk management and strategy formulation processes as well as fundamentally providing the understanding of broader factors that provide insight into how businesses or the sector might perform under future potential climate worlds. Ultimately, this should result in better strategic decisions and improve long-term resilience.

Further steps are required to develop scenarios fully and are detailed in the framework.

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10 APPENDIX: KEY FACTORS BEHIND EACH SCENARIO THAT AFFECT THE FORESTRY SECTOR

This appendix discusses the implications for forestry based on how the SSPs could impact four socio-economic drivers.

- Population affects demand for products.
- Land use change policies or market pressures can affect land prices and land availability for forestry, e.g. food security or the degree of environmental protection.
- Trade access can be influenced by the degree of international cooperation, where countries can introduce trade policies that protect their interests rather than collaborate on global mitigation.
- Consumption is an example of a megatrend that impacts the food sector but can have implications for forestry from increased demand for land and the behavioural determinants that drive food choice, which can also influence consumer demand for wood products and provide opportunities for sustainable products.

10.1 Population

Total population is at the core of anthropogenic climate change. The Kaya identity (Kaya, 1990) summaries succulently the role people have in greenhouse gas emissions: it states that the total emissions can be expressed as the product of four factors: human population, GDP per capita, energy intensity (per unit of GDP), and carbon intensity (emissions per unit of energy consumed).

Territorial CO_2 emissions = Population × per capita GDP x Energy intensity of GDP x CO_2 intensity of energy.

Globally, changes in the population vary across the SSPs. SSP 1 (Sustainability) and SSP 5 (Fossil fuelled development) have low population increases. In contrast, SSP 3 (Regional rivalry) and SSP 4 (Inequality) have higher growth rates globally due to increases in fertility.

In New Zealand, there is a projected slowing of population growth as the population ages and the gap between the number of births and deaths narrows. However, the population is expected to (90%) increase between 5.3 and 6.6 million by 2043 and 5.3 and 7.9 million by 2068. The UN projects a population of 6.1m by 2100.

Climate change will have negligible impacts on the levels and regional distribution of people in New Zealand (Cameron, 2017).

Some implications for forestry are:

- Population growth drives consumption.
- Population growth globally affects deforestation as land is converted for agricultural use to feed a growing human population, which can create demand for wood product imports.
- More people means more demand for products and energy. Growth in markets for traditional wood products and new products e.g. bioenergy and bioplastics
- Younger population growth drives demand for housing and the opposite for countries with ageing populations.
- Population growth drives CO_2 levels, hence increasing demand for mitigative, including carbon capture, responses.
- Changes in population in trading partners may mean that demand reduces and may require the development of new markets.

10.2 Land use change

The land is critical as it provides the principal bases for human livelihoods and well-being, including the supply of food, freshwater, and other ecosystem services essential to humanity's existence. The land is used for the primary production of food, feed, fibre, timber and energy. The land is both a source and a sink of GHG's and land is vulnerable to climate change, but to differing extents. Land use change is largely unregulated in NZ, but different SSPs will influence that.

The implications for land-use are summarised in Table 7.

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Table 7: Land use and SSP's

Land Use	SSP 1	SSP 3	SSP 4	• SSP 5
	• Reduction in land availability due to strong environmental regulation • Emissions pricing • Strong role for sustainable production • Sustainable landscapes • Recognition of multiple benefits from land • Circular / bio economic models • Local processing • Strong competition for land for other niche exporting sectors	• Less environmental regulation • Production emphasis and priority • Low technology improvements	• Primary sector business will be exposed to more risk from a lack of adaptation • NZ primary producers should prosper in a trading world that demands food and fibre. • In NZ, technological improvements drive productivity gains.	• A competitive world that rewards producers that are innovative, manage costs. • Strong trade creates a positive feedback loop with more investment in technology and IP.
Forestry	• Environmental regulation will protect species, soil and water. • Forestry will have a large sequestration role • There will be alternative harvest and silvicultural systems, potentially reducing clear-felling and increasing cost • Forests will be established and maintained for multiple benefits and products (fibre, timber, bioplastics, bioenergy) • Potential for payment of ecosystem services • Timber is a green product • Afforestation rates increase • With more land in forestry (from agriculture) water quality will improve as inputs are cut.	• Established only on marginal lands • Land is prioritised to profitable sectors, hence afforestation rates are low • Limited consideration of other forest benefits. • Harvesting on erosion prone soils will create land and water degradation • Forest land area will decrease • Forest sequestration will decrease • Forest land decrease and conversion to agriculture will have -ve impacts for water quality	• Forestry will prosper. Though its mitigation role will mean that land use change decisions will come with surrender costs • Forests will continue to have a strong mitigation role • Forests are exposed to increased risks, and costs of adaptation (incl planning) are met by the sector • Demand for wood products as well as sequestration payments means that forestry can compete for land	• There is a role for forests in global mitigation policy, but consensus is hard under positive economic returns (to HIC)

10.3 Trade

International trade has increased dramatically over the last 60-70 years. Most of NZ wealth comes from export earnings. The export of goods (June 2019) was $59.3 billion: Dairy $16.1b; Meat: $8b and Wood: $5b.

Trade contributes to climate change through emissions but is a core component of the solution as it enhances mitigation and adaptation and optimises comparable and competitive advantages. However, trade is affected by extreme weather events, especially when infrastructure and logistics sustain damage, and longer-term adverse impacts arise from loss of life and injury of employees and damage to assets (Brenton & Chemutai, 2021).

Imports are critical to the recovery where imports can meet the need for goods and services. (Brenton & Chemutai, 2021).

The World Bank (Brenton & Chemutai, 2021) identified the following realities about trade and climate change:

- While trade contributes to emissions, trade is part of the solution:
    - Trade shifts production to areas with cleaner production techniques;
    - Trade promotes the spread of environmental goods and services necessary for transitioning to low-carbon production; and
    - Trade delivers critical goods and services that are vital in periods of recovery from extreme weather events
- Carbon emissions can be reduced by modifying tariff regimes that support dirty goods, penalising clean goods.
- Carbon competitiveness along the value chain can offset the quantity of emissions from transportation.
- Trade and climate change policies intersect. For example, climate change policies must ensure that goods and services are produced in the most (carbon) efficient location.

Table 8: Story points for Trade under different SSP's

Trade	SSP 1	SSP 3	SSP 4	SSP 5
	• Demand for sustainable and well-priced products • Collaborative trading environment	• Highly competitive world • Commodity products are a price taker • Limited technological improvements to production efficiencies • Regional international trading partners limits trade		
Forestry	• There is demand for forest products as a green or low CO_2 intensive product • Demand will be strong for traditional products but also engineered and modified products that can substitute for concrete	• Ongoing competition from harvesting of global native forest • No real growth in productivity or in product improvements • No bioenergy to speak of in NZ • High demand in construction, paper and newsprint (i.e. traditional products) • Low demand for alternatives such as biofuels, bioplastics and other non-timber products • Scale effect: Forestry is medium but doesn't grow	• Low forest product demand • Some demand for new forest products from high-income countries	• High demand for construction • Low demand for paper and newsprint • Medium demand in packages • Limited demand for bioenergy

10.4 Consumption

Changing consumer preferences can have an impact on primary production. There are megatrends towards health and well-being that may impact forestry via policy, trade, consumer sustainability preferences and land use. In addition, forest products are used in value and supply chains for packaging and secondary production and housing and commercial real estate, particularly in environmentally aware demography. Simplistically, increased population and increasing middle class will drive demand and consumption of timber products, changes in attitudes will drive sustainable consumption and provide opportunities for product substitution (e.g construction, energy, plastics)

Food-specific trends drive agricultural future demand and impact land use. The story points are given in Table 9.

Table 9: Story points for Consumption under different SSP's

Consumption	SSP 1	SSP 3	SSP 4	SSP 5
	NZ a respected supplier of primary produce	NZ is a small but important provider of high-end products that return high yields. However, demand for milk powder still dominates, especially in the new middle and upper classes. Costs of exporting logs and increased demand for timber products shift NZ to more product export than round wood. Limited consumer barriers to products based on NZ environmental standards		
Forestry	Has a very positive environmental credential – sequestration, biodiversity, cement substitution Multiple fibre use – Biofuels, timber, pulp, bioplastics More niche/high-value products in smart packaging and multi-storey buildings	There is a low demand for forest products Commodity products Limited investment in onshore processing		High demand for forest products