SCION
forests · products · innovation

WoodScape Study
Regional Wood Processing Options

February, 2013

www.scionresearch.com

REPORT INFORMATION SHEET

REPORT TITLE	WOODSCAPE STUDY– REGIONAL WOOD PROCESSING OPTIONS
AUTHORS	PETER HALL (SCION), MICHAEL JACK (SCION), LUKE BARRY (SCION), ANDREW GOODISON (FPINNOVATIONS)
CLIENT	WOODCO
CLIENT CONTRACT NO:	QT2625 AND 77113
SIDNEY OUTPUT NUMBER	50741
SIGNED OFF BY	TREVOR STUTHRIDGE
DATE	FEBRUARY 2013
CONFIDENTIALITY REQUIREMENT	CONFIDENTIAL (FOR CLIENT USE ONLY; WOODCO, WOOD PROCESSORS ASSOCIATION, PINE MANUFACTURERS ASSOCIATION, NZ FOREST OWNERS ASSOCIATION, MINISTRY OF PRIMARY INDUSTRIES AND NZ TRADE & ENTERPRISE, UNTIL RELEASED BY WOODCO)
INTELLECTUAL PROPERTY	

Disclaimer

The information and opinions provided in the Report have been prepared using the WoodScape model, available industry data and exchange rates set at the date of production of the report. Accuracy of the outputs are subject to the accuracy of the data available and used, exchange rate fluctuations and the limitations of the model. They are also specific to specified circumstances and scenarios and are not necessarily transferable to different circumstances. Users of this report use the report entirely at their own risk. The Report has been provided in good faith and on the basis that reasonable endeavours have been made to be accurate (as of the date of production of the report) and not misleading and to exercise reasonable care, skill and judgment in providing such information and opinions. The report is not a substitute for proper due diligence of business opportunities or the exercise of sound business decision making processes.

Neither Scion, nor any of its employees, officers, contractors, agents or other persons acting on its behalf or under its control accepts any responsibility or liability in respect of any information or opinions provided in this Report.

WoodScape Study – Regional Wood Processing Options

Peter Hall[1], Michael Jack[1], Luke Barry[1] & Andrew Goodison[2]
Scion, 49 Sala Street Rotorua[1]
FPInnovations, 2665 East Mall, Vancouver[2]

February, 2013

Table of Contents

Introduction

In 2011, Woodco presented a strategy for the forestry and wood processing sector. The main aim of the strategy is to double exports (to NZ$12 billion) from increased onshore processing of New Zealand's expanding log supply by 2022. Increased onshore wood processing can have significant benefits for both national and regional economic development. The WoodScape study was commissioned by Woodco to identify pathways forward for the sector by identifying resource, market and wood processing opportunities.

The forestry and wood processing sector displays significant regional variation throughout New Zealand. Due to transport infrastructure, current wood processing plant, and wood resource characteristics, the forestry and wood processing sector displays significant regional variation throughout New Zealand. These factors will influence the wood processing future for each region and must be taken into account in assessing any future regional wood processing strategy.

To understand these regional differences and how they might affect the regional strategies the WoodScape study assessed plantation resources and wood processing options in five different regions (Figure 1):

- Northland
- Central North Island
- The East Coast
- Nelson/Malborough
- Otago/Southland.

For each region, the WoodScape study:

- analysed the plantation forest resources available now and in the future
- held workshops with stakeholders to explore the key factors impacting on wood processing
- carried out a tailored techno-economic assessment of wood processing technologies for the region.

This report summarises the key factors that will influence each of the five region's future wood processing strategies and presents the findings of the techno-economic assessment of wood processing technology options relevant to each region.

Other reports from the WoodScape study include:

- a Summary Report that presents the key findings of the study for Woodco's strategy
- a Technologies and Markets Report that presents more detail on the technologies and their markets
- a summary presentation.

These reports also provide more detail about the techno-economic assessment of the technologies. In total, 39 technologies were assessed covering a comprehensive range of both traditional and emerging wood processing technologies. The primary metric used for the assessment was Return on Capital Employed (ROCE) which provides a measure of how attractive the technology is to capital investment. The study also considered the technology's potential impact on GDP. This was measured in GDP per oven dry tonne (ODT) of input feedstock.

The table below shows a summary of the opportunities identified for each of the regions.

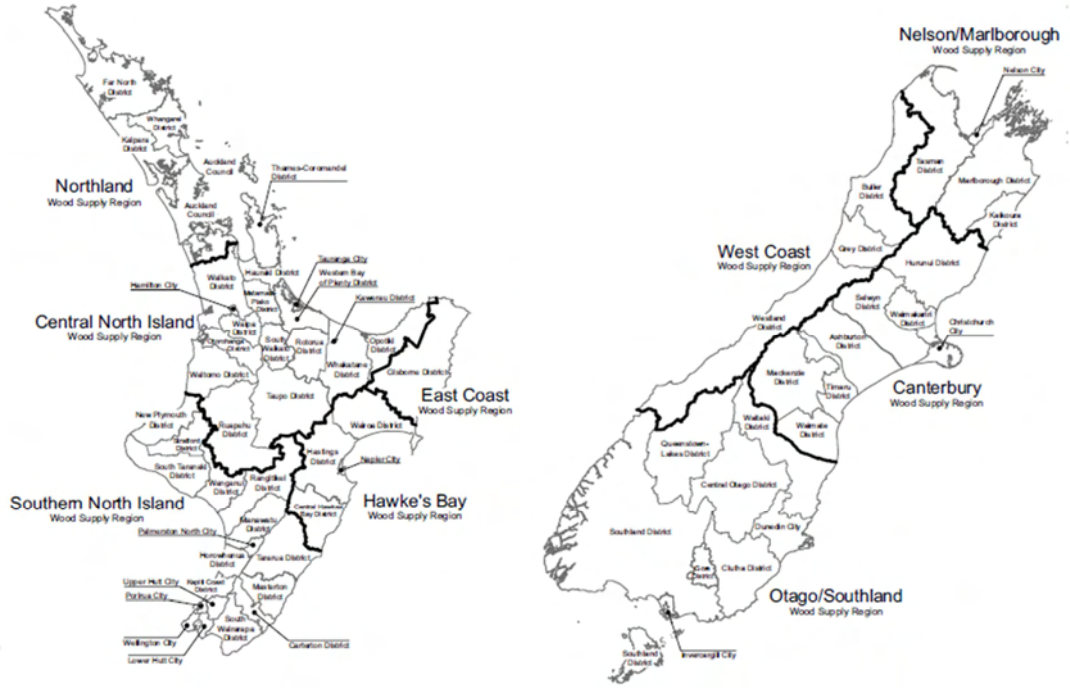

Figure 1. Maps of Wood Supply Regions. Sourced from the Ministry of Primary Industries - National Exotic Forest Description (2012).

Regional Opportunities Summary

Northland
- export of structural timber and structural engineered wood products (e.g. Plywood OEL and CLT)
- biofuels and chemicals from forest and solid wood processing residuals - exploiting the presence of the refinery.

Central North Island
- large scale integrated solid wood processing facilities
- large scale production of biofuels and chemicals
- integration of geothermal energy with wood processing.

East Coast
- opportunities for new processing facility using the wide range of log grades available
- distributed processing close to resource
- combined heat and power opportunities integrated with wood processing due to restricted electricity infrastructure north of Gisborne
- engineered wood products.

Nelson/Marlborough
- establish region as a wood-product innovation centre for small-scale high-value manufacturing of engineered wood products (e.g. CLT) and remanufacturing / tertiary products,(e.g. kitset houses. add novel technologies to existing MDF plant, e.g. wood fibre plastic composites.

Otago/Southland
- export of appearance grade timber remanufactured appearance products
- exploiting the long term opportunity from Douglas-fir
- building on existing processing capacity and expertise; MDF and veneer / plywood plant
- fuels and chemicals.

A & K grade log export volumes (M m^3 pa)

	A	K
Northland	1.26	1.03
CNI	2.45	2.20
East Coast	0.78	0.78
Nelson/Marlb.	0.66	0.54
Otago/South.	0.40	0.40

Northland

With its growing resource of higher density wood, Northland has the potential to make an important contribution to realising the Woodco strategy. WoodScape estimate the scale of the resource available for additional processing at approximately 2.3 million m^3 per annum of logs. Results show that wood product exports (or import substitution in the case of biofuels) can lead to a substantially greater economic contribution to the region than log exports. Additional domestic processing of 2.3 million m^3 of logs could potentially add around $1.2 billion to Northland's GDP.

Based on a high-level analysis of the Northland region, the WoodScape study has identified the ***key drivers*** for Northland to be:

- good quality structural resource in comparison to other regions
- geographically distributed resource
- existing sawmilling, LVL and particle board capacity
- presence of the Marsden Point oil refinery and North Port.

The ***key opportunities*** for increased wood processing in the region based on calculated return on capital employed are:

- export of structural timber and structural engineered wood products, (e.g. plywood OEL and CLT.
- biofuels and chemicals from forest and solid wood processing residuals - exploiting the presence of the refinery.

The ***key issues*** needing to be addressed to realise these opportunities are:

- ensuring export markets for New Zealand structural wood products
- developing onshore processing options for K and A grades
- development of a container facility at port for processed wood exports
- detailed evaluation of fuel and chemical processes.

Overview of the Northland Region

Wood supply available in Northland is currently estimated at 3.6 M m^3 per annum (Appendix A). It will remain at this level for the next few years and then climb rapidly to around 4.6 M m^3 per annum (figure 2) around 2022.

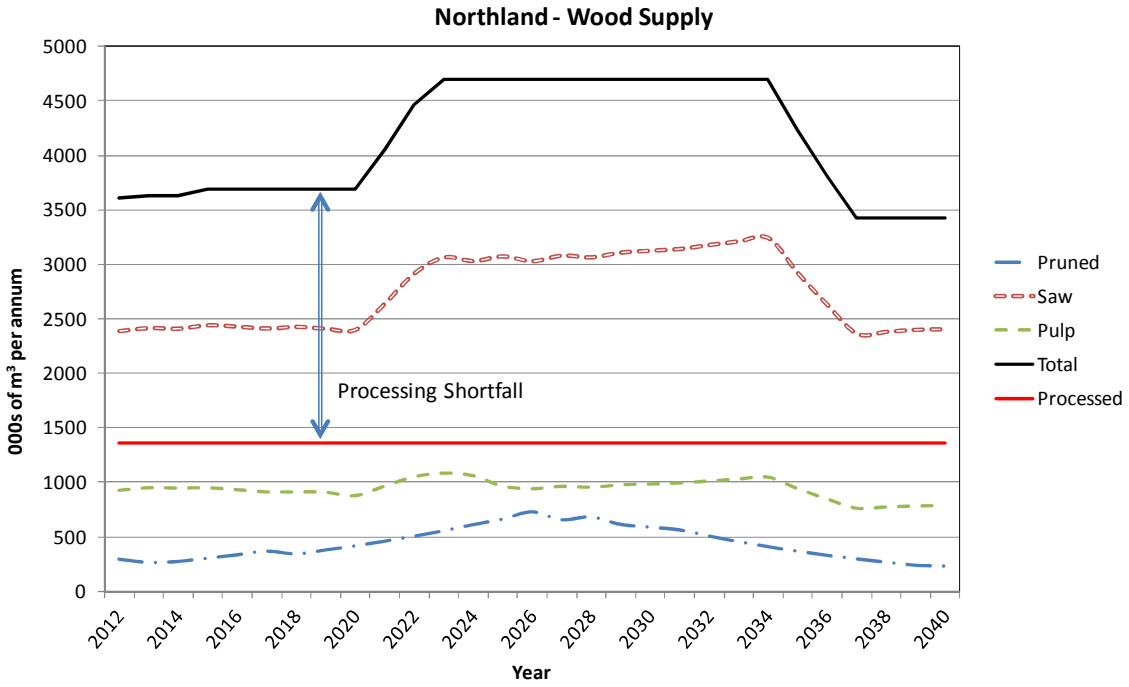

Figure 2. Northland wood supply and current processing. Derived from MPI Regional Wood Supply forecasts (split non-declining yield scenario).

There is a significant volume of wood that is being exported (processing shortfall in figure 2).

The wood resource (Radiata pine dominated) tends to be higher density and stiffness than other regions. Some concerns were expressed at the regional workshop around appearance uses due to the high resin content of the Northland radiata resource.

Currently the Northland region is processing 41% of its harvest (Appendix A). The main wood processing in Northland is sawmilling, LVL and particle board. There are two main centres for wood processing: Kaitaia (sawmill, particle board) and Whangarei /Marsden Point (sawmilling, LVL). Golden Bay Cement (Whangarei/Portland) is a large user of biomass for energy (~50,000 tonnes per annum) which is co-fired with coal in their cement kiln. Some pulp logs are currently transported to the Central North Island for processing. Current wood processing uses around 1.3 M m^3 per annum leaving 2.3 M m^3 per annum of logs in the region for export or other processing. Of the log export volume, the grade split is estimated to be 55% A grade and 45% K & KI grades.

Some of the features of the Northland region are captured in the strength, weaknesses, opportunities and threats (SWOT analysis, table 1). Northland has some electricity supply issues (which may be resolved by infrastructure development in the next 2 to 3 years), and the geography and topography makes centralising of wood processing a challenge.

Marsden Point is the location of New Zealand's only oil refinery. There is rail infrastructure leading to the north, south and west of Whangarei. There is no rail link to Marsden Point although this development has been mooted. The roading infrastructure has some quality issues. Air quality issues are less prevalent than other regions.

Table 1. SWOT analysis of the Northland forestry and wood processing sector. Developed as part of a WoodScape regional workshop.

STRENGTHS	WEAKNESSES
• good quality resource (high stiffness) = structural products • close to Auckland markets • oil refinery (biofuels refining) • Golden Bay Cement wood residue fuels user (50,000 tonnes per annum) • nice climate attracts labour • high density residues (fibre quality) • cheap land • existing wood processing infrastructure / cluster • rail link to Auckland, Port of Auckland, CNI and rest of NZ • significant industrial land available at Marsden Point • deep water port with capacity to expand • Ngawha geothermal • no air quality issues.	• dispersed resource • areas with few good roads • individual landholdings small – wood supply may not be consistent volume or quality • resource too small for very large biorefinery options • long thin region - difficult logistics • competition for low value resource (chip / fuel) • high resin and short internodes – not good for remanufacturing • port not containerised - needs container facility at port for processed wood exports • low margins for forestry – loss of forest resource long term • roading investment required • appearance and CLT use may be problematic with resin issues.
OPPORTUNITIES	**THREATS**
• electricity generation and supply • high unemployment = labour availability • deep water port (can export easily) • high growth rates for tree crop • port expansion possible • engineered wood products • Christchurch and Auckland markets • potential development of container facility at port • Northland Regional Council are becoming more industry friendly • engineered wood products for Christchurch rebuild (port to port freight) • LVL / Tri-board / OSB • large volume of low quality logs (K and KI) available.	• electricity supply constrained (short term) • port (want logs to export) – note there is no freight differential • lack of investment – attracting capital is difficult • Emissions Trading Scheme uncertainty (national level issue).

The key drivers for the region are identified as:

- good quality structural resource
- geographically distributed resource
- existing LVL, sawmilling and particle board capacity
- close to oil refinery
- deep water port.

Technology Options for Northland

Based on the Return on Capital Employed (ROCE) ranking of wood processing technologies in the WoodScape study, the available wood supply, and the key drivers, Northland's wood process in options are in figure 3.

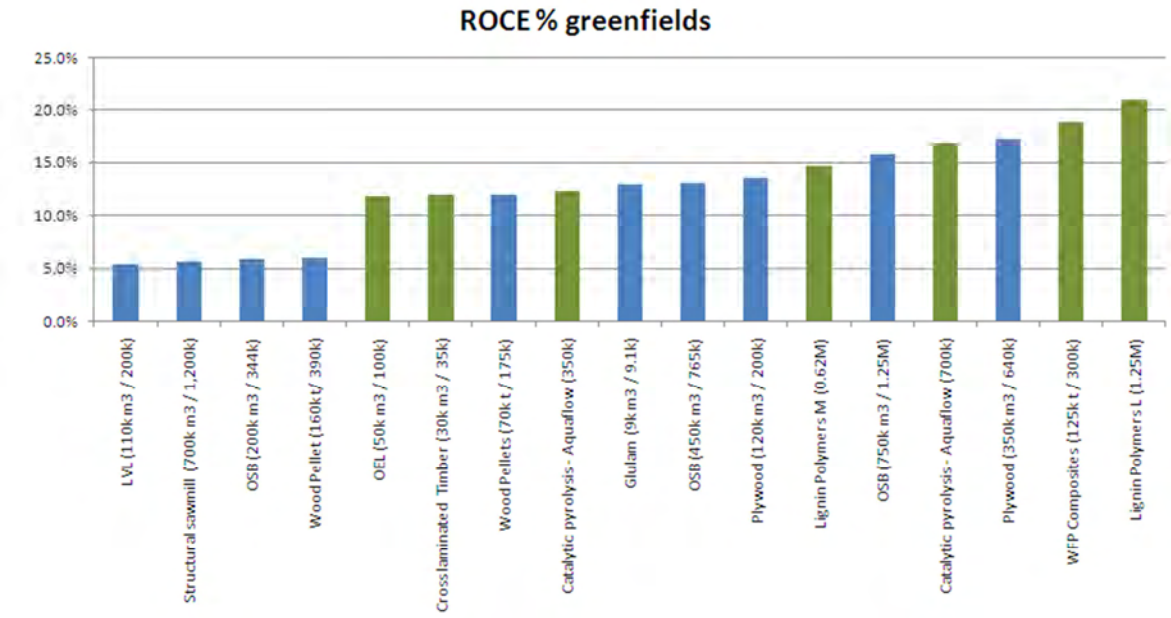

Figure 3. Wood processing options with a high return on capital – Northland. Green indicates an emerging technology, blue a traditional technology.

Solid wood processing options with potential are plywood, OEL, CLT, structural sawmill, and Glulam.

Secondary processing options could operate downstream of a sawmill and add value to a proportion of its lumber output. These are CO_2 modified wood, thermally modified wood, Glulam and CLT.

Viable options for chip and other residuals include Lignin Polymers (lignin and biocrude), Aquaflow catalytic pyrolysis biofuels, and wood pellets.

Options with lower returns are industrial sawmilling and LVL.

Most wood processing options result in an order of magnitude greater impact on GDP/ log than log exports (Appendix B). From a Northland regional perspective, this means that moving from log export to log processing (assuming 2.3 M m^3 of logs and based on average increase in direct GDP[2] across a range of processing options of $555/ODT) would add around $1.2 billion to Northland's GDP.

[2] Calculated as the sum of EBITDA and salary and wages.

Central North Island

The Central North Island (CNI) has by far the biggest forest resource of any region in New Zealand and due to its ability to support large scale wood processing facilities, has the potential to make a significant contribution to realising the Woodco strategy. WoodScape estimates the scale of the resource available for additional processing to be almost 4 million m^3 per annum of logs. The WoodScape results show that wood product exports (or import substitution in the case of biofuels and chemicals) can lead to a substantially greater economic contribution to the region than log exports. Transitioning from log exports to additional processing of ~4 million m^3 per annum of logs would add around $2.2 billion to the Central North Island's GDP.

Based on a high-level analysis of the CNI region, the WoodScape study has identified the ***key drivers*** for CNI to be:

- size and concentration of forest resource
- competitive logging costs and good transport infrastructure (including developing High Performance Motor Vehicle (HPMV) routes) leading to reduced wood delivery costs
- existing large-scale infrastructure and brownfield sites
- geothermal energy.

The ***key opportunities*** for increased wood processing in the region based on calculated return on capital employed and applicable to the resource are:

- large scale integrated solid wood processing facilities
- large scale production of biofuels and chemicals
- integration of geothermal energy with wood processing.

The ***key issues*** to be addressed to realise these opportunities are:

- developing onshore processing options for K and A grades is particularly relevant to the CNI due to scale of supply
- ensuring that the economic returns from log exports through the Port of Tauranga are put in the context of the much greater economic benefits of increased wood product exports from the region
- co-ordinated planning of developments of wood processing to enable both solid wood processing and reconstituted wood products (pulp, panel, fuel, chemicals etc) to work together to maximise the opportunity from the wood supply growth
- market research and development support
- technology focussed research and development.

Overview of the Central North Island Region

Wood supply in the CNI is currently 9.2 M m^3 per annum, with an increase to over 12.0 M m^3 per annum predicted by 2020 (figure 4). The wood supply is dominated by *Pinus radiata* with only a small amount of Douglas-fir and Eucalyptus. Wood density and stiffness vary over what is a large and diverse region; coastal forests produce higher density logs. Currently the CNI has around 3.9 M m^3 of sawlog material available, ignoring the 2025 peak; it climbs to over 4.4 M m^3 by 2040.

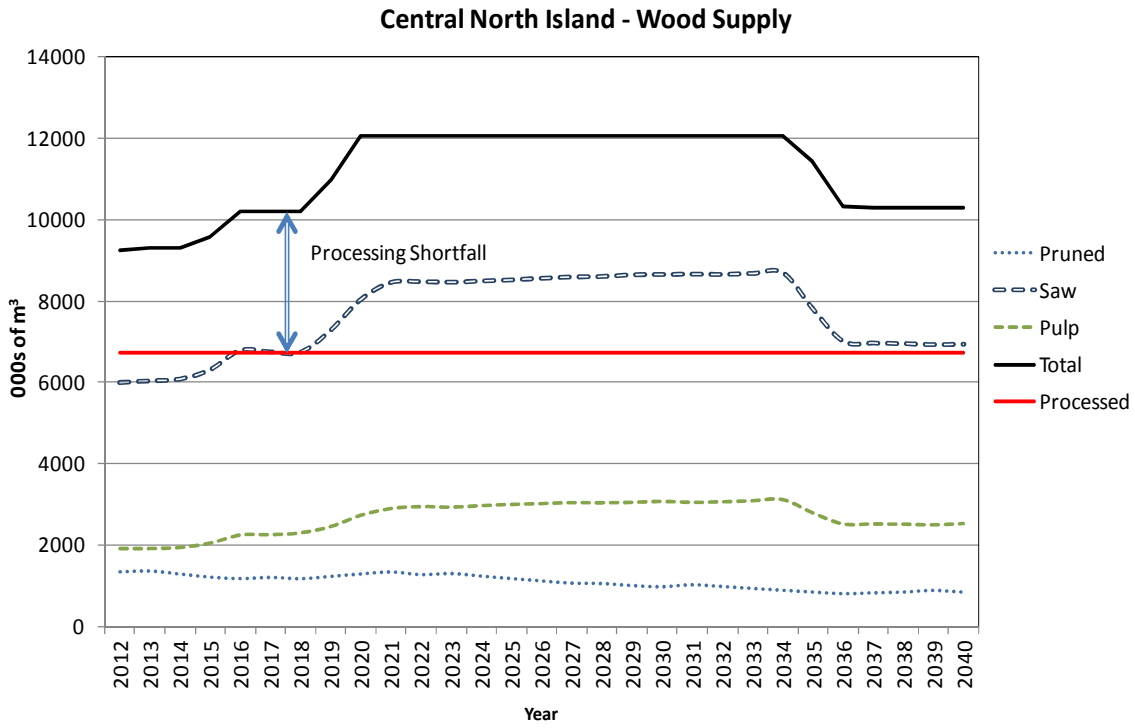

Figure 4. Central North Island wood supply and current processing. Sourced from MPI Regional Wood Supply forecasts (split non-declining yield scenario).

The CNI is currently processing 72% of its harvest (Appendix A). The CNI has extensive wood processing infrastructure with a number of pulp and paper mills and several large sawmills. There are also a plywood mill and a wood pellet plant. Recent trends are for reductions in processing volumes with closures of a paper machine, a pellet mill and reduced volumes going to plywood.

Wood processing centres are Kinleith/Tokoroa (pulp and paper, plywood), Kawerau (pulp and paper, sawmilling), Rotorua (sawmilling, re-manufacturing) and Taupo (sawmilling, wood pellets, remanufacturing). There are biomass fuelled combined heat and power plants at Carter Holt Harvey Pulp & Paper/Kinleith and Red Stag/Waipa. Current wood processing uses approximately 6.7 M m^3 per annum (MPI website). Log exports via Port of Tauranga are 4.9 M m^3 per annum (Appendix A).

Some of the features of the CNI region are captured in the SWOT analysis (Table 2). The CNI has several large forest estates with well established infrastructure with low roading and transport costs.

There is large scale electricity generation in, or adjacent to, the region from hydro and geothermal resources. There is gas supply via pipeline, Waikato coal fields are nearby and extensive use of, with the potential for more, geothermal heat. There is use of geothermal heat for wood processing at Kawerau and Taupo, with several opportunities to expand this, including developing geothermal power in Rotorua. Roading infrastructure is good and there are rail links from Murupara, Kawerau and Kinleith to the Port of Tauranga. The rail link from Rotorua to Kinleith is disused.

Table 2. SWOT analysis of the Central North Island forestry and wood processing sector. Developed as part of a WoodScape regional workshop.

STRENGTHS	WEAKNESSES
• large scale resource and available wood supply (but shortage of pulp logs) • large scale infrastructure • skilled and plentiful labour force • training base (Waiariki) • pulp mills • close to Auckland (market) • flat land and volcanic soils = low roading and transport costs • efficient port infrastructure • geothermal heat • social acceptance of forest industry • research infrastructure • existing appearance capability • ease of expansion of processing (existing sites).	• many old small processing plants • little pruning being done • newsprint outlook weak (threat to existing mill) • pine is poorly accepted overseas as structural timber • location of new resource (more remote and steep terrain).
OPPORTUNITIES	**THREATS**
• Maori land owners • integrating geothermal heat • brownfield sites with latent capacity • wood residue available for fuels and chemicals • large biorefinery option • super mill with integration to geothermal and downstream wood processing • small bioenergy options (200k odt pa).	• brownfield / latent capacity (stops new comers) • dairy conversions of forested area • geothermal power stations (taking heat resource) • port (capable of, and wanting to export logs).

The key drivers for the region are identified as:

- size and concentration of forest resource
- competitive logging costs and good transport infrastructure (developing HPMV routes)
- existing large scale infrastructure and brownfield sites
- geothermal energy
- large scale wood supply and export log volumes represent a significant resource for large scale wood processing.

Technology Options for the Central North Island

Based on the Return on Capital Employed ranking of wood processing technologies in the WoodScape study, the available wood supply, and the key drivers, Central North Island's wood process in options are in figure 5.

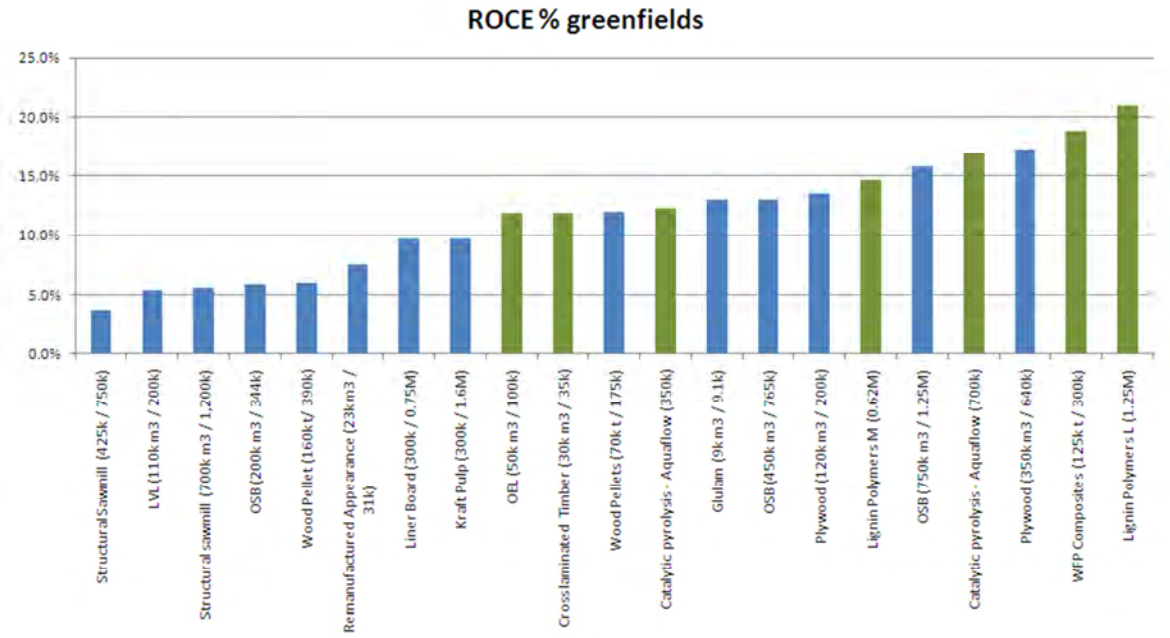

Figure 5. Wood processing options with a high return on capital for Central North Island. Green indicates an emerging technology, blue a traditional technology.

Solid wood processing options are plywood (industrial and appearance), large sawmill (structural and appearance) and OEL. Note that there is significant latent sawmilling capacity (possibly up to 1.0 M m^3) and limited scope for additional structural timber in New Zealand's domestic markets. The ROCE of a structural sawmill is heavily dependent on being able to get a structural price for its lumber.

Resource estimates suggest that over time pulp log supply expands with a consistent extra volume of 500 to 700k m^3 per annum. Assuming a significant increase in solid wood processing there could be a total supply of chip log and residuals of around 2.0 M m^3 per annum. This is sufficient to consider large scale production of biofuels and chemicals.

Viable options for chip and other residues include Kraft mill, dissolving pulp mill, Lignin Polymers biocrude and lignin, Aquaflow catalytic pyrolysis biofuels and OSB operating on chip logs.

There are a number of small-scale ancillary and secondary processing options that could operate downstream of sawmills and add value to a proportion of its lumber output. These are CO_2 modified wood, thermally modified wood, Glulam and CLT.

Lower return options are LVL and industrial sawmills.

There is a significant advantage in large scale integrated facilities producing multiple products, often referred to as "biorefineries" (dissolving pulp, Lignin Polymers). CNI also has significant potential to exploit its geothermal resource. Although energy costs are not the key driver for the technologies, they still impact on return on technologies that are importing significant quantities of energy.

Most wood processing options result in an order of magnitude greater impact on GDP/ log than log exports (Appendix B). From a CNI region perspective, this means that moving from log export to log processing (assuming 4.9 M m^3 of logs and based on average increase in GDP across a range of processing options) would add around $2.2 billion to the CNI's GDP.

East Coast

With its growing resource of uncommitted wood and higher than average proportion of pruned stands, the East Coast region has the potential to make an important contribution to realising the Woodco strategy. WoodScape estimates the scale of the resource available for additional processing to be approximately 1.5 million m^3 per annum of logs. Of the regions studied, the East Coast has the lowest proportion of its log harvest being processed locally (21%). The results show that wood product exports (or import substitution in the case of biofuels) can lead to a substantially greater economic contribution to the region than log exports. Additional domestic processing of 1.5 million m^3 of logs could potentially add around NZ$0.8 billion to the East Coast's GDP.

Based on a high-level analysis of the East Coast region the WoodScape study has identified the ***key drivers*** for East Coast to be:

- high costs of in-forest roading, transport and harvesting
- poor electricity infrastructure to the north of Gisborne
- no local wood processing residue off-take at present
- region is isolated and the export port is volume constrained
- low levels of local processing (only 21% of the harvest).

The ***key opportunities*** for increased wood processing in the region based on calculated return on capital employed are:

- opportunities for new processing facility using the wide range of log grades available
- distributed processing close to resource
- combined heat and power opportunities integrated with wood processing due to restricted electricity infrastructure north of Gisborne.

The ***key issues*** needing to be addressed to realise these opportunities are:

- improvement of port, road and rail infrastructure to overcome isolation of the region
- development of small to medium scale distributed wood processing options
- integration of wood processing options.

Overview of the East Coast Region

Wood supply on the East Coast is currently around 1.946 M m^3 per annum, with just under 400,000 m^3 per annum processed locally. Wood availability is expected to rise over the next 6 to 8 years, reaching 3.4 M m^3 per annum, with 2.5 M m^3 per annum available for processing by 2020 (figure 5).

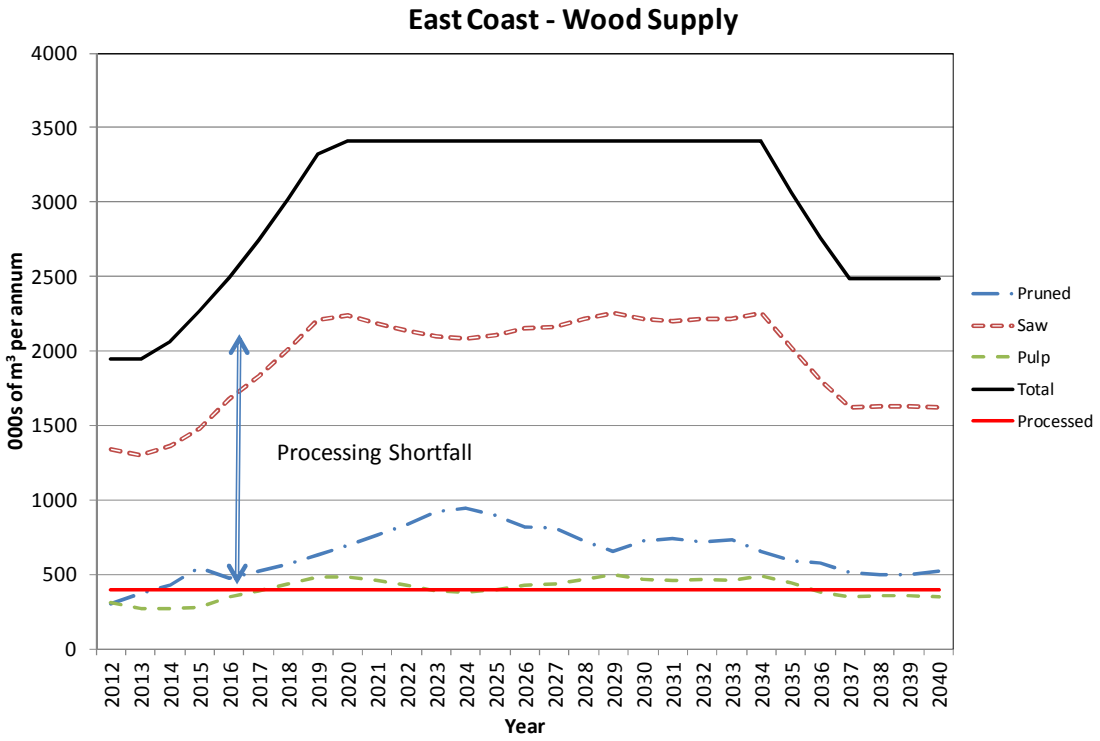

Figure 5. East Coast Wood Supply and current. Sourced from MPI Regional Wood Supply forecasts (split non-declining yield scenario).

The wood resource is dominated by radiata pine and has moderate density and stiffness. There are some concerns over resin pockets in pruned logs and the impact of this on appearance uses. Log exports are expected to be a 50/50 split between A and K grade.

The East Coast currently processes 21% of its harvest (Appendix A). The Gisborne region has limited wood processing with modest sized sawmills and an LVL plant. There is currently no local demand for chip logs and these are exported through the port. The nearest user of pulp logs is the Pan Pac mill near Napier (200 km from Gisborne). Anecdotally, chip logs in the more remote forests are not being extracted, or if collaterally extracted, not being processed at logging landings or transported out of the forests (regional workshop).

Some of the features of the East Coast region are captured in the SWOT analysis (table 3). East Coast forests face the challenges of steep terrain, difficult roading and poor regional roading with no rail access.

With many forests being remote and on steep on erodable soils, logging and road construction costs are high, leading to higher log delivery costs than other regions. Transport distances to Gisborne are often high, with no realistic alternatives currently available.

The East Coast also has constrained electricity supply and limited local electricity generation. Electricity supply is particularly constrained north of Gisborne. There is a gas pipeline from Hawkes Bay to Gisborne but coal fields are remote.

Table 3. SWOT analysis of the East Coast forestry and wood processing sector. Developed as part of a WoodScape regional workshop.

STRENGTHS	WEAKNESSES
• cheap land for forests and industrial development • high tree growth rates in some areas • lots of pruned logs (over 500,000 m^3 pa) • lots of wood available for processing (1.55 million m^3 pa.) including high quality logs • council looking for economic development, supportive – has land zoned for processing • East Coast forest subsidies • under developed processing – clean slate.	• steep erodible land • high roading / harvesting / transport costs = high wood delivery costs • transport infrastructure poor with high maintenance costs • low skill base, difficult to find skilled labour • isolation • long transport distance to port / processors • small port – 9m draft, no container crane • medium density wood • resin pockets in pruned logs • no pulp log or mill residue off- take • electricity constraints north of Gisborne • distance to markets.
OPPORTUNITIES	**THREATS**
• electricity generation needed (CHP possible), high electricity charges • land available for more forests ~120,000 ha • distributed processing • Maori land • industrial site available • existing brown field sawmill site (with equipment for 100k m^3 p.a.) available • appearance mill • residuals and pulp logs available • range of log grades available for processing.	• limited capital available for wood (national issue) processing • Emission Trading Scheme uncertainty (national issue) • compliance costs and environmental performance pressures.

Key drivers for the region are identified as:

- high costs of in-forest roading, transport and harvesting
- poor electricity infrastructure to remote sites
- no local residue off-take at present
- isolated and export port volume constrained
- pulp volume largely unused.

Technology Options for East Coast

Based on the Return on Capital Employed ranking of wood processing technologies in the WoodScape study, the available wood supply, and the key drivers, East Coast's wood process in options are in figure 7.

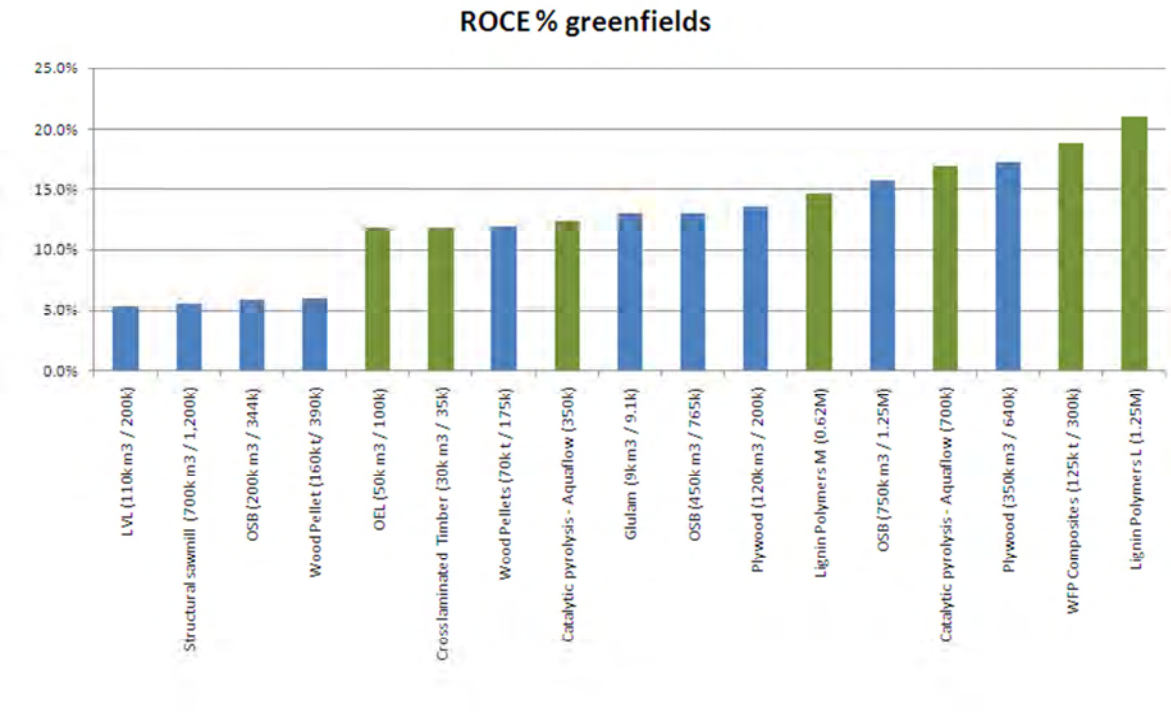

Figure 7. Wood processing options with a high return on capital for the East Coast. Green indicates an emerging technology, blue a traditional technology.

Viable solid wood processing options include appearance and industrial plywood, OEL, CLT, and structural sawmill.

A large structural and appearance sawmill ranks highly in terms of ROCE. However the East Coast has some features such as long transport distance over poor roads and constrained electricity supply, that might make one large mill located at Gisborne (or anywhere on the coast) difficult to justify.

Secondary processing options that could operate downstream of a sawmill and add value to a proportion of its lumber output are CO_2 modified wood, thermally modified wood, Glulam and CLT.

The East Coast has a very limited amount of solid wood processing and no local use of its slab chip and cores. If sawlog processing increased to take advantage of the consistently available log volume, there would be approximately 0.64 M m^3 of additional wood processing residues available. With the chip logs and the existing and potential processing residues, there could be 1.0 M m^3 of chip log (0.35 M m^3) and processing residues (0.63 M m^3) available in the East Coast region.

Viable options for chip and other residuals include Lignin Polymers, Aquaflow catalytic pyrolysis, OSB (note OSB plant require logs as their infeed stock, not slab chip) and wood pellets.

Due to the lack of electricity infrastructure, any distributed sawmilling north of Gisborne may need to have a CHP facility. CHP facilities do not rank well in terms of ROCE based on average electricity prices, but a higher electricity price can have a significant effect on the ROCE of CHP options (figure 8).

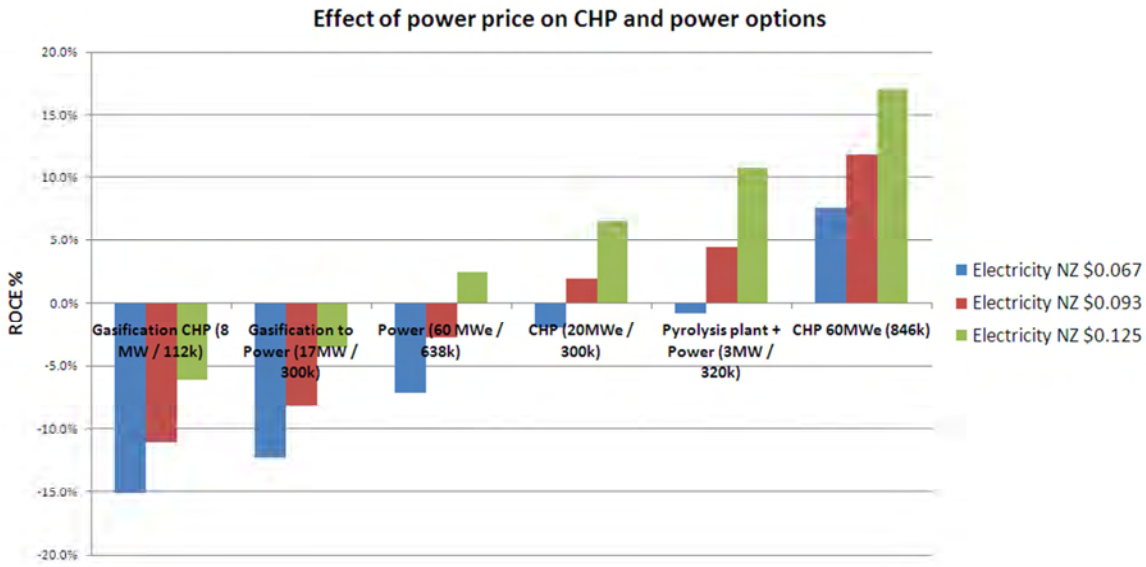

Figure 8. Impact of electricity price on the ROCE% of CHP options

Most wood processing options result in an order of magnitude greater impact on GDP/log than log exports (Appendix B). From an East Coast region perspective this means that the processing of the extra 1.5 M m^3 of logs available, as opposed to exporting them could add $0.8 billion to the East Coast's GDP.

Nelson/Marlborough

With its growing innovative industries in forestry and wood processing the Nelson/Marlborough (N/M) region has the potential to make a significant contribution to realising the Woodco strategy. WoodScape estimates the scale of the resource available for additional processing to be greater than 1 million m^3 per annum of logs. The results show that wood product exports (or import substitution in the case of biofuels) can substantially increase economic contribution to the region over and above that of log exports. Additional domestic processing of 1 million m^3 of logs could potentially add around $0.5 billion to the N/M region's GDP.

Based on a high-level analysis of the N/M region, the WoodScape study has identified the ***key drivers*** for N/M as:

- geographically split resource (two concentrations)
- variable wood quality
- centre for harvesting and wood-product innovation
- concentrated resources, established processing and good ports
- environmentally sensitive region.

The ***key opportunities*** for increased wood processing in the region based on calculated return on investment are:

- establish region as a wood-product innovation centre for small-scale, high-value manufacturing of engineered wood products (e.g. CLT) and remanufacturing / tertiary products, e.g. kitset houses. (regional workshop)
- add novel technologies to existing MDF plant, e.g. wood fibre plastic composites.

The ***key issues*** that need to be addressed to realise these opportunities are:

- ensuring coordinated support of wood processing by local authorities
- ensuring the environmental and economic benefits of forestry are communicated with the aim of balancing economic aspirations of the region with environmental issues concerns
- coordination of small wood-lot growers.

Overview of the Nelson/Marlborough Region

The N/M region has a potential cut of around 2.2 M m^3 per annum and currently processes around 1.2 M m^3 per annum. The peak in log supply is later (2030) and narrower (10 years) in N/M than in the other regions studied (figure 9). The increase would see the potential cut rise to 3.6 M m^3 per annum in 2023.

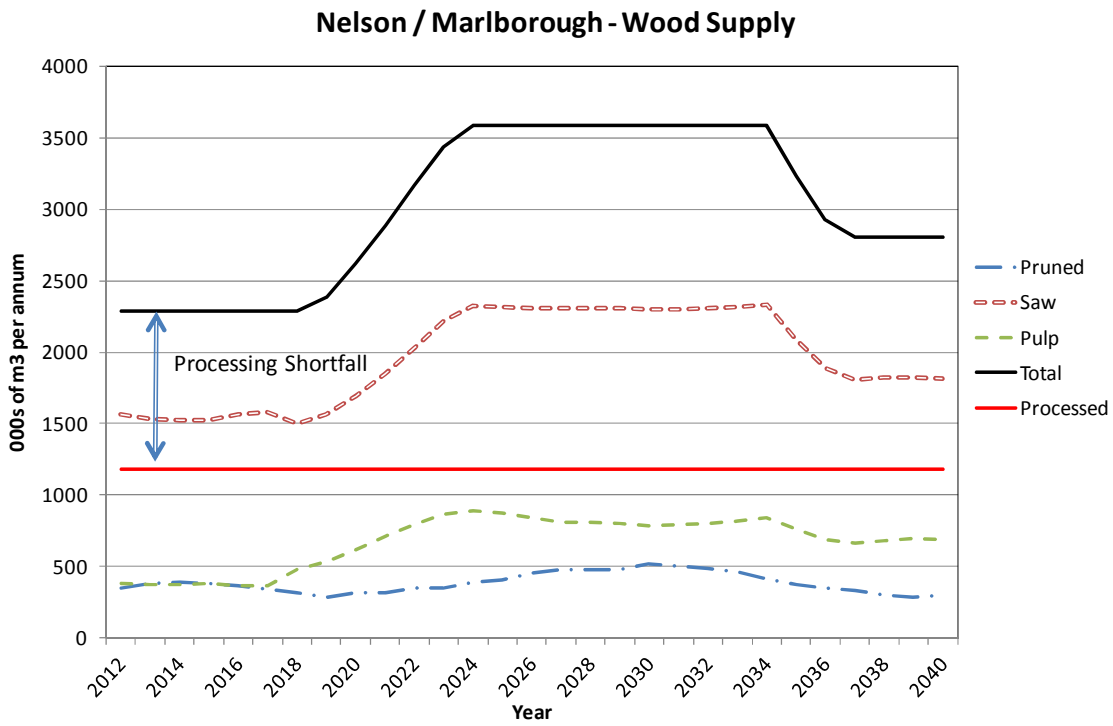

Figure 9. Nelson/Marlborough wood supply and current processing. Sourced from MPI Regional Wood Supply forecasts (split non-declining yield scenario).

The log volume available by grade is estimated to be 0.66 M m^3 of A grade and 0.54 M m^3 of K grade in 2013, and by 2020 the volume would be 1.32 M m^3 of A grade and 1.0 M m^3 of K grade. In the N/M region, 6% of the afforested area is Douglas-fir. Unpruned logs are transported from Marlborough to Nelson for processing.

The N/M region has a number of small to medium sawmills and a large MDF plant. There is an LVL plant co-located with the MDF mill. A CLT plant is under development (commissioning). Douglas-fir is the planned feedstock for the current CLT development.

N/M has three main wood processing or export centres: Nelson/Richmond (process and export), Blenheim (sawmilling) and Picton/Shakespeare Bay (export). The main processing area is centred on Richmond. The large solid wood processors have unutilised capacity and processing volumes could increase with both extra shifts and investment in new plant on these sites.

Chip log and slab chip supply is currently reasonably tight. Availability of structural logs is a constraint on existing processors; local growers expect this to change over time as forests with management regime changes mature, and improve the volume and quality of the structural log supply.

Some of the features of the N/M region are captured in the SWOT analysis (table 4). Water supply is seen as a constraint, with only one major river in the Motueka valley. This will limit processing options and will probably exclude pulp and paper options. Air emissions are a consenting issue for new plant. N/M forests have an extensive history and are well established with good roading infrastructure. N/M has no gas pipeline but is close to the West Coast coal fields.

Electricity supply is constrained at times, with the capacity of the major lines coming into the region being the limiting factor. Lines upgrade or local generation is required for any

major new capacity expansion. Industrial land for wood processing is constrained in the Marlborough region.

Table 4. SWOT analysis of the Nelson/Marlborough forestry and wood processing sector. Developed as part of a WoodScape regional workshop.

STRENGTHS	WEAKNESSES
• deep water access Shakespeare Bay, Port Nelson draught limited • mature D. fir resource (6% of area) • concentrated resource • attractive to work force – large population base • new, or growing industries – innovative (logging equipment, bioenergy, CLT, re-manufacturing) • existing large scale processing (MDF and LVL, sawmill) • forests and mills close to ports • small scale, high value yield • track record of business co-operation across supply chain • strong industry associations • improving wood quality and yield • central to New Zealand via coastal shipping • proximity to Christchurch (Picton/Blenheim rail link to Christchurch).	• varied resource (wood quality) • limited availability of sawmill residues to new industries • resource competition for high density logs • limited water supply • shortage of high skill labour • traditionally low wages and high cost of living • three local authorities in region (not always co-ordinated or supportive) • fumigation costs and capacity at Nelson • small woodlots are 50% of resource in Marlborough.
OPPORTUNITIES	**THREATS**
• innovative options • new species (dry climate) – Eucalypts • Coastal shipping from Picton • potential large residue supply (in forest) and from new solid wood processing • new forests ~100,000 ha • biofuels • expansion of existing plants – adding new technology • Iwi land ownership.	• some resource may not be replaced • could lose container ships from region • large sawmill elsewhere in New Zealand • environmental issues - protecting lifestyles above economic development; tight air quality restrictions (PM10 particulate emissions).

The key drivers for the region are identified as:

- geographically split resource (two concentrations)
- variable wood quality
- centre for forestry and wood-product Innovation
- environmentally sensitive region.

Technology Options for Nelson/Marlborough

Based on the Return on Capital Employed ranking of wood processing technologies in the WoodScape study, the available wood supply, and the key drivers, Nelson/Marlborough's wood process in options are presented in figure 10.

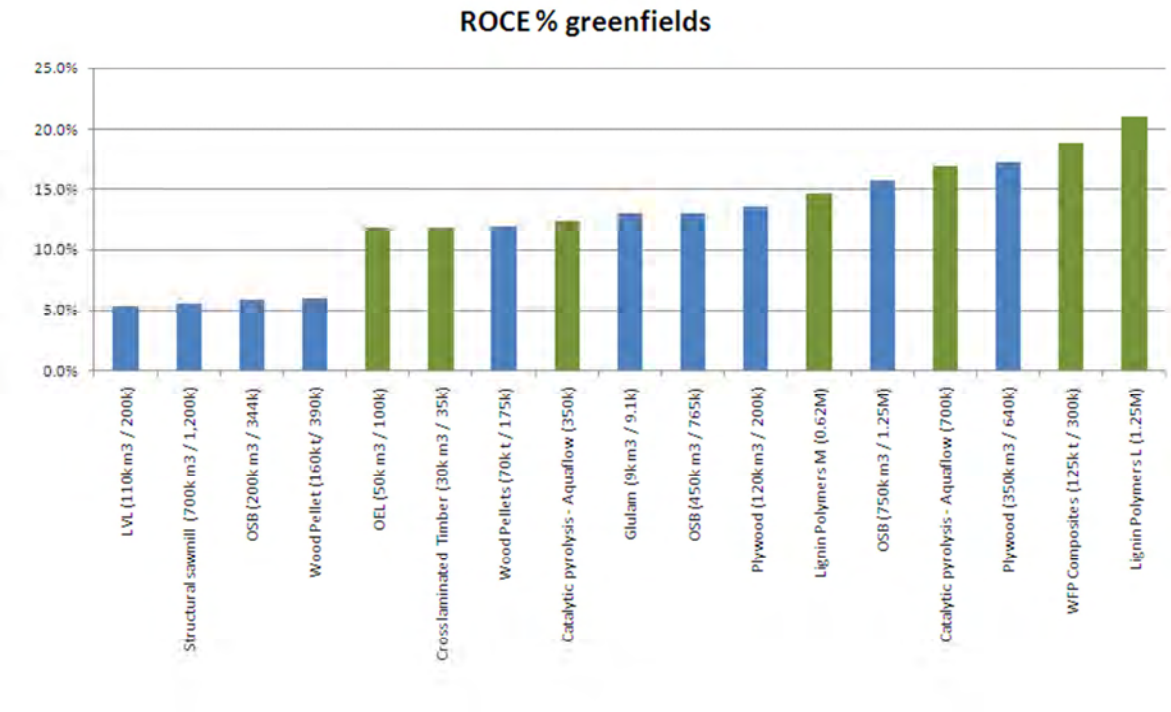

Figure 10. Wood processing options with a high return on capital for Nelson/Marlborough. Green indicates an emerging technology, blue a traditional technology.

Wood quality dictates that any sawmill will be mostly appearance grade, with engineered wood products as a possibility. Existing sawmill capacity can expand if prices are sufficiently attractive.

Viable solid wood processing options include appearance and industrial plywood and CLT.

Secondary processing options that could operate downstream of a sawmill and add value to a proportion of its timber output, are CO_2 modified wood, thermally modified wood, Glulam and CLT.

There is little spare chip log or solid wood processing (SWP) residue at the moment. The processing of the extra 0.8 M m^3 of sawlogs could create additional residues of 0.3 - 0.36 M m^3 of chip logs and SWP residues. By 2040 there will be approximately 0.1 M m^3 of chip logs and up to 0.3 M m^3 of SWP over current volumes. As the large MDF plant consumes most of the current chip log and SWP residues, there is limited room for major expansion.

Viable options for chip and other residuals include wood fibre pellets or wood pellets.

Some lower return options include OEL.

Most wood processing options result in an order of magnitude greater impact on GDP/ log than log exports (Appendix B). From a Nelson/Marlborough region perspective, this means that moving from log exports to log processing (assuming 1.1 M m^3 of logs and based on average increase in GDP across a range of processing options) would add around $0.5 billion to Nelson/Marlborough's GDP.

Otago/Southland

With its growing resource of Douglas-fir the Otago/Southland region (O/S) has the potential to make an important contribution to realising the Woodco strategy in the long term. WoodScape estimates the scale of the resource available for additional processing at around 2.3 million m^3 per annum of logs. The results show that wood product exports (or import substitution in the case of biofuels) can lead to much greater economic contributions to the region than log exports. Additional domestic processing of 1.1 million m^3 of logs could potentially add around $0.6 billion to the Otago/Southland region's GDP.

Based on a high-level analysis of the O/S region, the WoodScape study has identified the ***key drivers*** for Otago/Southland to be:

- current radiata pine resource is not suited to structural sawn lumber or structural engineered wood products such as LVL or CLT
- light coloured wood
- plentiful electricity and lignite (cheap energy)
- in the longer term (20+ years) the region will have a significant Douglas-fir resource.

The ***key opportunities*** for increased wood processing in the region, based on calculated return on investment are:

- export of appearance grade timber and re-manufactured appearance products
- exploiting the long term opportunity from Douglas-fir
- building on existing processing capacity and expertise: MDF and veneer and plywood plant
- fuels and chemicals
- K grade to OEL and industrial plywood.

The ***key issues*** needing to be addressed to realise these opportunities are:

- ensure the development of export markets for New Zealand appearance grades – using light-coloured wood as selling point
- coordination among small forest owners to ensure the long term ability of the industry to transition from a radiata dominated resource to an increasing proportion of Douglas-fir.

Overview of the Otago/Southland Region

Otago/Southland currently has an estimated 1.55 M m^3 per annum of wood potentially available for harvest (2012 – 2015). Processing is estimated to consume 1.1 - 1.2 M m^3, leaving around 0.4 - 0.3 M m^3 per annum available for other uses. Exports are currently 0.8 M m^3 (June 2012 year) and have increased in recent years. Around half of this volume is expected to be A grade, with the other half K grade. Current harvest levels are above the MPI predictions.

Wood supply for additional processing is projected to rise to 1.75 M m^3 per annum by 2022, and to 2.4 M m^3 by 2025. Douglas-fir is projected to have 0.146 M m^3 available for harvest in 2022, and 0.44 M m^3 in 2025. Wood available in 2025 is likely to be split as shown in figure 11.

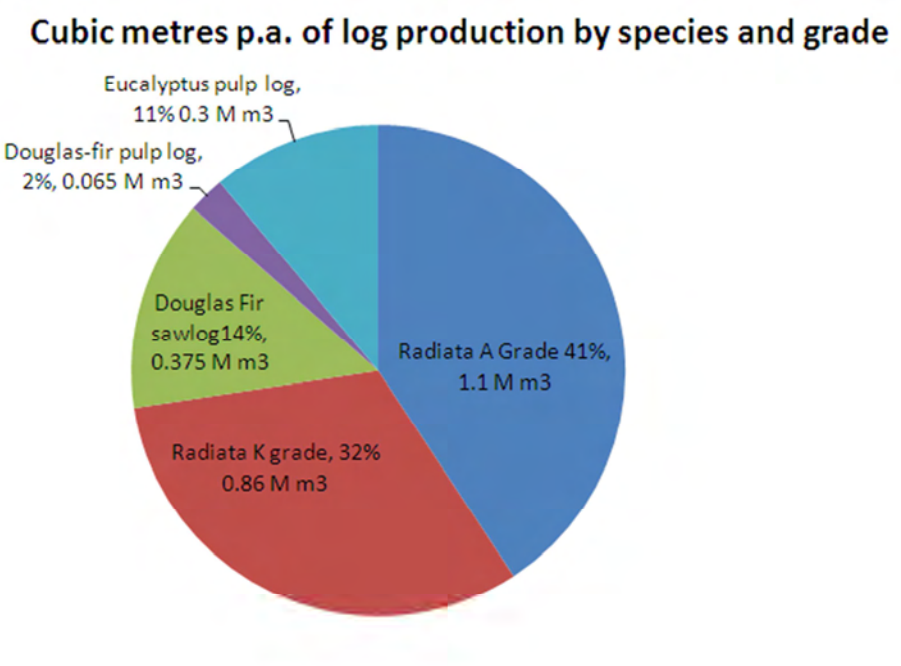

Figure 11. Otago/Southland volume and percentage of potentially available log supply in 2015, by species and grade.

The resource in O/S is somewhat different to other regions (figure 12); it has a much higher proportion in Douglas-fir (26% by area) and more hardwoods (6% by area). This has a significant effect on wood supply in the longer term.

Most regions see a drop off in total wood supply around 2035 as wood supply from 1990s plantings falls away. In O/S there is a slight drop back in supply (~0.4 M m^3) for a few years, but then the supply of wood from the currently immature Douglas-fir resource becomes available, and the wood supply goes back up to around 2.5 M m^3 per annum (figure 12).

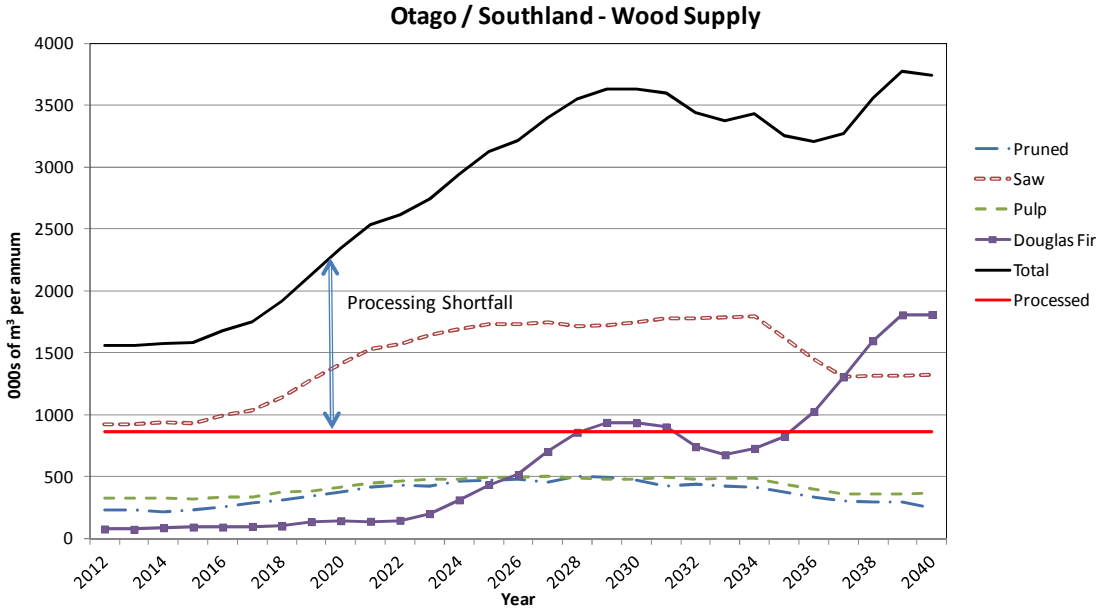

Figure 12: Otago/Southland wood supply and current processing. Sourced from MPI Regional Wood Supply forecasts (split non-declining yield scenario).

There are six corporate owners in O/S with 10,000 - 30,000 hectares of plantings, and a significant proportion of smaller growers (36% of the resource is in holdings of less than

1,000 hectares). The harvest timeframes for smaller growers tend to be more variable than for the corporate estate. Smaller growers may delay, or bring forward harvesting depending upon prices and individual circumstances. This can see harvesting delayed beyond the normal rotation by several years. In general, rotation lengths tend to be longer.

Quality and properties of the small owner resource are not well known but are considered to be variable. Combined, these issues may mean that securing a consistent volume and quality of log supply is more difficult than in some other regions.

Current wood processing is centred on the Balclutha to Milburn area (in the Clutha District), Invercargill, Mataura and Winton. The region's wood processing activity includes sawmilling, veneer and panel products, along with wood mouldings. The O/S wood supply region has a centrally located MDF plant at Mataura. The MDF plant was designed as a two stage development and has potential for additional capacity.

There is under-utilised capacity in the sawmilling infrastructure, with several recent closures, and existing mills able to increase capacity with additional shifts. A sizeable new mill is currently being commissioned at Milburn which is planned to run at 400,000 m^3 per annum, but may also have spare capacity.

Some of the features of the O/S region are captured in the SWOT analysis (table 5). Otago/Southland has no gas pipeline but has reliable supplies of electricity and a massive lignite resource which, to date, has been only lightly used. The region has a good quality roading system. There is rail access from rural areas in central and eastern Southland to ports at Bluff and Port Chalmers, but the distances are relatively short. Council support is variable – Clutha County is strongly supportive of wood processing. Dunedin City and the Taieri Plains have air quality restrictions, which add cost.

Table 5. SWOT analysis of the Otago/Southland forestry and wood processing sector. Developed as part of a WoodScape regional workshop.

STRENGTHS	WEAKNESSES
• lignite for process heat – constrained by RMA / consents • light coloured wood • D. fir resource large in the future • good roading and rail (except for woodlots) • two ports (three if include Timaru, which is outside the region but accessible) • long internodes – exist but not a major driver at the moment • less resin pockets • stable workforce • some councils supportive • lack of dominant forest owner.	• low density wood • isolated • more tapered trees • snow damage to P.rad (reducing over time) • D. fir resource young (20+ years to maturity) • scattered resource that may require co-ordination to ensure consistent supply • limited scope to increase workforce • mixed ownership.
OPPORTUNITIES	**THREATS**
• brownfield sites – latent capacity • potential for much larger resource (~400,000 ha) • co-firing lignite with biomass • alternative species (Euc. species, nitens etc) • appearance timber • bioenergy – eucalypts • non solid wood options • engineered wood options (OEL) • domestic use of D. fir • D. fir resource eliminates post 2025/2030 supply slump • availability of industrial land • change transport to hub and spoke • re-manufacturing (utilise appearance wood) • forest growers co-operation and co-ordination.	• many small forest owners and poor information on their resources • inconsistent forest management • wildings and the perceptions or planting restrictions • resource consent restrictions around PM10 particulate emissions.

The key drivers for the region are identified as:

- current resource not suited to structural sawn lumber or structural engineered wood products such as LVL or CLT
- light coloured wood
- plentiful electricity and lignite (cheap energy)
- in the long term, the region will have a significant Douglas-fir resource, suitable for structural lumber and engineered wood products – this will require changes in processing
- good infrastructure
- appearance sawmilling, medium scale, expanded MDF (specialist product), and engineered wood products.

Technology Options for Otago/Southland

Based on the Return on Capital Employed ranking of wood processing technologies in the WoodScape study, the available wood supply, and the key drivers, Otago/Southland's wood process in options are presented in figure 13.

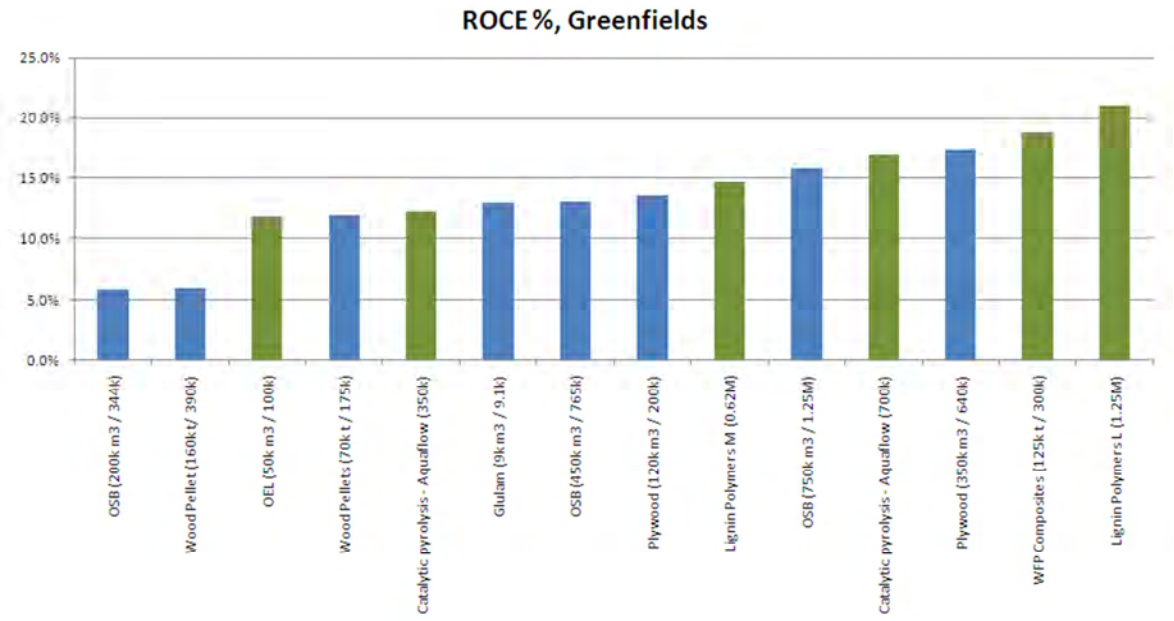

Figure 13. Wood processing options with a high return on capital for Otago/Southland. Green indicates an emerging technology, blue a traditional.

One option is for greater processing in existing sawmill infrastructure. Getting a viable outlet for solid wood processing (SWP) residues material will be a key to getting the local SWP industry on a strong footing. Plywood is also an option.

Secondary processing options that could operate downstream of a sawmill and add value to a proportion of its timber output, include CO_2 modified wood, thermally modified wood, and re-manufactured appearance products.

Assuming a greater level of solid wood processing, would make the total residue supply 0.7 - 0.8 M m^3.

Viable options for chip and other residuals include Lignin Polymers, Aquaflow catalytic pyrolysis biofuels, and wood fibre pellets.

Lower return options include industrial sawmill and MDF.

Most wood processing options result in an order of magnitude greater impact on GDP/ log than log exports (Appendix B). From an Otago/Southland region perspective, this means that moving from log exports to log processing (assuming 1.1 M m^3 of logs and based on average increase in GDP across a range of processing options) would add around $0.6 billion to Otago/Southland's GDP.

Acknowledgements

The authors wish to acknowledge

The input of the attendees at the five regional workshops;

The hosts of these workshops: Northland Regional Council, Juken New Zealand, Nelson Pine Industries and City Forests;

The input of the Technical Working Group which consisted of:

Jason Cordes	Red Stag
John Galbraith	John Galbraith Ltd
Sean Wright	Pan Pac
David Evison	University of Canterbury
Nick Ormrod	New Zealand Trade and Enterprise
Stuart Anderson	Ministry of Primary Industries
John Reid	Carter Holt Harvey Pulp and Paper

And all those who contributed data or comment on the model inputs and analysis.

References

Ministry of Primary Industries. *Regional Wood Supply Forecasts* (2006, 2008, 2009 and 2010).

Ministry of Primary Industries. *National Exotic Forest Description* (2012 and 2011).

Nielsen D. (2010). The *New Zealand Forest Products Industry Review 2010 Edition*. DANA Limited.

Glossary

D. fir	Douglas-fir
Euc.	Eucalyptus
CHP	Combined heat and power
CHH P&P	Carter Holt Harvey Pulp and Paper
CLT	Cross laminated timber
CNI	Central North Island
Cm	centimetre
CO2	Carbon dioxide
GDP	Gross Domestic Product
Glulam	Laminated lumber beams and columns
ha	Hectare
k	Thousand
m	Metre
M	Million
m^3	Cubic metre
MDF	Medium Density Fibre Board
Min.	Minimum
LVL	Laminated Veneer Lumber
odt / ODT	Oven dry tonne
OEL	Optimised Engineered Lumber
OSB	Oriented Strand Board
P. rad	*Pinus radiata*
ROCE	Return on Capital Employed
Radiata	*Pinus radiata*
sed	Small end diameter
SWP	Solid wood processing
SWOT	Strengths, weaknesses, opportunities and threats
t	Tonne
Wood pellets	Pelletised wood from sawdust – used for fuel
Wood fibre dice	Wood fibre similar to MDF formed into dice – used in plastics reinforcing
A Grade	Saw log: unpruned, min. sed 30 cm, max. knot 10cm, min length 3.7 - 6.1 m
K grade	Sawlog: unpruned, min. sed 20 - 34 cm, max. knot 15 cm, lengths vary 3.6 - 12 m
S grade	Sawlog: unpruned, min sed 30 - 40 cm, max. knot size 6 cm, lengths 4.1 - 6.4 m.

Appendix A. Wood processing versus regional wood supply

Northland

Table 1 shows estimated log demand from current processing plant. Table 2 shows wood supply by log type. Table 3 shows estimated wood available for processing.

Table 1. Current wood processing - Northland

	Number	Volume in, log equiv, 000s m^3 pa.	Volume out 000s m^3pa	Slab chip	Saw dust
Sawmills / re-manufacturing	12	778	400	186	77
Engineered wood	2	410	200	82	120
Reconstituted panel	1	250	80	-	-
Total	**17**	**1438**	**680**	**268**	**197**

Table 2. Wood supply projection, 000s m^3 pa (MPI wood supply forecast scenario 4)

	2012	**2020**	**2030**	**2040**
Pruned	298	419	589	235
Sawlog	2348	2937	2123	2401
Chip	923	875	980	784
Total	**3569**	**4231**	**4692**	**3420**

Table 3. Wood available for processing, 000s m^3 log or log equivalent (above current use)

	2012	**2020**	**2030**	**2040**
Pruned / sawlog	1458	2168	2524	1448
Chip log	673	625	730	534
Slab chip*	186	186	186	186
Other process residues	123	123	123	123
Total	**2440**	**3102**	**3563**	**2291**

*Slab chip believed to be going to Central North Island / Kinleith to make up CNI shortfall

Central North Island

Table 4 shows estimated log demand from current processing plant in the CNI. Table 5 shows wood supply by log type. Table 6 shows estimated wood available for processing in the CNI.

Table 4. Current Wood processing - CNI

	Number	Volume in, log equiv, 000s m^3 pa	Volume out 000s m^3 pa	Slab chip	Saw dust
Sawmills	17	3420	1854	820	342
Pulp	3	2340	1050	-	-
Paper	2	895	445	-	-
Engineered wood	1	200	100	48	50
Reconstituted panel	1	40	31	-	4
Wood pellets	1	85	40	-	-
Total	**25**	**6980**	**3520**	**868**	**396**

Table 5. Wood supply projection, 000s m^3 pa (MPI wood supply forecast scenario 4)

	2012	**2020**	**2030**	**2040**
Pruned	1340	1288	967	830
Sawlog	6010	8055	8663	6953
Chip	1898	2730	3074	2522
Total	**9248**	**12068**	**12704**	**10305**

Table 6. Wood available for processing, 000s m^3 log or log equivalent, (above current use)

	2012	**2020**	**2030**	**2040**
Pruned / sawlog	3930	5923	6210	4363
Chip log / Slab chip	-84	700	1092	500
Other process residues	217	217	217	217
Total	**4063**	**6840**	**7519**	**5080**

East Coast

Table 7 shows estimated log demand from current processing plant on the East Coast. Table 8 shows wood supply by log type. Table 9 shows estimated wood available for processing on the East Coast.

Table 7. Current Wood processing – East Coast

	Number	Volume in, log equiv, 000s m^3 pa	Volume out 000s m^3 pa	Slab chip	Saw dust
Sawmills	3	133	77	32	13
Pulp	-	-	-	-	-
Paper	-	-	-	-	-
Engineered wood	2	140	70	28	35
Reconstituted panel	-	-	-	-	-
Total	**5**	**273**	**147**	**60**	**48**

Table 8. Wood supply projection, 000s m^3 pa (MPI wood supply forecast scenario 4)

	2012	**2020**	**2030**	**2040**
Pruned	298	691	721	517
Sawlog	1340	2236	2215	1619
Chip	307	478	465	346
Total	**1945**	**3405**	**3401**	**2482**

Table 9. Wood available for processing, 000s m^3 log or log equivalent (above current use)

	2012	**2020**	**2030**	**2040**
Pruned / sawlog	1365	2654	2663	1663
Chip log	307	478	465	346
Slab chip	32	32	32	32
Other process residues	13	13	13	13
Total	**1717**	**3177**	**3173**	**2054**

Nelson/Malborough

Table 10 shows estimated log demand from current processing plant in the Nelson/Malborough region. Table 11 shows wood supply by log type. Table 12 shows estimated wood available for processing in the Nelson/Malborough region.

Table 10. Current Wood processing – Nelson/Marlborough

	Number	Volume in, log equiv, 000s m^3 pa	Volume out 000s m^3 pa	Slab chip	Saw dust
Sawmills	11	954	524	230	95
Pulp and Paper	-	-	-	-	-
Engineered wood	1	200	100	48	20
Reconstituted panel	1	950	400	-	4
Total	**13**	**2104**	**1024**	**278**	**119**

Table 11. Wood supply projection, 000s m^3 pa (MPI wood supply forecast scenario 4)

	2012	**2020**	**2030**	**2040**
Pruned	346	313	516	300
Sawlog	1562	1692	2296	1816
Chip log	378	616	781	688
Slab chip	278	278	278	278
Total	**2286**	**2621**	**3593**	**2804**

Table 12. Wood available for processing, 000s m^3 log or log equivalent (above current use)

	2012	**2020**	**2030**	**2040**
Pruned / sawlog	754	851	1658	962
Chip log				
Slab chip	-79	+63	+228	+135
Other process residues				
Total	**1525**	**1860**	**2832**	**2043**

Southland/Otago

Table 13 shows estimated log demand from current processing plant in the Southland/Otago region. Table 14 shows wood supply by log type. Table 15 shows estimated wood available for processing in the Southland/Otago region.

Table 13. Current Wood processing – Otago/Southland

	Number	Volume in, log equiv, 000s m^3 pa	Volume out 000s m^3 pa	Slab chip	Saw dust
Sawmills	16	1129	617	270	115
Pulp and Paper	-	-	-	-	-
Engineered wood	1	60	30	12	6
Reconstituted panel	1	395	165	-	4
Total	**18**	**1184***	**812**	**282**	**125**

*Could soon rise with commissioning of new mill in Milburn; potentially +400

Table 14. Wood supply projection, 000s m^3 pa (MPI wood supply forecast scenario 4). Sawlog figures in Italics = Douglas fir

	2012	**2020**	**2030**	**2040**
Pruned	228	376	471	246
Sawlog	922+*76*	1410+*143*	1745+*933*	1326+*1535*
Chip log	350	494	593	635
Slab Chip	270	270	270	270
Total	**1750***	**2472**	**3742**	**3743**

*based on actual not projections – column may not add up

Table 15. Wood available for processing, 000s m^3 log or log equivalent (above current use)

	2012	**2020**	**2030**	**2040**
Pruned / sawlog	857	740	1860	2190
Chip log and slab chip	805	900	955	1270
Other process residues	125	125	125	125
Total	**1787***	**1765**	**2940**	**3585**

* Below current log export levels (~800k), implies some harvest brought forward