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Analysis of wood processing opportunities in Kawerau using the WoodScape model

November 2013

REPORT INFORMATION SHEET

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WoodScape

Mapping the future for New Zealand's forest products

EXECUTIVE SUMMARY

Previous WoodScape analyses have shown that the broader Central North Island (CNI) area generally has advantages for the wood processing industry over the rest of New Zealand in terms of the scale of the available wood resource. It also has well-developed infrastructure and (in some locations) access to geothermal energy suitable for providing heat for wood drying and other process heat demands. Generally, therefore, the CNI is an attractive region for developing large-scale wood processing.

Within the CNI, there are a number of industrial centres that have substantial wood processing capacity, such as Kawerau, Rotorua, Taupo and Tokoroa/Kinleith. The strategic drivers for Industrial Symbiosis Kawerau - an industry/community-based initiative to develop new investment opportunities for the wood processing industry – are premised on the basis that Kawerau offers particular advantages for establishing new wood processing industries.

These advantages are gained by locational, logistics and resource synergies and measured by i) improved financial performance of businesses established there, ii) better regional/national gross domestic product impacts, iii) employment resourcing opportunities, and iv) more effective use of co-located resources, such as geothermal energy. However, logistics benefits would be dependent on the feedstock (logs, lumber or residues) and the product market (export or domestic). The relative impact of geothermal energy would also vary with the process being assessed and their demands for process heat.

In this report, results of analyses using the WoodScape model are presented. These compared the investment returns from wood processing based in Kawerau with those from other parts of New Zealand:

- Logistics advantages in Kawerau were estimated to confer a benefit of $4 to $6 per tonne of log feedstock in comparison to other sites in the Central North Island due advantages in road and forest infrastructure.
- Costs of getting product to an export port (Tauranga) were estimated to be $10 per tonne less than other major processing sites due to rail access.
- Geothermal heat ($4/GJ) was found to be less expensive per unit than either coal ($6/GJ) or gas ($10.0/GJ).

Kawerau has all three of these benefits co-located in one place.

From this analysis, locating wood processing in Kawerau has advantages on a Return on Capital Employed (ROCE) basis across a range of wood processing technologies. The size of this advantage varied with the type of process and the significance of process heat demand to its operation:

- The change in ROCE% gained from locating in Kawerau (relative to other parts of the CNI) ranged from 0.6 to 8.7 %) with an average of 6% (relative percentage increase 5% to 219.
- Clustering and integrating primary solid wood processing and secondary wood processing (at complementary scales) on the same site in Kawerau gave a further gain of 1 in ROCE%.

The GDP and employment impacts for an exemplar cluster (producing sawn lumber, engineered wood products and biofuels and based on the plant scales that fitted with the estimated wood supply) were also estimated:

- New wood processing operations – based on a cluster - in Kawerau could provide over 344 permanent direct jobs (30% in management, trades and skilled labour; 70% as labour).

- This cluster of wood processing operations would also create an increase in GDP of approximately $282 million per annum.

Overall, this work confirmed the robustness of the WoodScape approach to quantifying economic gains for a region and investment opportunity.

More importantly, it was able to conclude that Kawerau can be considered a favoured location for wood processing development when compared to the New Zealand average.

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INTRODUCTION

The WoodScape study was conducted by Scion on behalf of Woodco from June 2012 to February 2013. The aim of the WoodScape study was to identify wood processing technologies that would align with the Woodco strategy of increasing on-shore processing of logs and increasing the export earnings of the forestry and wood processing sector from around $5 billion in 2012 to $12 billion by 2022.

Part of this study involved creating a techno-economic model (WoodScape model) that could be used to compare the potential impacts of a range of wood processing technologies. Model outputs included Return on capital employed (ROCE), employment gains and Gross Domestic Product (GDP). The model could also be used to test the responses of the technologies to changes in inputs, such as feedstock, labour and energy costs.

A key assumption in the WoodScape modeling is that the products (except heat and electricity options) are going to an export market as the domestic market is largely saturated. Thus the operations are sensitive to exchange rate fluctuations.

The study reports were released by Woodco in June 2013 and can be found at woodco.org.nz/strategic-plans/woodscape. Some of high level conclusions offered include:

- A large part (5.2 million m^3 or 40%) of the 13 million m^3 of logs exported unprocessed in 2012 were K grade. Generally these logs are considered to be of insufficient quality to use for structural or traditional appearance sawmilling due to large knots (Appendix 1).

- A further 6.4 million m^3 were A grade logs, which could be suitable for appearance sawmilling and engineered wood products, such as plywood.

- Of the estimated 11.6M m^3 of A and K grade logs being exported, ~4.65M m^3 (40%) are located in the Central North Island and exported via Port of Tauranga.

- The scale of the processing operation was related to its economic performance, with most wood processing plants being more efficient at larger scale. Clustering of these plants also offered clear benefits.

- A range of technologies, both traditional and emerging, offered investable economic metrics.

This current study used the WoodScape model to compare a range of wood processing options when they were based in Kawerau relative to their economic performance against the New Zealand average. In addition to investment metrics, such as ROCE, this study assessed the impact of increased wood processing on employment and the gross domestic product (GDP) of the local economy.

These analyses focused particularly on three perceived positive impacts of processing in Kawerau:

- Expected lower log delivery costs relative to other sites
- Reduced energy costs through the available incorporation of geothermal heat.
- Lower costs in getting product to an export port via the existing rail system.

Primary and secondary wood processors are generally inter-dependent (Appendix 2). When developing large scale primary solid wood processing it is important to consider not only the available wood supply and market for the primary product, but also what will be done with the secondary products, such as slab, slab chip, sawdust, shavings and trim. The volumes of these secondary products can be very substantial when the primary processor is taking several hundred thousand tonnes of logs and may only have a conversion factor of 50 to 60%.

Therefore, this study also estimated the impact of clustering complementary technologies (for example, partnering an industrial sawmill with engineered wood products and biofuels) compared to stand-alone plants.

WOODSCAPE MODEL & ASSUMPTIONS

The WoodScape model uses a set of base case assumptions in the calculation of values and production of rankings. Critical values which are subject to fluctuations are:

- Log prices.
- Product prices.
- Exchange rate NZ$ versus US$ (foreign exchange rate effects product prices and some input costs, such as chemicals. The log and product prices can also be manipulated separately to exchange rate)

Input and output prices

Log prices used came from the original WoodScape study, which were the 12 month average (Agrifax) for 2012.

Delivered log costs were expected to be lower for Kawerau than most other wood processing centres except Kinleith and Taupo. Kawerau would be a preferred delivery point for most forest growers near Kawerau, especially those that are able to deliver logs off-highway. At some point this should at least in part be reflected in log price:

1. At least half of the forest area potentially supplying Kawerau can be accessed by off-highway routes. This means that trucks can run higher gross vehicle weights and consequently increased payloads and do not incur road user charges. Combined, these factors were estimated to reduce the average transport cost ($/tonne) by around 13%.

2. Due to the close proximity of a large area of forest, the average transport distance is going to be lower than that found in other regions (86 km, NZFOA 2007; See map Appendix 3).

Off-highway transport and reduced average transport distance therefore lowered transport costs to Kawerau by an estimated $4 to $6 per tonne compared with the national average. A $5 per tonne reduction was used in the final modelling exercise.

It is important to note that the lower cost of delivering logs to Kawerau may not necessarily translate into a real gain to the processor. The forest grower may take this as increased profit margin or the benefit may be shared.

Product prices were derived from a number of sources, including;

- WoodScape study participants.
- Market data from newsletters (Random lengths etc.).
- Consultant's report (Indufor 2013).

Other critical values which were obtained from industry participants were plant capital costs, operating costs and product yields.

Exchange rate impacts

The base case foreign exchange rate was set at NZ$1 buys US$0.82 (it was US$0.82 in the original WoodScape study and has varied from 0.775 to 0.862 in the last six months). The ROCE's of the wood processing options analysed in this study are highly sensitive to Forex rate as the product is assumed to be exported.

Wood pellet prices are linked to the Euro (currently the NZ$ buys ~€0.60) and based on a CIF (cost insurance and freight) price delivered to Rotterdam.

Biofuels are expected to be sold domestically, but competing with fossil derived fuels on price and substituting for imports, means they are linked to the US dollar.

Prices for heat and electricity are not affected by Forex as they are only bought and sold in the domestic market.

Overall Kawerau assumptions

Based on the above, in the Kawerau case:

- log prices were assumed to be $5 per tonne lower that the rest of New Zealand or most other sites (except Kinleith and Taupo) due to the close proximity of the forests and large volume of wood available using off-highway transport.

- the impact of using geothermal heat at $4/GJ was also included in this assessment.

- the impact of rail transport of product to the export Port at Tauranga was also included (estimated at a reduction of $10 per tonne of product) where relevant.

The impact of these factors would vary with processing technology as some are more impacted by the availability of cost effective heat than others.

Some processes (CLT, Glulam) also require sawn lumber as their feedstock and are not directly affected by log prices.

Some products are assumed to be used domestically (liquid biofuels) and hence the transport to the port does not affect costs.

KAWERAU ADVANTAGES

New Zealand has forests and wood processing spread from Kaitaia to Bluff. The question might be posed by an investor – **why should I locate in Kawerau to do wood processing?**

Elements of the assessments to answer this question are broken down below:

Wood supply

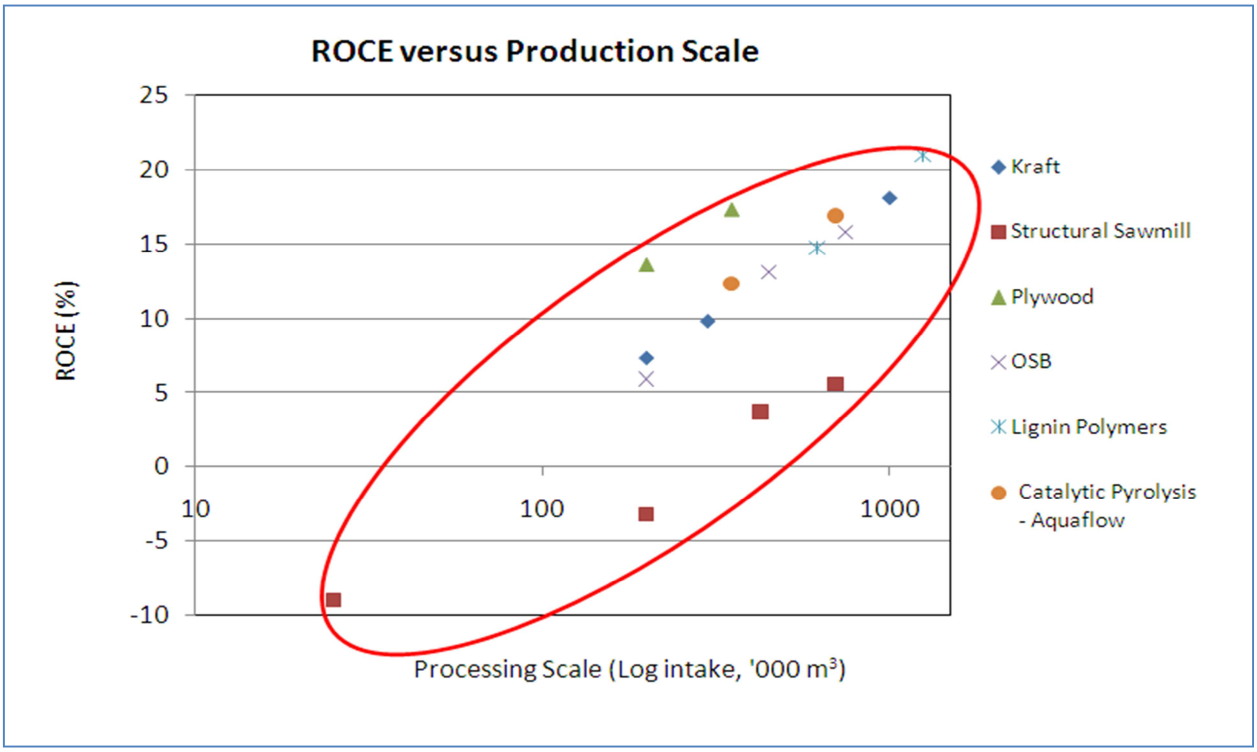
The CNI wood supply region has the largest forest area of any of the New Zealand wood supply regions. Consequently, current and potential future wood supplies are the highest of any region in New Zealand (Ministry of Primary Industries National Exotic Forest Description and Wood supply forecasts). As a result, the CNI exports more unprocessed logs than any other region. Of the ~12.8 million m^3 of logs exported from New Zealand in 2012, 4.6 million m^3 (36%) went through the Port of Tauranga (Table 1).

The CNI therefore also has a greater volume of uncommitted resource than any other (Table 1). This is important as it enables larger scale processing, which is a key factor in achieving higher returns (Figure 1).

Table 1 - A & K grade log exports 2012 (M m^3 p.a.) by region

	A	K	Total
Northland	1.26	1.03	2.29
CNI	2.45	2.20	4.65
East Coast	0.78	0.78	1.56
Nelson / Marlborough	0.66	0.54	1.2
Otago / Southland	0.40	0.40	0.8

Figure 1 – ROCE versus plant scale for a range of processing options
(Source; WoodScape study – New Zealand average)



The forest industry is well established in the CNI and has significant service, training and science infrastructure and good access to a port with container services for export of processed product.

Collectively these factors make the CNI an obvious first choice for location of wood processing within New Zealand.

Location

Within the CNI there are a number of locations with large, well established wood processing industries:

- Kawerau - sawmilling, pulp, paper
- Rotorua - sawmilling, secondary and tertiary solid wood processing
- Taupo - sawmilling, remanufacturing, wood pellets
- Kinleith - Kraft pulp, liner board, post and poles

Kawerau has three key features that are not all available to the same extent at other sites:

- High volume off-highway access to a very large forest resource.
- Rail access to the Port of Tauranga
- Ready access to geothermal heat.

Economic benefits – relative to NZ

The impact of these logistics and infrastructure gains on ROCE and EBITDA are shown in Table 2 and Figures 2 and 3.

Table 2 – ROCE changes from logistic and geothermal benefits for Kawerau for a range of potential processes

	NZ baseline	Logistics benefit - feedstock	Logistics benefit - product	Resource benefit - geothermal	**Total Kawerau Benefit**
Newsprint (0.3M t / 0.84M m^3)*	-1.0	0.8	1.0	0.1	**1.9**
Industrial sawmill (210k m^3/400k m^3)	4.3	1.9	3.5	4.0	**9.4**
LVL (110k m^3 / 200k m^3)	6.2	0.7	0.1	3.0	**3.8**
Wood pellet (160k t/ 390k m^3)	9.4	1.6	4.5	2.6	**8.7**
Liner board (470k t/ 1.1M m3)	9.8	0.0	0.8	2.2	**3.0**
Kraft pulp (300k t / 1.6M m^3)	9.8	0.9	0.3	1.9	**3.1**
Cross laminated timber (30k m^3/35k m^3)	11.9	0.0	0.5	0.1	**0.6**
Wood pellets (70k t / 175k m^3)	12.0	0.0	4.5	2.6	**7.1**
Catalytic pyrolysis (118m l/ 350k odt)	12.3	1.2	0.2	0.0	**1.4**
Plywood (350k m^3 / 640k m^3)	17.3	1.4	1.5	5.6	**8.5**
Dissolving pulp (225k / 1.4M m^3)	22.1	1.7	0.5	0.6	**2.8**
OEL™ (50k m^3 / 100k m^3)	28.9	2.2	2.3	4.0	**8.5**

*(figures in brackets show product out / feedstock in)

Figure 2 – ROCE gains from locating in Kawerau

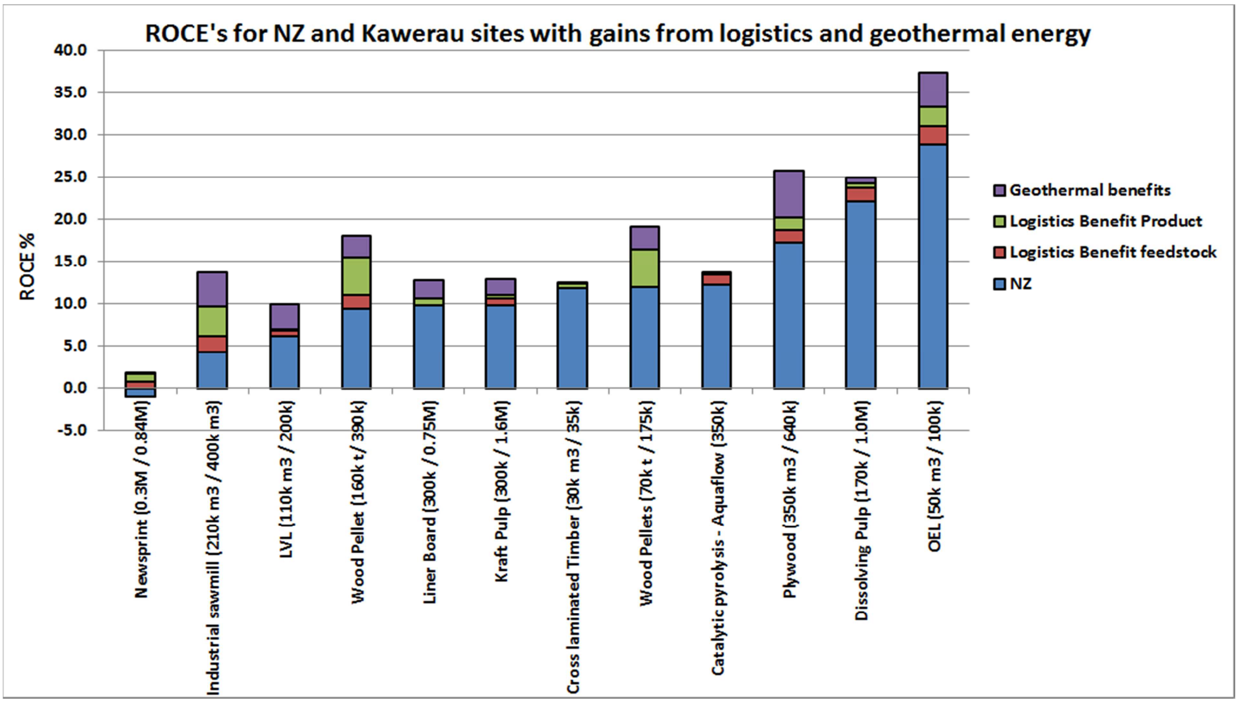
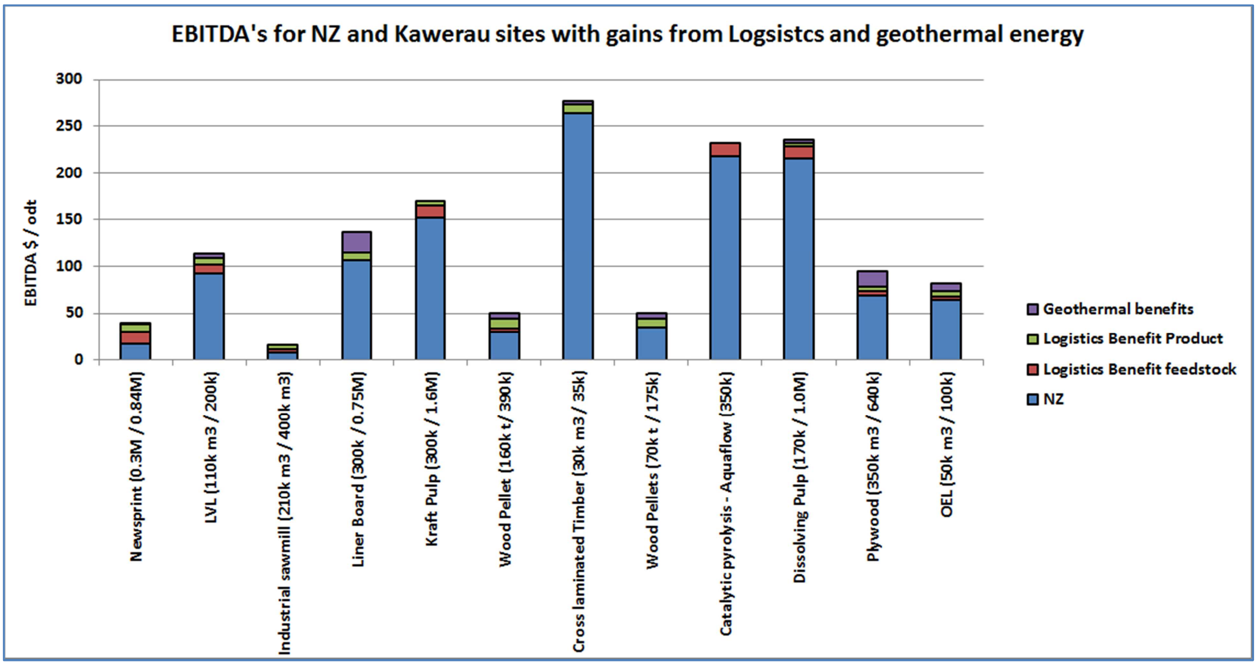


Figure 3 – EBITDA gains from locating in Kawerau



As can be seen, the impact of a Kawerau location varied with the individual process and the feedstock it is taking (logs, lumber or residues).

As would be expected, only log-based processes benefited from cheaper delivered log costs.

Whilst some gains in EBITDA look small, many are substantial in terms of % improvement. Gains in EBITDA ranged from 5 to 135% with an average of 41%. Some processes gain from all of the Kawerau advantages and some only from one or two, depending on the type of feedstock and the energy demand. Care needs to be taken with interpreting Figure 3, for example the Industrial sawmill looks to have a small gain, but the % increase is 100%. Cross laminated timber does have a small (5%) gain in part because it is running of sawn lumber as its feedstock, not logs and does not get the logistics gain for its feedstock, which are 50% of its costs.

The cost of wood is a significant proportion of the costs for all process, over 50% in some cases. Energy is a much less substantial cost to most processes (2 to 25%), with some potentially independent of external energy sources.

Energy impacts also varied with the demand for drying, with some primary solid wood processes making large gains from the presence of geothermal heat as they have high demands for process heat for drying.

The only process to have no gain from being located in Kawerau was the catalytic pyrolysis biofuels option. This was due to the combination of; it running off residues from the primary process, the process generating sufficient waste heat internally that the geothermal energy was of no benefit and the product being a liquid fuel that would be consumed locally.

IMPACTS OF KAWERAU BENEFITS

Potential wood supply

Available wood supply within the Kawerau catchment was considered in two parts. Firstly, there are logs for primary solid wood processing (Table 3). In this study we have limited this volume to that not already committed to an existing processor and which are currently exported as unprocessed logs.

Table 3 – Projected uncommitted log supply within 75km average haul distance from Kawerau, m^3 per annum

	A grade	K grade	Total
2015	350,000	360,000	710,000
2020	390,000	390,000	780,000
2025	770,000	680,000	1,450,000

The second part of the wood supply is the residual fibre from the primary solid wood processing. If these logs were processed in Kawerau, a significant quantity of residues (chip, sawdust, shavings etc.) suitable for downstream processing would be created.

For example; if these logs were processed at a sawmill, then (based on the 2015 estimated log volume) there would be approximately 365,000 m^3 of log equivalent per annum of residues, made up of:

- 240,000 m^3 of log equivalent per annum of chip
- 85,000 m^3 of log equivalent per annum of sawdust
- 20,000 m^3 of log equivalent per annum of shavings
- 20,000 m^3 of log equivalent per annum of off-cuts

Exemplar cluster analysis

The WoodScape model was used to undertake an assessment of the benefits of a processing cluster in Kawerau. To assess the benefits of clustering we have assumed a simple scenario where a secondary process located on the same site as a primary process does not pay for the residue transport costs. The cluster was designed to fit with the estimated log supply and consisted of:

Industrial sawmill	350,000 m^3 log in
Plywood mill	350,000 m^3 log in
Catalytic pyrolysis biofuels	350,000 m^3 log equivalent in (residuals from primary processing)

The industrial sawmill was slightly reduced in scale to fit with the wood supply, this would not have a significant impact on the ROCE or EBITDA results, as it is similar to that modelled. However, the mill would be built to fit the expected resource availability.

The principal calculated gain from clustering was in the reduced cost of transporting material from one site to another. This was mostly gained through mostly truck loading/unloading but also allowed for a short transport distance (5 to 10 km) from mill to mill.

This cost saving was assumed to be $10 per green tonne of feedstock.

The ROCE of these plants, located in Kawerau, but operating separately from each other, was estimated at:

Industrial sawmill	13.7%
Plywood mill	25.8 %
Catalytic pyrolysis biofuels	13.7%

As these plants have different capital costs, a weighted capital ROCE was used across the cluster. This was estimated to be 18.8%.

As a result, it was found that if these plants were clustered, the catalytic pyrolysis plant gained from a lower infeed cost, which increased it ROCE from 13.7% to 14.8% and the capital weighted ROCE rose overall to 19.3%.

Therefore, it can be seen that the gains through clustering at Kawerau are relatively small (approximately 1%) and do offer substantive increases over the identified broader locational gains relative to the CNI or NZ overall.

Employment from expanded wood processing

It is possible to estimate the number of jobs that would be created in Kawerau from development of increased wood processing using labour data in the WoodScape model

Direct employment numbers associated with these plants are shown in Table 4. As can be seen, direct employment numbers in the cluster described would be in the order of 344 full time jobs.

Table 4 – Employment numbers by job type for direct employees for 2015, based on the plant types assumed in the Cluster Scenario

	2015
Management	24
Administration	32
Labour	200
Skilled labour	46
Trades	46
Total	**344**

However, there are two categories of employment - direct (at the wood processing plants) and indirect, which are jobs created in the wider community and can be estimated from multipliers used in the WoodScape model (2.68 for solid wood processing and 4.64 for fuel and chemicals). The figures in Table 4 are for the direct employment only – no attempt has been made to categorise the indirect jobs created, which will be a mix of service related jobs, including retail, engineering and labour.

When the employment multipliers were applied to direct jobs the indirect jobs were estimated at 670. In other words, approximately 1000 new jobs would be created by investment in the cluster scenario.

A summary of the number of jobs by employment types is presented in Table 4 and Figures 4 & 5. These data are meant to be indicative of the level of employment created, as the mix of processing may be different to that described, but the mix of primary and secondary wood processing will be similar regardless of the actual processing technology used and the number of jobs created will be similar in many cases.

Figure 4 – Employment numbers by job type in 2015 with development of new OEL™, plywood, and catalytic pyrolysis plants in Kawerau

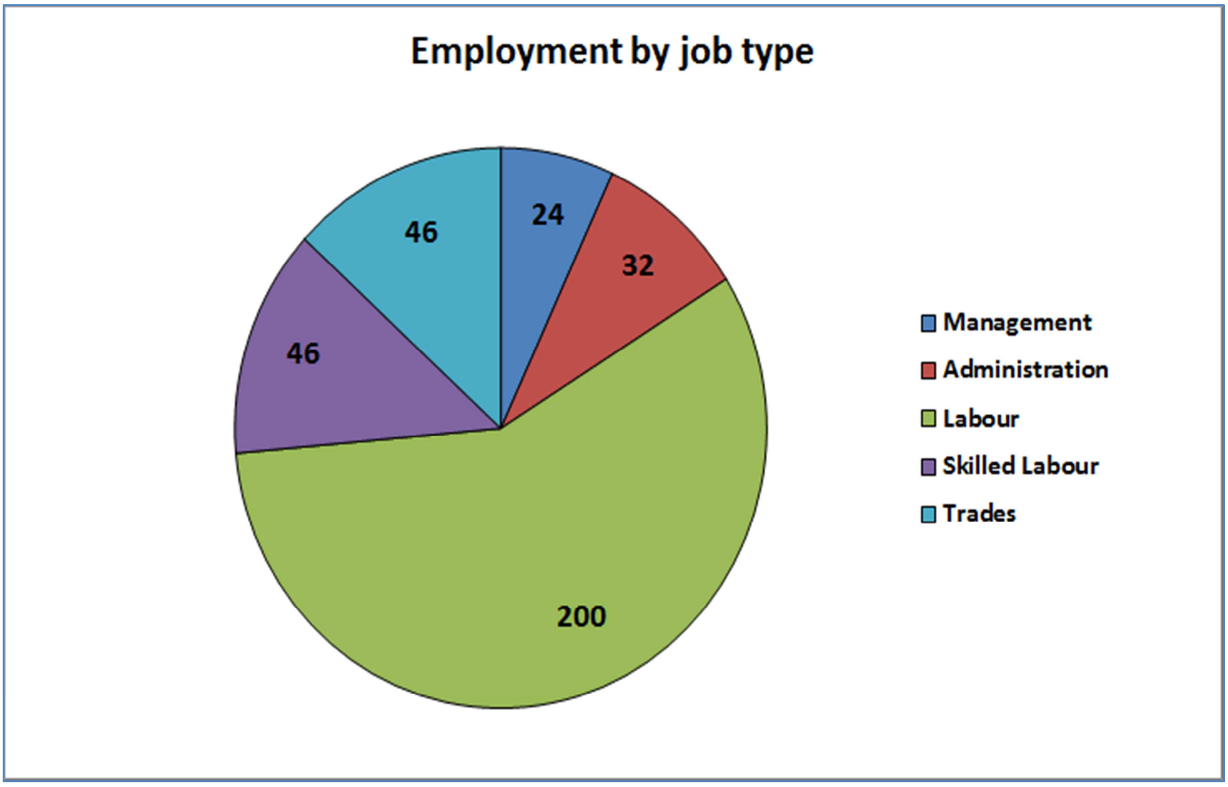
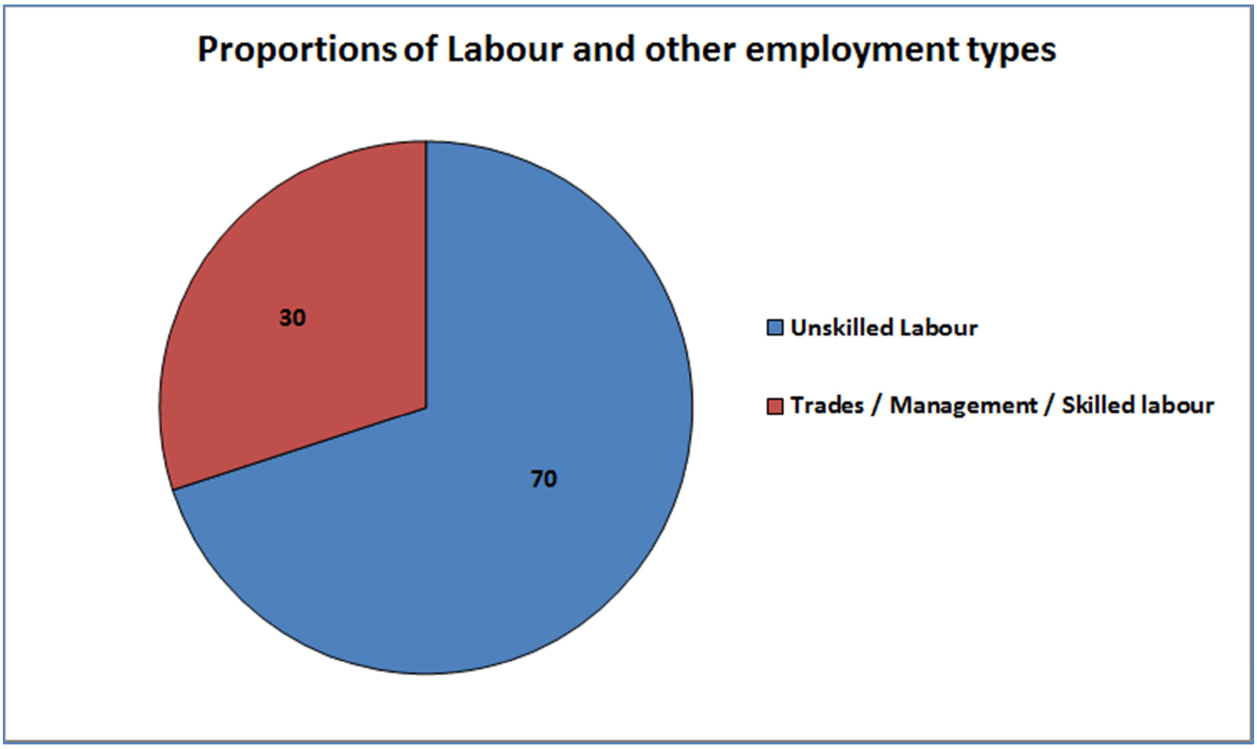


Figure 5 – Proportions of jobs in labour and management, trades and skilled labour, in a Kawerau wood processing cluster in 2015



GDP from expanded wood processing

An estimate of the GDP that could be created from additional wood processing based on the exemplar cluster is presented in Table 5. The GDP from log exports which are diverted to the increased wood processing were deducted from the total added GDP.

Table 5 – GDP ($ millions (M) per annum) created from additional wood processing in Kawerau

	2015
Total	357
Less log exports displaced	75
Increased GDP	282

As can be seen, the technologies in the cluster scenario could give an increase in GDP of $282 million per annum, based on the volume of wood available in 2015.

SUMMARY

The WoodScape model was used to assess Kawerau's advantages as a wood processing centre using a range of economic and employment metrics. The impact of clustering large scale primary and secondary wood processing together was also assessed.

From these analyses, we can conclude the following:

Kawerau's advantages as a wood processing centre –

- The combination of reduced log transport costs, reduced product transport costs to an export port due to rail access and the availability of geothermal heat give Kawerau an advantage in ROCE for most wood processing technologies when compared to other sites.

- The size of the benefit varies with the technology and is largely driven by heat demand and the feedstock type (logs, lumber or residues).

- The average gain in ROCE% is 5, ranging from 0.6 to 8.7. This may be lowered slightly depending on the assumptions around who takes the gain from the lower delivered log costs.

- If these actual gains in ROCE% are expressed as a % gain, the range is from 5 to 219%.

- If the full estimated available log volume is processed in Kawerau, then using an integrated set of wood processing industries with the highest ROCEs, employment increases by 344 direct jobs and 670 indirect jobs in 2015.

- The expanded wood processing based on this grouping with the highest ROCE would add as much as $282 million per annum to Kawerau's and New Zealand's GDP by 2015.

- Clustering of technologies where the residuals from primary solid wood processing could be transferred with no transport cost to an integrated secondary wood process will give gains in the ROCE of the secondary wood processing technologies and in the capital cost weighted ROCE for the cluster. However, a fully-integrated wood processing cluster that fits with the Kawerau wood resource (scale and log type) and each other (primary and secondary wood processing) could only increase the capital weighted ROCE of the cluster by around 1%.

In conclusion, given the advantages that Kawerau has in terms of delivered feedstock costs, availability of low cost process heat and export logistics, it is a favoured location for New Zealand wood processing development.

KEY ASSUMPTIONS

Exchange rate	NZ$1 buys UD$0.82
Geothermal heat	$4/GJ
Coal	$6/GJ
Gas	$10/GJ
Log delivery benefit	$5 / tonne
Rail to port benefit	$10 / tonne

GLOSSARY

adt = air dry tonne
cif = cost, insurance & freight
CLT = Cross Laminated Timber
cm = centimetre
EBITDA = earnings before interest, tax, depreciation and amortisation
GDP = gross domestic product
ha = ha
k = thousand
km= kilometre
m^3 of log equivalent = residues in chip, sawdust or shavings form, but expressed as a log volume equivalent
m^3 = cubic metre
M = million
odt = oven dry tonne
OEL™ = Optimised Engineered Lumber
primary wood processing = wood processing that take logs and produce solid wood products (sawmilling, plywood)
secondary wood processing = processing that takes residuals or chip and produce reconstituted wood products or wood derivatives (MDF, pulp, paper, biofuels)
ROCE = return on capital employed
SED = small end diameter
t = tonne

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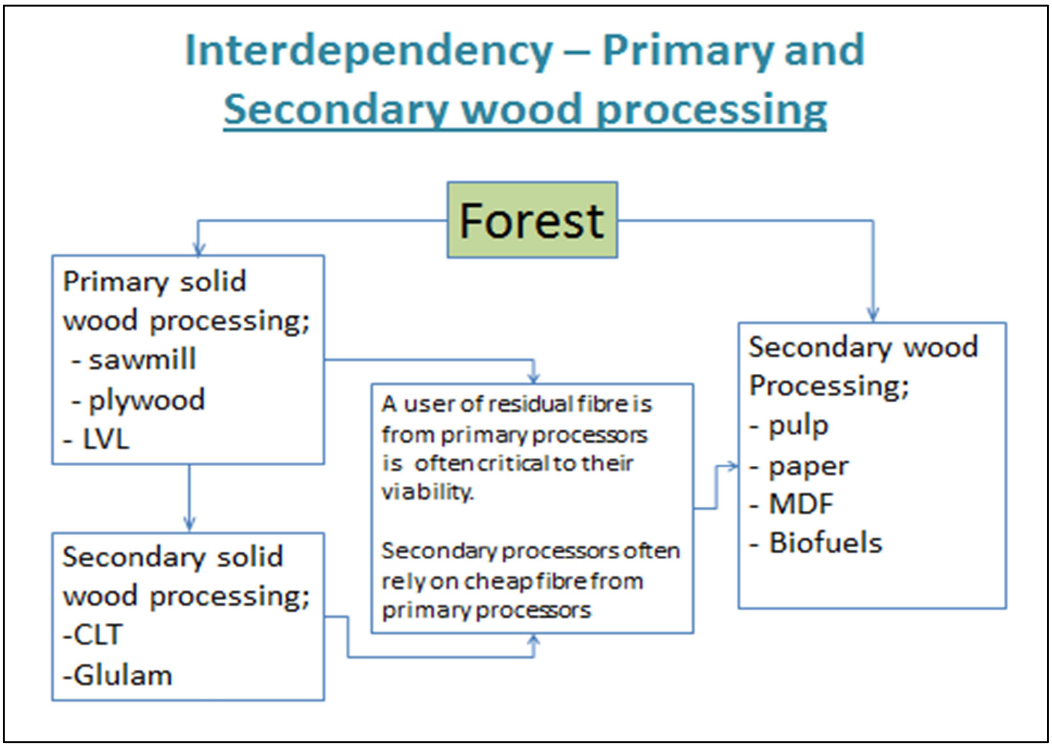
APPENDICES

Appendix 1 – Specifications for A and K grade logs (Agrifax 2013)

	A grade	K grade	KS grade	KI grade
SED, minimum, cm	30	20 to 34	20 to 26	26
Length, minimum, m	3.7 to 6.1	11	3.6	4.0
Knot size maximum, cm	10	15	15	25

Appendix 2 – Interdependency of wood processors



Appendix 3 – Forest centred on Kawerau – rings represent 25, 50 and 75 km from Kawerau mill site