Modelling wood processing options for New Zealand: Economic impact analysis

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Abstract

A national-level financial model was used in the WoodScape study to analyse the potential of a range of traditional and emerging wood processing technologies. The model inputs industry sourced techno-economic data on wood processing options and macroeconomic impacts from across New Zealand and, where necessary, the rest of the world to assess the increase in GDP, employment and export earnings from processing wood harvested in this country. This identified a number of traditional and emerging technologies, which offer potentially significant increases for both the individual firm and the wider economy. The WoodScape modelling shows that GDP could increase by almost NZ$1.1 billion per annum, almost 4,500 extra jobs could be created, and export earnings could rise by an estimated NZ$2 billion. This was estimated by applying a conservative average increase in GDP, employment and export earnings across WoodScape technologies from onshore processing of an extra 11 million cubic metres of typically exported logs. Increased wood processing has an important role in New Zealand's economic growth. The WoodScape study found that most wood processing options can make a significant contribution to GDP. A number of the options also look attractive for investment based on their return on capital (>20 per cent), cash flow and the market opportunity for their products. Several wood processing options show a labour productivity greater than $200 per hour of employment, comparable to the highest performing sectors of the economy.

Background

The economic impacts reported here were developed from the WoodScape study. WoodScape (2012) looked at a wide range of wood processing options to determine those that would be likely to perform well in New Zealand based on the operating conditions at the time of the study (2012). An important measure of performance was return on capital employed (ROCE). A summary of the ROCE results from the model used in the study is presented in Figure 1.

This data shows a range of technologies that have ROCE results above 10 per cent. There is a trend for larger-scale operations to perform better than the same technology at a smaller scale. There are a number of engineered wood product, and fuel and chemical, options that look promising although some are not developed to full commercial operations yet.

The ROCE results are highly sensitive to foreign exchange fluctuations as well as product and feedstock price changes. The primary resource considered was the logs which are currently being exported (A and K grade). Additional processing capacity is assumed to be targeted at the export market as the domestic market is largely saturated and cannot absorb the volume of product that could be generated by the development of processing on a scale that could take a substantial proportion of the 2012 export log volume (~13.0 million cubic metres per annum). The export log volume has risen since the original study/report was published and is now ~16 million cubic metres per annum.

The log export market is a crucial outlet for domestic log supply surplus, but the wood processing sector also has the potential to add significant value to each log harvested. More onshore processing, starting with the initial increases in production and employment from this, will have a multiplicative effect throughout the economy. The purpose of this paper is to quantify and discuss the macroeconomic contribution resulting from increased wood processing across a range of wood processing options.

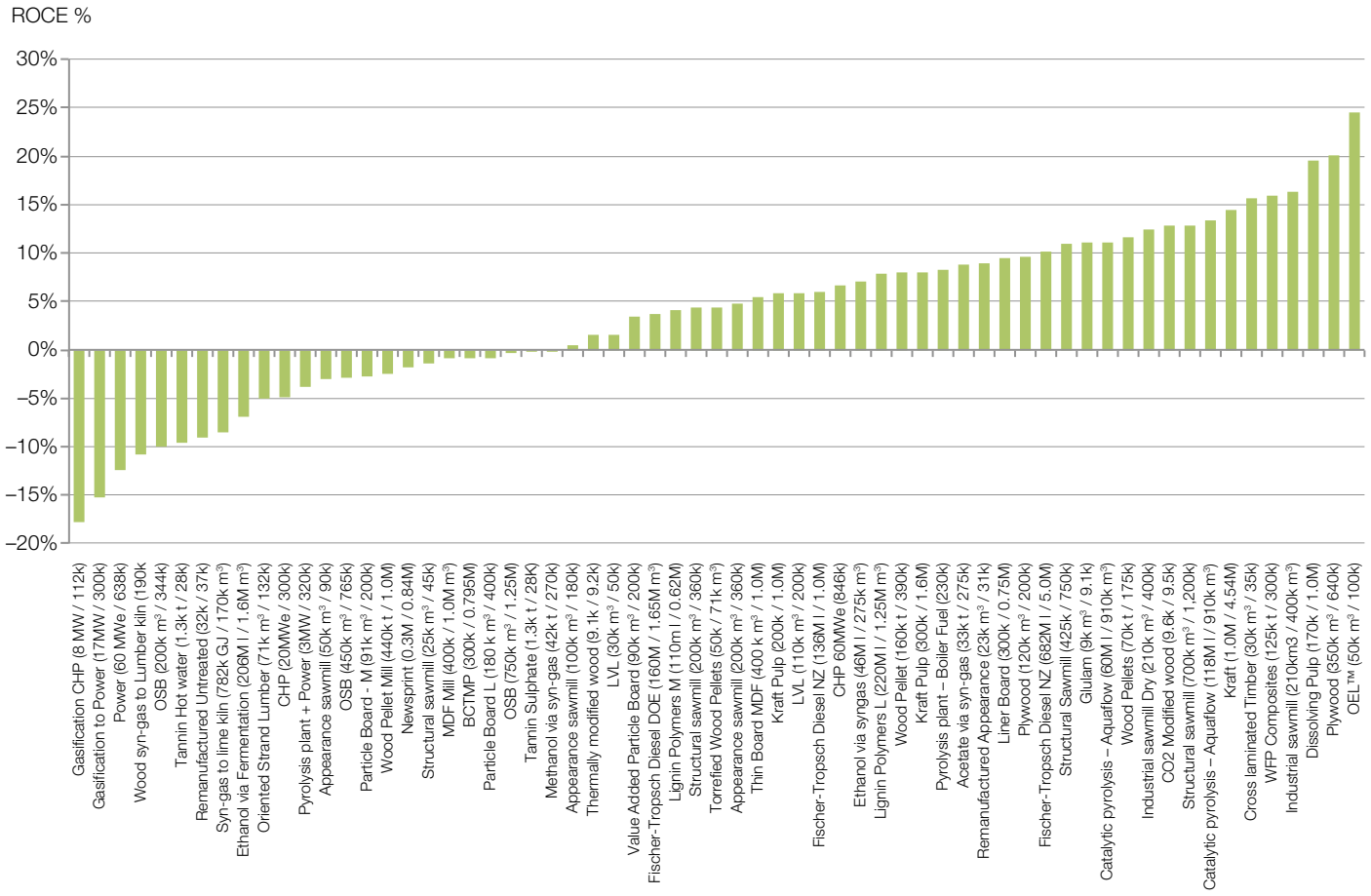
The scale of the opportunity is significant as New Zealand exported around 50 per cent (~13 million cubic metres per annum) of its ~26.5 million cubic metres per annum log harvest in 2012. Increased onshore processing of this log supply is an important part of the Woodco Strategic Action Plan (SAP). The plan states its goal is to increase export earnings from forestry and wood processing to $12 billion per annum by 2022, up from its current $5 billion. These figures for gross export earnings should not be confused with GDP figures, this being a lower figure as it is based on the value added by profitable processing and not the gross income from any processing.

Macroeconomic multipliers

A macroeconomic impact or effect refers to changes in economic activity in relation to a change in gross output. A macroeconomic multiplier is the ratio of the sum of impacts, for example direct plus indirect, to the direct impact. The effects of an increase in wood processing production in New Zealand are multiple and are generally broken down into three categories:

- **Direct** – additional domestic manufacturing, perhaps as a result of a sustained increase in offshore demand, requires manufacturers to purchase more

Figure 1: ROCE% by wood processing technology – assumes a greenfields development



wood, hire new staff, buy more electricity to power machinery and so on. These initial impacts are the direct results of an increase in production.

- **Indirect** – as a result of this initial direct increase in production every incremental purchase by the manufacturer leads to increased spending by their suppliers. They, in turn, purchase from their suppliers who buy from their suppliers and so on. The sum of these impacts is termed the 'upstream effect' as a result of the initial increase in production. The sum of the direct and indirect effects is known as a Type 1 effect or impact, while the ratio of a Type 1 effect or impact to the direct effect is the Type 1 multiplier.
- **Induced** – individuals who are employed by the manufacturer, and the firms supplying the manufacturer in some way, earn an income. After income tax is deducted, a proportion of this income will be spent on consumption in the economy, which further contributes to GDP and employment.

The sum of the direct, indirect and induced effects is known as a Type 2 impact, while the ratio of the Type 2 impact to the direct effect is the Type 2 multiplier. The main assumptions in this analysis are that:

- Impacts are assessed from an increase in gross output – we assume that there would be a sustained level of demand in order to provide a signal to increase production
- Supply-chain patterns are fixed – so any additional production results in the purchase of supplies in local, regional and national industries in fixed proportions, assuming local suppliers are able to meet this demand
- Resources are already available to meet increased demand – so each project is assumed to be a genuine source of new net economic activity
- Relative prices (of goods, services and resources) are fixed – where relative prices change then behaviour changes, the impact of which is not captured by standard multiplier analysis (NZIER, 2010).

Multipliers may overestimate the true contribution of increased production, because in reality behaviour changes as prices change and some resources will be diverted. A comparison across potential projects means that each project incurs the same over-estimation. An understanding of these limitations is important for interpretation, but should not affect the central aim of the WoodScape study, which is a comparison across a number of processing options. Note that for comparisons with actual New Zealand data only direct GDP and employment estimates were used.

Methods

Where possible, updated multipliers for 2010/11 relating to the New Zealand domestic manufacturing industry were used in this analysis. These were calculated using 59 industry input-output tables for the March 2010/11 year (Dixon, Stokes et al., 2012). These industries were grouped under 13 sub-sectors of manufacturing for which the multipliers were calculated. These multipliers were then applied to each WoodScape technology according to the industry sub-sector it related to (ANZSIC06 Codes).

The results are presented in GDP per 100,000 oven dry tonne (ODT) of wood because there is a wide range of product outputs – timber, panel, fuels, chemicals and heat – with very different conversion factors from log to product. Basing the comparison of the processing options on the volume of infeed allows a consistent comparison across the range of technologies.

To measure the overall impact of each wood processing option on the New Zealand economy, the GDP per tonne and employment per tonne values need to be multiplied by the scale of production. Different technologies in the WoodScape study have very different scales of production and potential market sizes. Plant size, based on log infeed volume, ranged from 9,000 to 5,000,000 cubic metres per annum.

GDP contribution (value added)

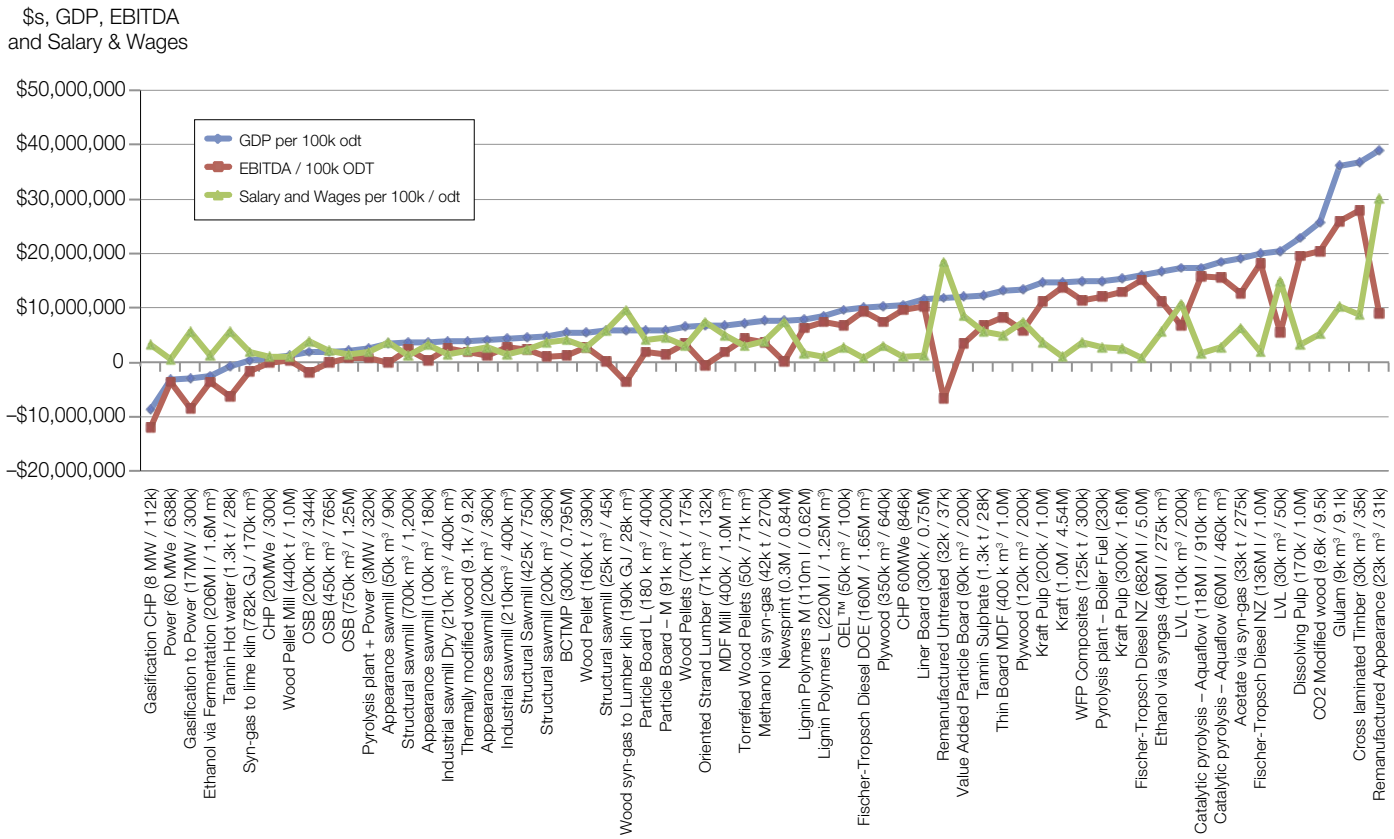
Value added refers to the gross output from a product of a firm minus the cost of the intermediate goods used to make that product. Hence GDP is calculated as the sum of the gross products. In this case, the value added for each product represents its contribution to GDP, or the increase in its contribution as a result of the production increase. Value added for each industry – GDP contribution per firm – is gross output minus intermediate consumption (Statistics NZ, 2008). The direct value added for each product is calculated as the earnings before interest tax, depreciation and amortisation (EBITDA) and total salary and wages.

The indirect and induced GDP contributions as a result of the initial increase in production were calculated by multiplying the direct value added, i.e. direct GDP, for each processing option with its associated multiplier. The impact from the majority volume product is used in cases where more than one product is produced per technology and is classified under different ANZSIC06 Codes to avoid double counting.

Employment

Employment refers to the number of full-time equivalents (FTEs) created. An FTE is classified officially as a person working 30 hours or more per week

Figure 2: Direct GDP/100,000 ODT, total salary and wages/100,000 ODT, and EBITDA/100,000 ODT for a range of potential wood processing options



(Statistics NZ, 2012). The indirect and induced FTE generation as a result of the increased production was calculated by multiplying the FTEs created directly for each processing option by its associated multiplier.

Results

Total value added is a function of direct value added and the economic multiplier for the sector that the processing option relates to. Direct value added is a function of a firm's total salaries and wages (S&W) and its EBITDA. Much of the variation in value added between technologies can therefore be explained through the variation in salaries and wages and EBITDA.

An extremely high GDP will be as a result of extremely high salaries and wages (for instance remanufactured appearance wood products) or alternatively because of extremely high EBITDA (for example glulam) or both (for instance plywood) (Figure 2). While seemingly intuitive, where salaries and wages are a low proportion of the operation's costs, the contribution of a firm to the New Zealand economy (GDP) may still be quite high because of a very profitable operation (high EBITDA and high ROCE). For example, Catalytic Pyrolysis – Aquaflow 700k (see Figure 2).

Similarly there are some processing options where the contribution to the economy may be relatively high due to salaries and wages even when the firm has low or negative earnings, for example, untreated remanufactured wood. However where EBITDA is negative, this would be a moot point because a firm could not survive in the long term to maintain this employment. Thus any option would need to have positive earnings before the macroeconomic effects could be considered.

Indirect and induced employment throughout the economy are both functions of the direct employment from each processing option and the multiplier according to the industry sector it relates to.

Macroeconomic impact

Although the macroeconomic impacts for some processing options may be quite high, these should only be considered if the outlook for the firm is good, i.e. it has positive earnings. Processing options that involve organic chemical manufacturing, such as fuel and chemical and some pulp and paper, have a relatively high Type 2 employment multiplier in comparison to some other options and would induce a larger amount of employment in the New Zealand economy.

Processing options such as reconstituted wood products, panel manufacture, sawmilling and secondary wood processing have higher Type 2 GDP multipliers, and thus the flow throughout the New Zealand economy would be higher for these products. Products such as pulp and paper perform well across value added and employment. The total GDP and employment impacts of a range of wood processing technologies are shown in Figures 3 and 4.

Figure 3: Total GDP $million per 100,000 ODT of log input for 63 wood processing options – blue bars indicate traditional technologies and green bars emerging technologies

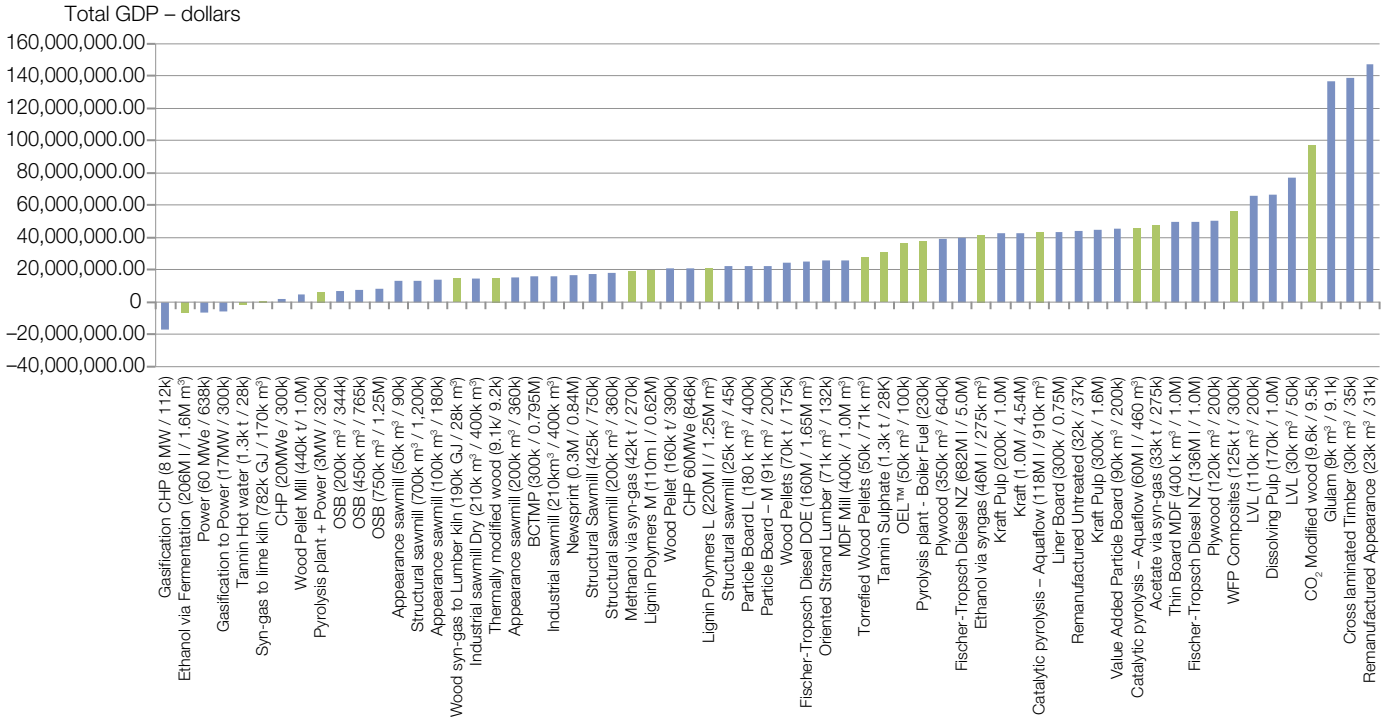
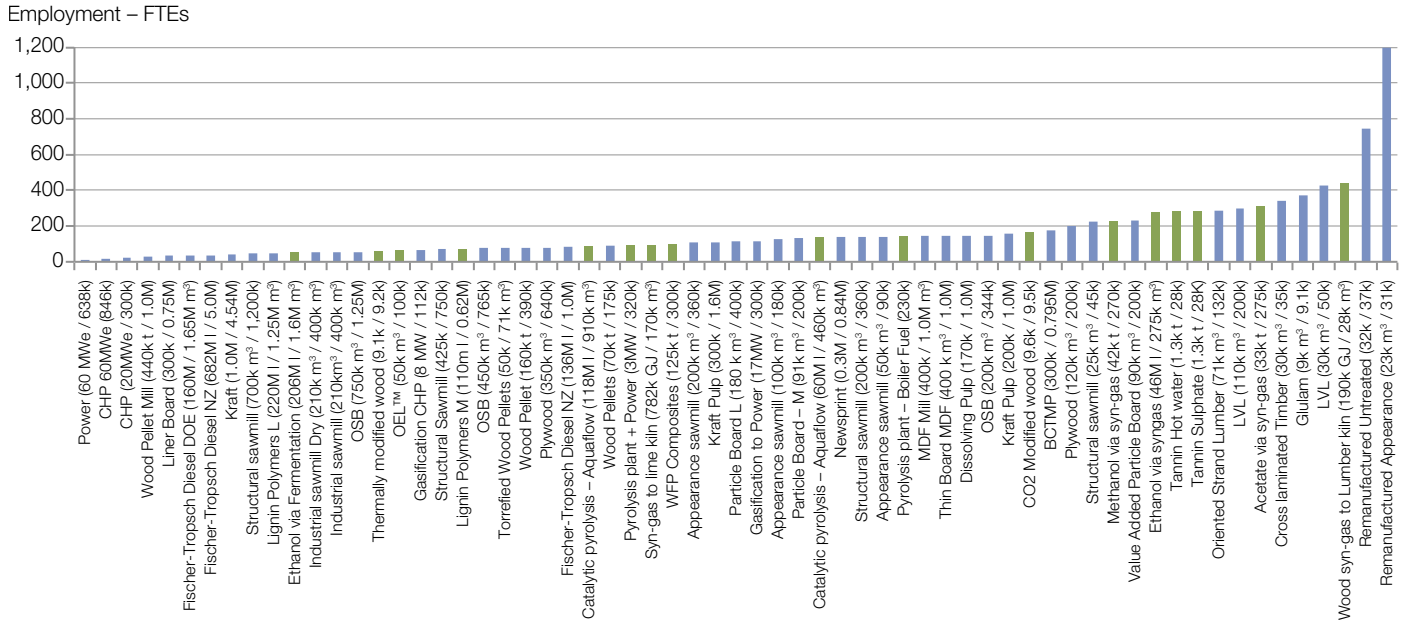


Figure 4: Total employment (FTE) per 100,000 ODT of log input for 63 wood processing options – blue bars indicate traditional technologies and green bars emerging technologies



Export logs versus onshore processing

Log exports are an important part of the New Zealand forestry market, providing an outlet for log grades not currently consumed in this country and fluctuations in wood availability. However a shift to more onshore wood processing rather than exporting logs has the potential to increase both GDP and employment. The example in Table 1 provides a snapshot of the current GDP from forestry and logging operations (Statistics NZ, 2011), along with a potential scenario that reduces the amount of log exports and increases the level of onshore processing by using average increases in GDP and employment from a collection of WoodScape technologies.

This scenario takes 11 million cubic metres of logs and applies an average GDP and employment increase for a range of first-stage wood processing technologies, then applies an average GDP and employment increase for residue processing to an approximate residual volume of 3.5 million cubic metres. Wood processing technologies were selected if they had a ROCE (greenfield value) greater than 10 per cent as these would be more likely investments.

Any options that had a negative EBITDA were also excluded as a consequence of focusing on those options with a higher ROCE. The example assumes international markets will exist to purchase the additional products at current market prices, and that the technologies built will have the capacity to process an extra 11 million cubic metres of logs each year.

It also assumes that the increase in value added from additional transport, associated with more onshore wood processing, would negate the value lost in wharfage from less export volume. From Table 1, an increase in GDP of 133 per cent is possible along with the creation of over 3,200 extra jobs.

A shift from exporting the 12.89 million cubic metres of logs currently exported to processing an additional 11 million cubic metres would lead to a net export earnings increase of approximately NZ$2 billion (Table 2).

Scenario 1 in Table 2 is conservative and uses average returns from a range of primary and secondary wood products. Focusing on just a few high value add products would give a substantially higher figure for increased export earnings. For example, if the earnings from plywood and biocrude are used then the total export earnings would be around $4.9 billion. A range of alternative earnings increases is possible based on the mix of primary and secondary products used in the estimate.

The important point is that there is potential for substantial gains in export earnings from increased onshore processing. This can be maximised by choosing high value added primary and secondary processing options that integrate together well.

Labour productivity

In this analysis, productivity is the ratio of a volume measure of output relating to a volume measure of input use. Measuring labour productivity as the contribution to GDP per hour worked helps provide a better understanding of the development of living standards.

Table 1: One possible scenario for increased GDP and employment from increased onshore wood processing

	Status quo	Scenario 1
Forestry and logging volume (M m^3)	12.89	12.89
Forestry and logging GDP (M NZ$)	825	825
Forestry and logging employment (FTE)	3,251	3,251
Log export quantity (000,000 m^3)	12.89	1.89
Primary wood processing volume (M m^3)	0	11
Primary wood processing GDP (M NZ$)	0	805
Primary wood processing employment (FTE)	0	2,800
Residual wood processing volume (M m^3)	0	3.5
Residual wood processing GDP (M NZ$)	0	291
Residual wood processing employment (FTE)	0	432
Total GDP (M NZ$)	825	1,921 (+133%)
Total employment (FTE)	3,251	6,482 (+ 3200)

Table 2: Scenario for increased export earnings from increased onshore wood processing

	Status quo		Scenario 1	
Export product	Volume (M m^3)	Export earnings (Bn NZ$)	Volume (M m^3)	Export earnings (Bn NZ$)
Logs	12.89	1.6	1.89	0.2
Primary processed	0	0	11	2.8
Residual processed	0	0	3.5	0.6
Total	12.89	1.6	16.39	3.6

This is particularly important for the WoodScape study because investment in new technologies can increase productivity, which consequently leads to improved living standards.

At a micro-level this may lead to the entry and exit of individual firms. However by reallocating these resources into more productive uses, the industry as a whole can compete better, thus providing an overall improvement in the industry's productivity.

The example below provides a comparison of New Zealand sector-level productivity and compares it with the inter-industry level productivities from the WoodScape model. The model uses statistics from ANZSIC06 classification for nominal GDP production measures (value added) for 2010 and divides them by ANZSIC96 classification measures for annual paid employment hours for 2010.

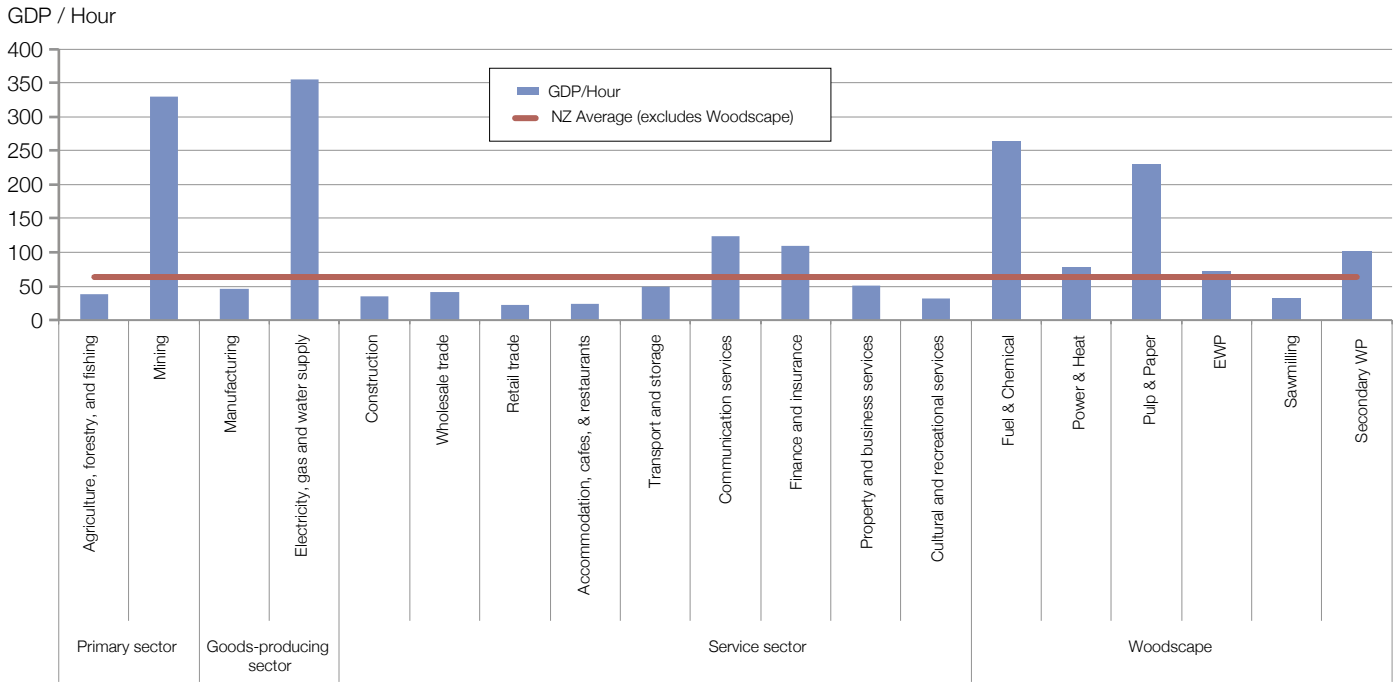
The results are then compared with the GDP measures (value added) from the WoodScape model divided by the hours worked. The overall message is that the forest industry has an opportunity to practice 'creative destruction' by reallocating resources away from traditional processing to high-value manufacturing options such as fuel and chemicals, reconstituted wood products, and engineered wood products like plywood and optimised engineered lumber (OEL™).

The opportunity for the wood processing industry to reallocate resources into technologies that perform much better than the current average manufacturing industries and the New Zealand average is highlighted in Figure 5. These technologies could be comparable to extractive industries, such as mining or gas, which have high returns for relatively low labour inputs.

Conclusion

Increased wood processing of ~12.89 million cubic metres per annum of exported logs would add significantly to New Zealand's employment and GDP, assuming a suite of profitable processing options are available. Some options offer a significant gain for the economy as they are above the national average for GDP per hour of employment, and they are potentially larger-scale operations employing significant numbers of workers.

Figure 5: Direct GDP/hour across ANZSIC06 sectors and WoodScape sectors (Source: Statistics NZ and WoodScape)



A scenario which processes the majority of current log exports could lead to an additional annual GDP contribution to the New Zealand economy of approximately NZ$1.1 billion, adding 0.5 per cent to this country's total GDP and almost 4,500 extra jobs, an increase of around 25 per cent for the sector. Export earnings could also rise by approximately NZ$2 billion, an increase of around 40 per cent for the sector based on 2012 figures.

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References

ANZSIC06 Codes. Available at: http://www.stats.govt.nz/surveys_and_methods/methods/classifications-and-standards/classification-related-stats-standards/industrial-classification.aspx.

Dixon, H. and Stokes, F. et al. 2012. *Updated Manufacturing Multipliers From 2010/11 Data*. Wellington, NZ: Business and Economic Research Ltd.

Ministry for Primary Industries. 2012. *Series, GDP(P), Chain Volume Actual, ANZSIC06 Industry Groups: Forestry and Logging*. Wellington, NZ: MPI.

Nana, G. and Boshier, J. et al. 2011. *Preliminary Analysis of the Economic Impact of the New Zealand Bioenergy Strategy*. Wellington, NZ: Business and Economic Research Ltd.

New Zealand Institute of Economic Research. 2010. *Dairy's Role in Sustaining New Zealand: The Sector's Contribution to the Economy*. Wellington, NZ: NZIER.

Statistics NZ. 2008. *Quarterly Gross Domestic Product: Sources and Methods*. Wellington, NZ: SNZ.

Statistics NZ. 2011. *Gross Domestic Product – Product Measure*. Wellington, NZ: SNZ.

Statistics NZ. 2012. *Hours Worked in Employment*. Wellington, NZ: SNZ.

Wood Council of NZ. 2012. *New Zealand Forest and Wood Products Industry Strategic Action Plan*. Wellington, NZ: Woodco.

WoodScape. 2012. *WoodScape Summary*. Available at: http://www.woodco.org.nz/strategic-plans/woodscape.

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