

Incorporating Geothermal into Wood Processing and Bioenergy

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July 2021



Why?

Residue Energy value vs disposal cost vs extra product value?

Wood processing generally produces a range of low energy density, high moisture residues

Sawdust, sander dust, shavings, chip

Some have application in secondary processing eg pellets

Remainder burned for process energy (sometimes inefficiently)

Can new high value products be made from wood residues?



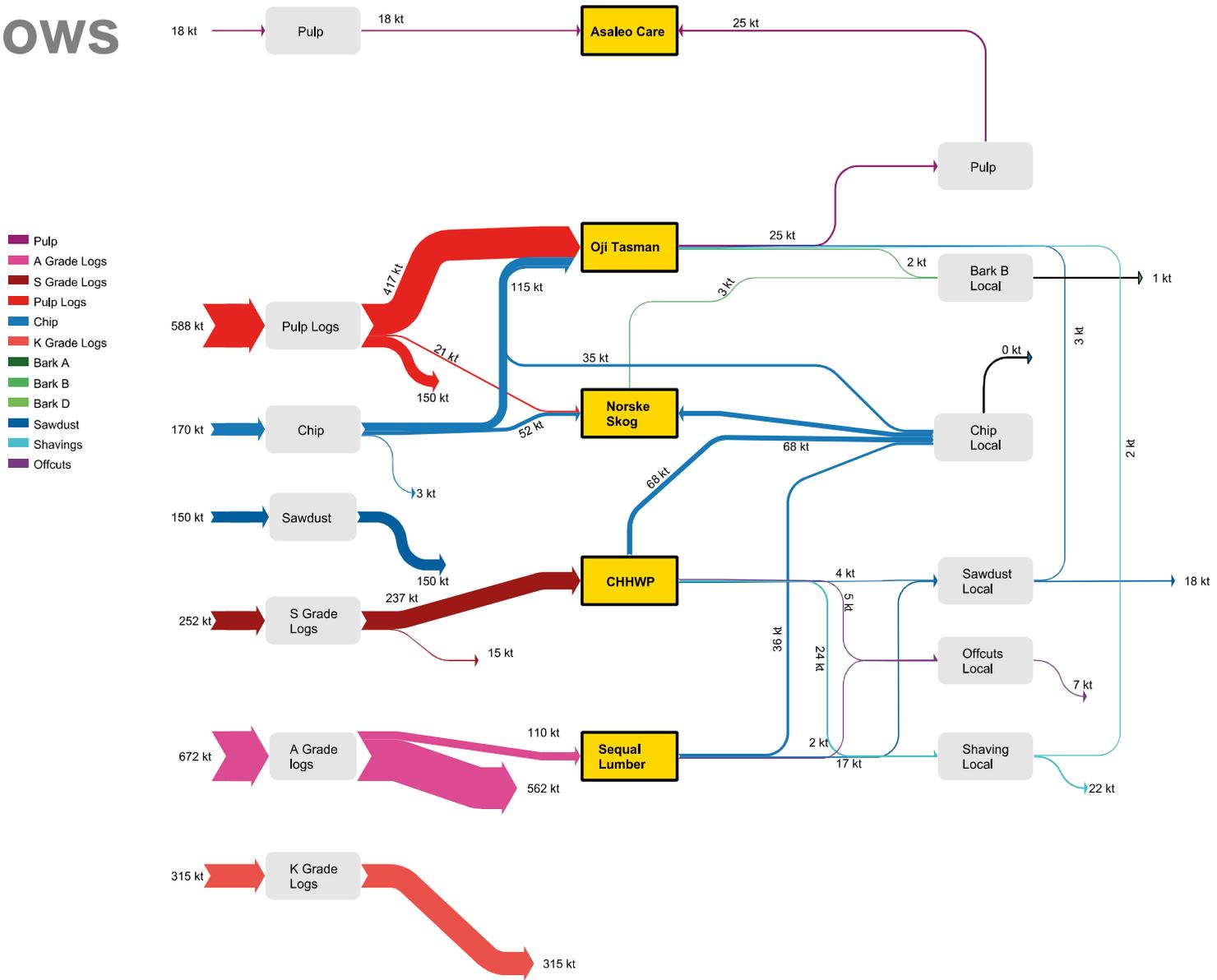
Analysis of Kawerau Residue and Energy Flows

- 5 wood fibre processing plants
 - 3 pulp mills
 - 2 sawmills
- Log yard for export log
- Large geothermal resource (3300GWh)
 - Used to some extent in all 5 processing plants
- Some re-use and some export of residues out of cluster (largely for energy)

- Can residues be used for new products rather energy value?



Mass Flows



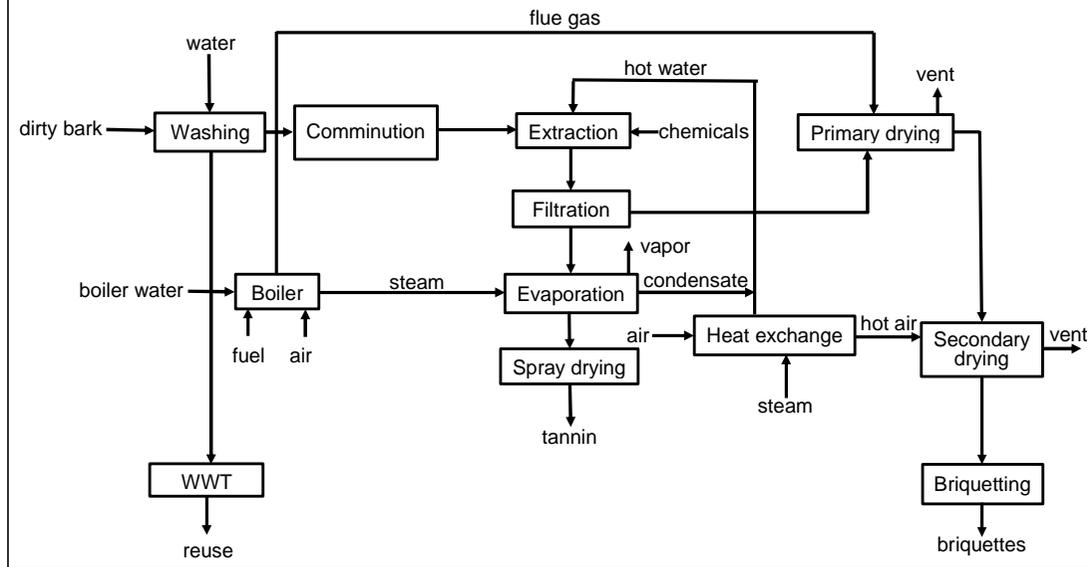
Initial screening of options

Product	Feedstock
Briquettes	Bark
Tannins	Bark
Process heat	Bark, sawdust
Wood pellets	Sawdust
Torrefied pellets	Sawdust
Terpenes	Sawdust, wood chip
Wood resin	Sawdust, wood chip
Lactic acid	Wood chip
Particleboard	Wood chip
Wood sugars	Wood chip
Transport fuels	Wood chip

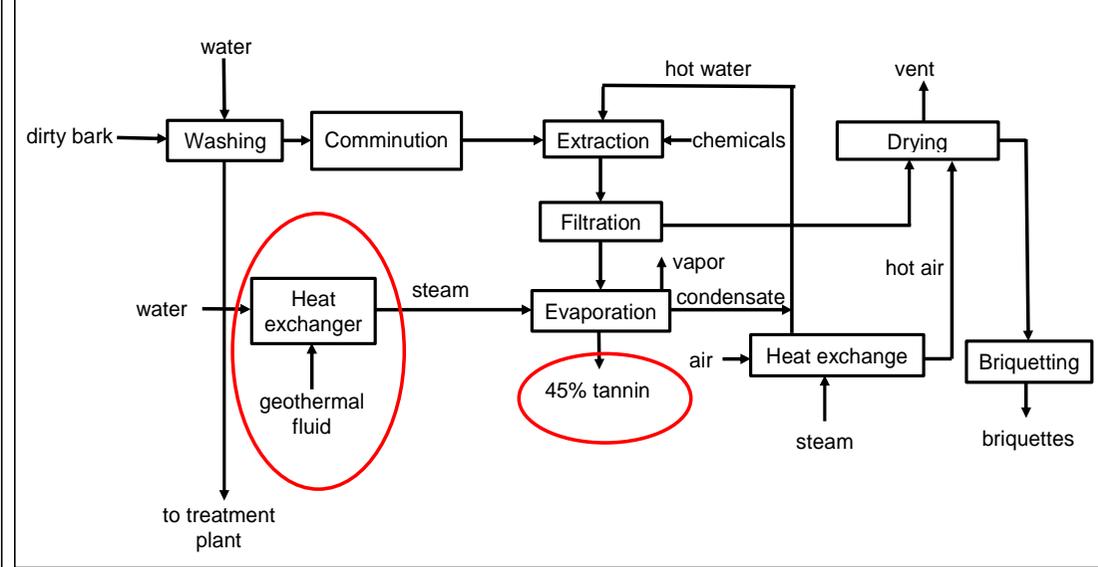
- Type of Assessment
 - Markets
 - Size, growth, price, drivers
 - Economics
 - WoodScape model based on publically-available prices and costs
 - Risks
 - Technology, commercial, market
 - Site symbiosis
 - Feedstocks, energy, transport

Tannin and bark briquettes

Greenfield



Kawerau - Brownfield



Financials for 20,000 odt pa bark processing plant

Metric	Greenfield	Kawerau
Total Opex M\$	4.3	3.9
Total Capex M\$	15.2	9.0
Revenue M\$	10.5	10.5
IRR %	8	19
NPV M\$	-3.7	15.2
Payback yrs	>22	8



Introduction of geothermal, lower wastewater costs, less drying of tannin

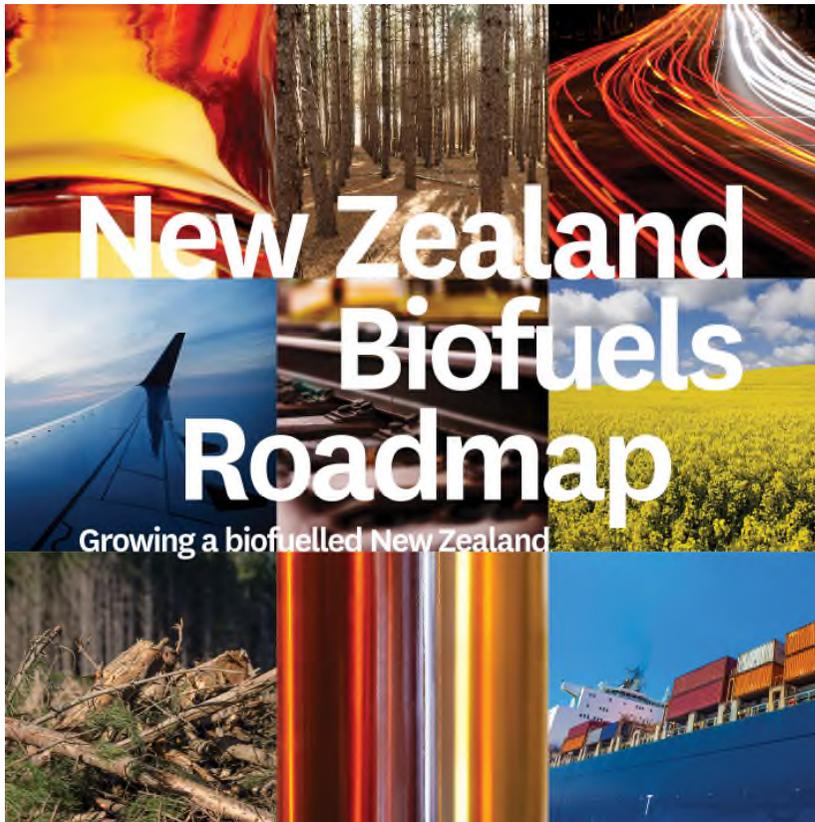
Financials for 70,000 odt sawdust to Lactic Acid plant

Metric	Greenfield	Kawerau
Total Opex M\$	16.4	18.2
Total Capex M\$	95.2	75.0
Revenue M\$	55.7	57.3
IRR %	22	28
NPV M\$	106	128
Payback yrs	7	5



Introduction of geothermal, lower waste water costs, clean lignin (energy value),

2018 Scion's NZ Biofuels Roadmap



Purpose: How large scale biofuels could become a viable economic and environmentally optimum option for New Zealand.

- 23 stakeholders (including a wide range of industry, government) acknowledged for valuable input

Key Conclusions

1. Focus on drop-in biofuels that can be used in existing vehicles, ships and planes
2. Reduce future market risk by focussing on feedstocks grown on non-arable land
3. **Plantation forest feedstocks are New Zealand's best long-term large-scale biofuel production option**
 - Develop new forestry options that grown specifically for energy

Can you make liquid fuels from wood?

Existing technology – Commercial plants being built now

Red Rock Biofuel US

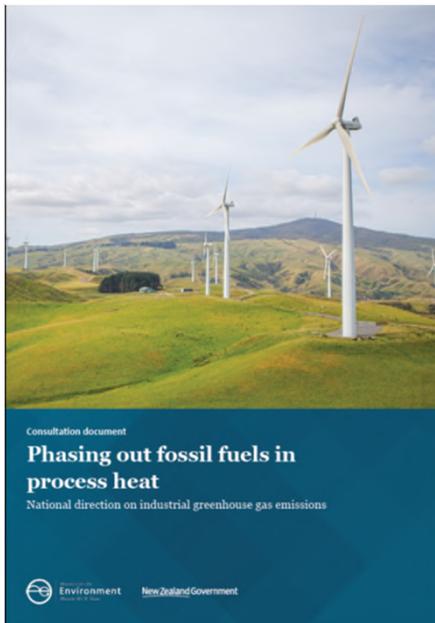


Pyrocell Sweden

Start with residues first then short rotation Forestry

New Zealand produces about 2 million te (dry) waste = 11% of New Zealand fuel demand

Policy Consultation – Wood Availability?



Replacing 500,000 tonne
Coal by 2037
= 1 million green tonnes



Increasing the use of biofuels in transport:
Consultation paper on the Sustainable
Biofuels Mandate

3.5% GHG reduction by 2025

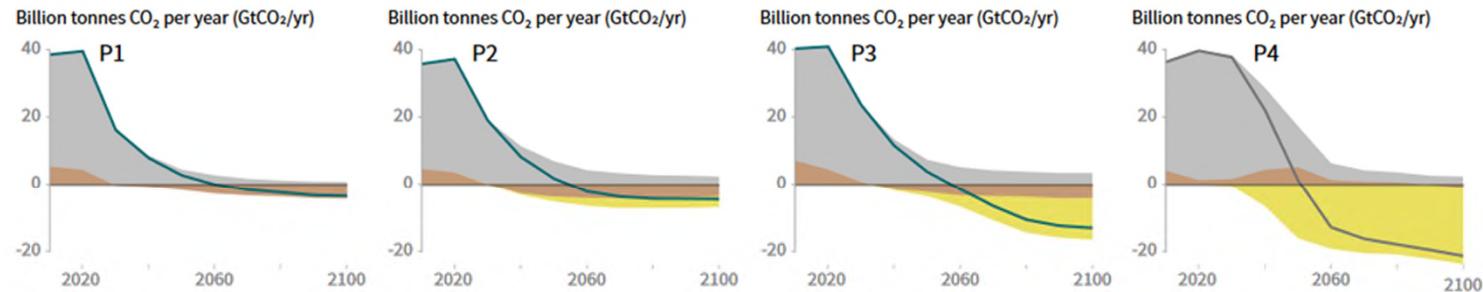
Replacing 250-400 billion litres of fuels (8 to 9B
total) by 2025
= 1.8-2.9 million green tonnes

The need for carbon capture?

Source: IPCC SR1.5 report

Breakdown of contributions to global net CO₂ emissions in four illustrative model pathways

● Fossil fuel and industry ● AFOLU ● BECCS



P1: A scenario in which social, business and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A downsized energy system enables rapid decarbonization of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

P4: A resource- and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas-intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.

Carbon capture and storage from bioenergy, but technology being developed is transferrable to Geothermal

Conclusions

- Geothermal heat has the ability to improve wood processing economics
- Releases residues for secondary processing and value creation
- Potential process heat and biofuel legislation may be gamechanger in wood/forestry sector
- Overlap between Bioenergy and Geothermal for CO₂ capture technologies

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Prosperity from trees *Mai i te ngahere oranga*

Scion is the trading name of the New Zealand Forest Research Institute Limited

Kawerau site benefits vs Greenfield site

Wood residues

Lower feedstock transport costs

Brownfield infrastructure

Adjacent to a large forest / wood resource

Lower consenting costs

Extra wood passing through the site

Low-grade heat

Rail to port access

Internal market for feedstocks, products and by-products

Eco-industrial park

Geothermal heat