Incorporating Geothermal into Wood Processing and Bioenergy

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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?

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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?

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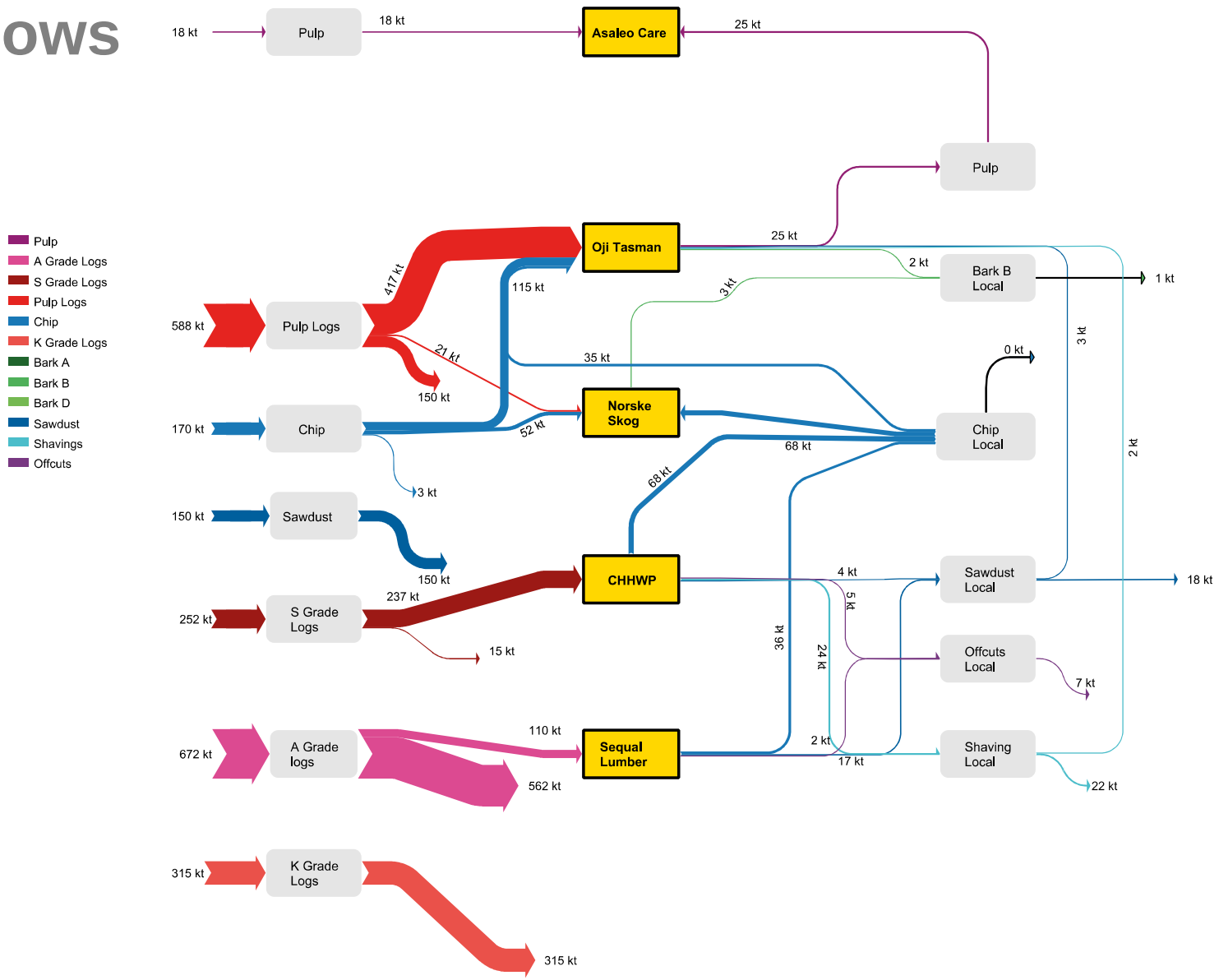
Mass Flows


Pulp
A Grade Logs
S Grade Logs
Pulp Logs
Chip
K Grade Logs
Bark A
Bark B
Bark D
Sawdust
Shavings
Offcuts
18 kt
Pulp
18 kt
Asaleo Care
25 kt
Pulp
Oji Tasman
25 kt
2 kt
Bark B Local
1 kt
3 kt
588 kt
Pulp Logs
417 kt
115 kt
21 kt
150 kt
35 kt
0 kt
3 kt
Norske Skog
170 kt
Chip
52 kt
68 kt
Chip Local
3 kt
68 kt
150 kt
Sawdust
150 kt
CHHWP
4 kt
Sawdust Local
18 kt
237 kt
5 kt
252 kt
S Grade Logs
15 kt
36 kt
24 kt
Offcuts Local
7 kt
110 kt
672 kt
A Grade logs
Sequal Lumber
2 kt
17 kt
Shaving Local
562 kt
22 kt
315 kt
K Grade Logs
315 kt

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

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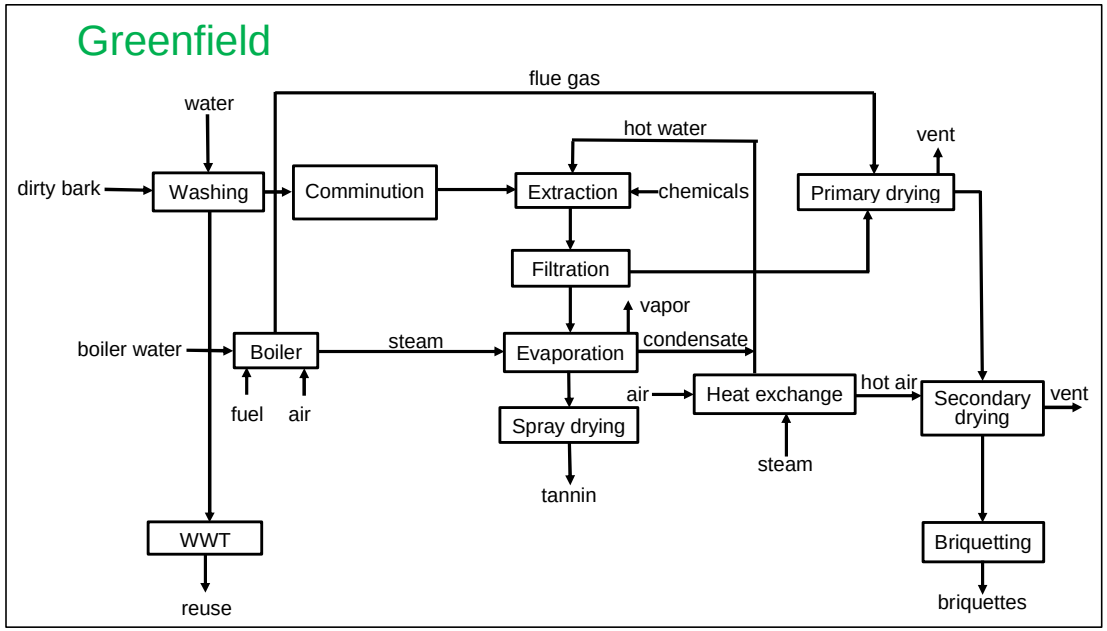
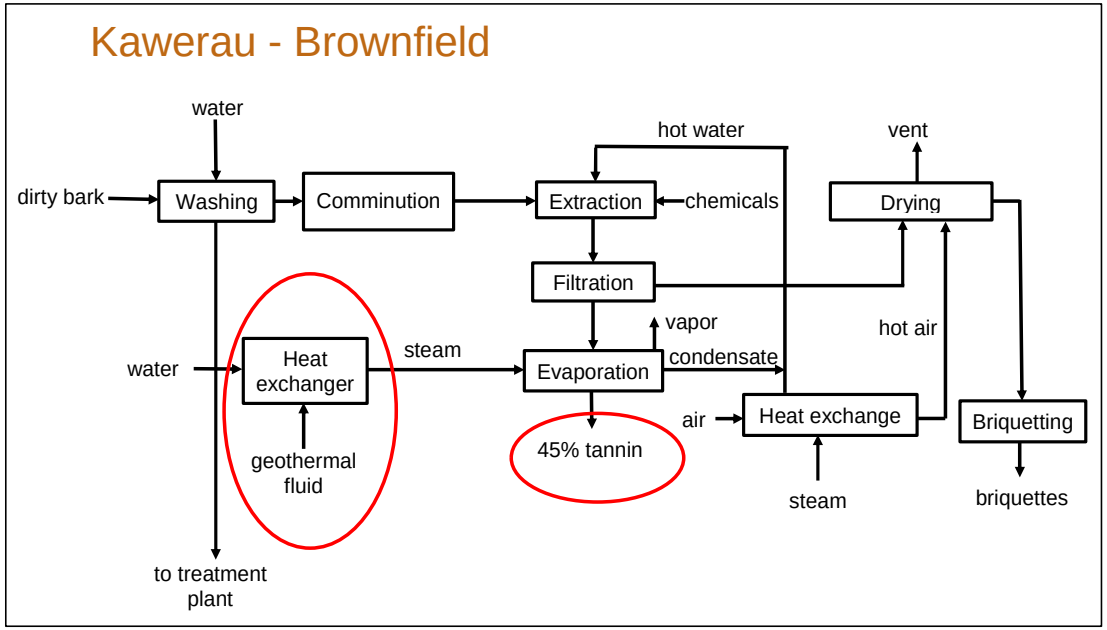
Tannin and bark briquettes





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

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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),

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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 rage 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

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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

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Policy Consultation – Wood Availability?

Replacing 500,000 tonne Coal by 2037

= 1 million green tonnes

Ministry of Transport
TE MANATŪ WAKA

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

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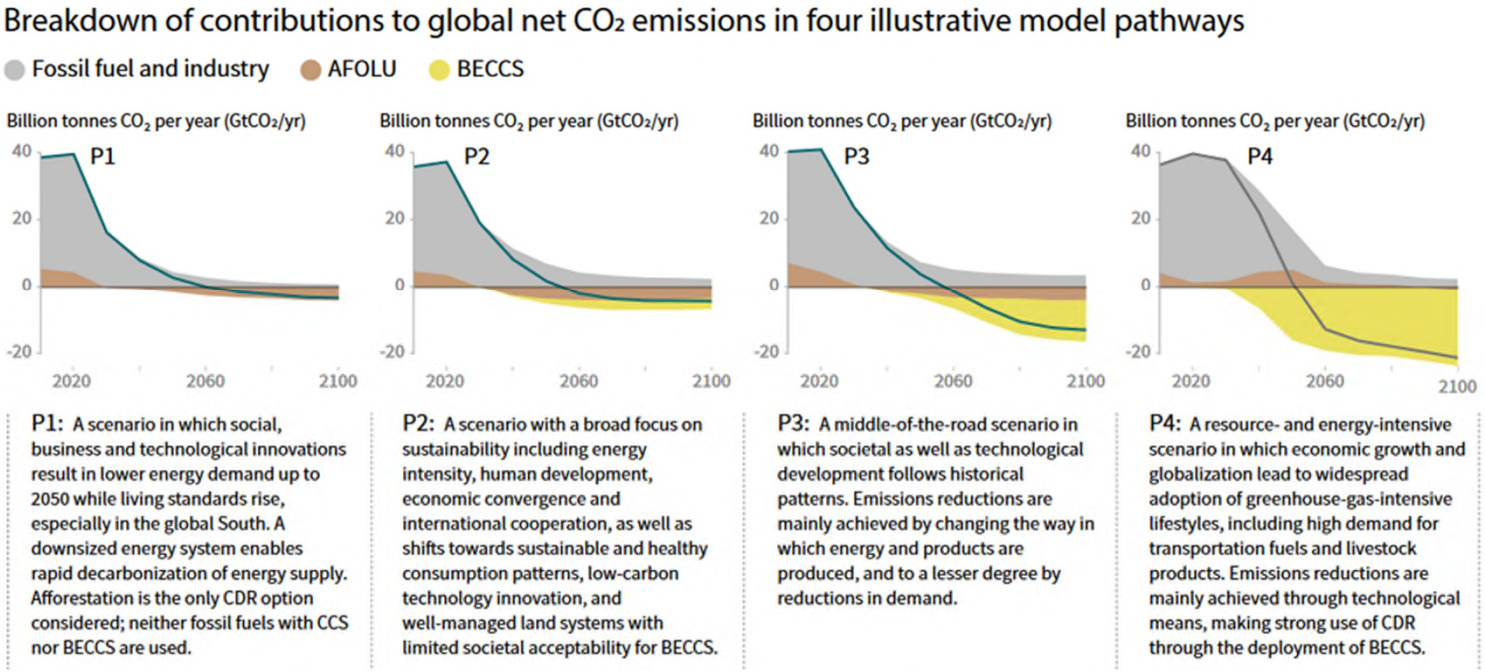
The need for carbon capture?

Source: IPCC SR1.5 report



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

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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 gamecharger in wood/forestry sector
- Overlap between Bioenergy and Geothermal for CO2 capture technologies

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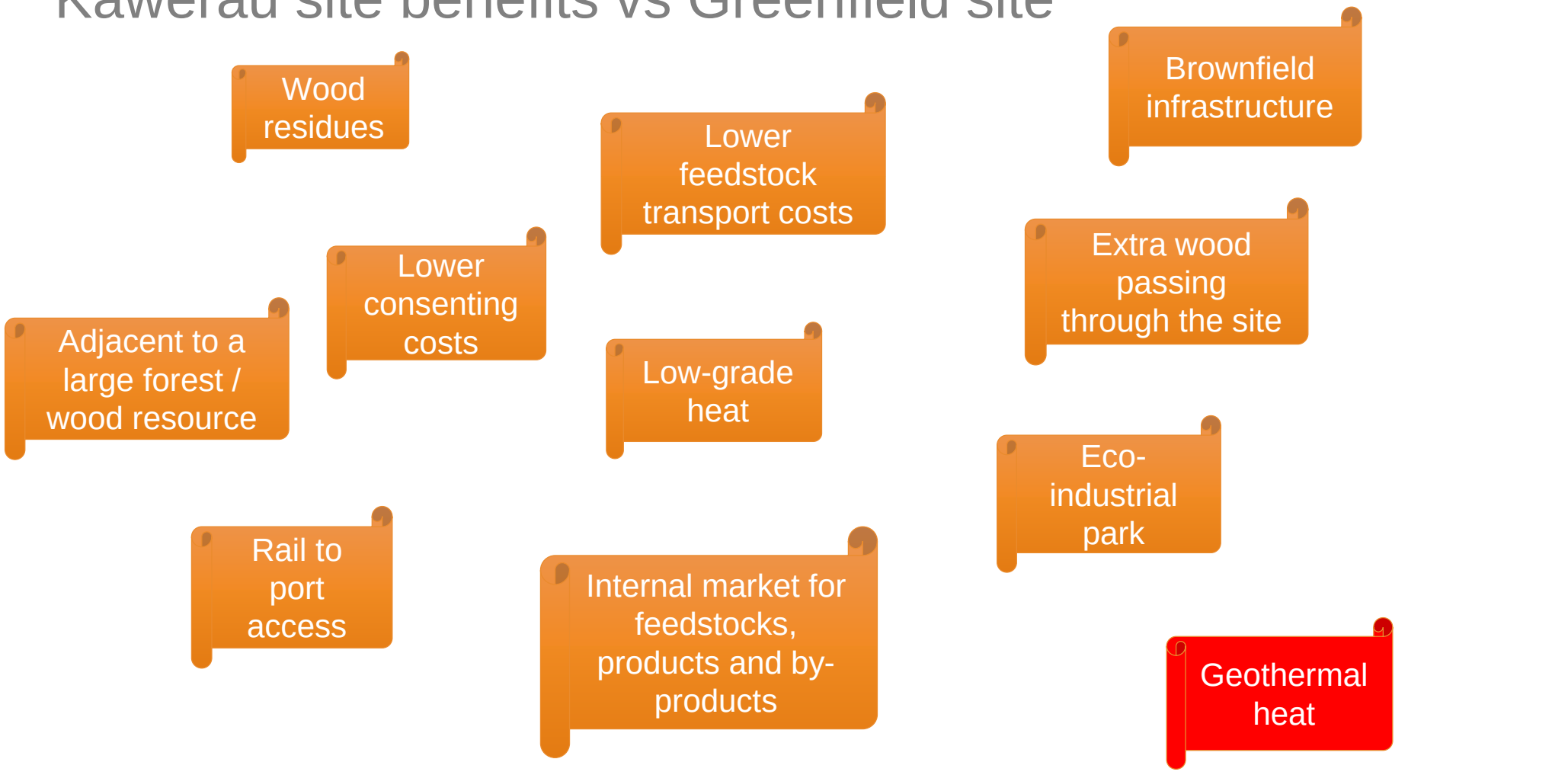
Prosperity from trees *Mai i te ngahere oranga*

Kawerau site benefits vs Greenfield site



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