Forestry Residues to Biofuels
Case Studies

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Acknowledgements

FIDA and EECA

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Central Wood Recyclers
Materials Processing
Plateau Bark

Full report available on;
www.bioenergy-gateway.org.nz
Residues to Revenues NZ 2007

National Wood Supply

New Zealand wood supply

Logging Residue Supply

Logging Residue Volumes
Residues to Revenues NZ 2007

Energy content

Energy Content of Residues

Regional supplies of landing residues

Regional Landing residue supply
### Scale

- Residues have at least **18 PJ** of energy, could rise to **50 PJ** by 2030
- Geothermal is 81 PJ
- Coal use is 140 PJ,
- Energy demand is increasing every year

### Case Studies

3 operations observed

**Aims**
- to identify issues that affect production,
- identify common issues
- and obtain some indicative production and cost data.
### Common features

- mobile plant that operates from a variety of locations
- multiple customers for the output
- a variety of feed-stocks going into the processing equipment
- a variety of materials being produced, not limited to bio-fuels
- raw material is often being obtained free of charge
- none are collecting forest cutover residues

### Ripper

![Ripper Image](image-url)
<table>
<thead>
<tr>
<th>Processing Machine</th>
<th>Ripper</th>
<th>Woodweta</th>
<th>Crambo 6000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine Size kW</td>
<td>298</td>
<td>372</td>
<td>447</td>
</tr>
<tr>
<td>Approx Cost</td>
<td>$640,000</td>
<td>$700,000</td>
<td>$800,000</td>
</tr>
<tr>
<td>Weight, tonnes</td>
<td>24</td>
<td>36</td>
<td>26.2</td>
</tr>
<tr>
<td>Height, m</td>
<td>3.9</td>
<td>4.2</td>
<td>3.155</td>
</tr>
<tr>
<td>Width, m</td>
<td>3.04</td>
<td>3.05</td>
<td>2.95</td>
</tr>
<tr>
<td>Length, m</td>
<td>10.6</td>
<td>15.85</td>
<td>6.58</td>
</tr>
<tr>
<td>Transport Operating</td>
<td>12.65</td>
<td>11.04</td>
<td></td>
</tr>
</tbody>
</table>
Case Studies Summary

<table>
<thead>
<tr>
<th>Processing Machine</th>
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<tbody>
<tr>
<td>Mounting</td>
<td>Tracks, Remote control operation</td>
<td>Semi Trailer + Partial RC operation</td>
<td>Tracks, Remote control operation</td>
</tr>
<tr>
<td>Production</td>
<td>25 to 30 t/hr</td>
<td>25 to 30 t/hr</td>
<td>20 to 40 t/hr</td>
</tr>
<tr>
<td>Dollars per tonne, on truck</td>
<td>$22 to $24</td>
<td>$18 to $20</td>
<td>$18+</td>
</tr>
</tbody>
</table>

The costs of production presented are average costs and reflect the cost of processing the material the machine was typically working in.

Differences between machines, can largely be attributed to the material being worked, the site they were operating in.
Similarities

All 3 of the observed operating systems were variations on the same basic structure of:

- 1 20 tonne excavator to in-feed material to the processing machine
- 1 processing machine (hogger)
- 1 Rubber Tyred Front End Loader to clear the out-feed and load out

Observations

None of the operations go landing to landing as normal practice.

However,

The Woodweta was working on a landing when observed, as a trial.
### Observations

Hard to work effectively on small volumes of material

Difficult to work on small, rough landings

Difficult to transport unprocessed residues cost effectively

2 staging is a compromise, adds handling and cost

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### Observations

Materials being processed are very diverse in size, shape, composition.

If it's viable, due to scale;
- segregation and accumulation of differing materials would allow different products to be created
R&D needs;

Improve the transport efficiency of unprocessed residues,

- aim of centralising the hogging and having only one transport.

This also minimises material losses at the hogger

Key Issue - Payment

All operations, both hogger and transport were being paid by the tonne.

The product is energy,
- energy content in biomass varies with moisture content,
- the weight also varies with moisture content.

More water = more weight = Less energy

Less water = less weight = More energy
Energy content of wood

Weight and energy of wood by Moisture content

Key Issue - Material Losses

In all the operations;

- processed material out of the hogger and piled on the ground.

- this costs at least 5% to 10% of the through-put of the hogger,

- Risk of contamination with dirt and stones
### Material losses

Productivity gains of 5 to 10% are possible, by processing directly into trucks.

Issues to resolve:
- truck scheduling and design
- machine design,
- site layout
- option to take the material if a scheduled truck does not arrive.

<table>
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<th>Direct loading into trucks is common in residue &amp; chip harvesting operations in USA, Australia and Europe.</th>
</tr>
</thead>
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<tr>
<td>The cost of the hogging equipment is in the order of $350 to $400 per hour,</td>
</tr>
<tr>
<td>- truck cost is $140 to $170 per hour</td>
</tr>
<tr>
<td>- better to have a truck waiting for 10 to 15% of its time (loading or queing), than to have 10% of the production from the hogger wasted.</td>
</tr>
</tbody>
</table>
Material losses

10% loss of 250 tonnes a day = 25 tonnes (1 hours work?)

25 tonnes * $30/tonne = $750/day of revenue

5800 tonnes or $174,000 per annum

Competition

Competitor fuels are coal ($4.5 to $5.5 per GJ) and gas ($5.5 to $6.5 GJ).

On short hauls, forest residues can be delivered at $3.0 to $3.5 per GJ.

However there are fuel handling costs with residues that the others, especially gas, do not have.
Conclusions

Cost is critical, must be as low as it can

- Reduce handling losses (material losses)

- Reduce transport costs

- Optimise hogger for raw material input and specification required of output

Conclusions

Scale of opportunity is significant:

- for no new investment in land or crops or time we can get several hundred thousand tonnes of fuel.
What is the energy balance? (Is it worth it?)

Diesel in
= 2600 litres /day at 35.8 MJ/l = 93 GJ
Hog fuel out
= 250 tonnes at 50% mc (8.5 gj/t) = 2125 GJ

Energy balance 22:1 (22 units out for 1 in)

Convert hog fuel to heat/steam @ 65% efficiency = 14:1
Convert hog fuel to heat/power @ 70% efficiency = 15:1
Convert hog fuel to ethanol at 160 litres/m3 (solid) = 7:1?

No account for energy used in growing.

That's all!!

Any Questions?