Analysis of on-site energy generation options for
sawmills from process residues

Michael Jack and George Estcourt

Talk Overview

- Sawmill residue use in New Zealand
- Potential options for unused residues
- Sawmill case study
  - Assumptions
  - Heat-demand calculations
  - Economic evaluation of options
- Conclusions

Based on a EECA funded feasibility study.
High use of residual biomass for heat in NZ sawmills
- National average 85%

North Island Sawmills: Installed Capacity
- Biomass: 74%
- Coal: 5%
- Co-firing: 12%
- Gas: 9%

South Island Sawmills: Installed Capacity
- Biomass: 94%
- Coal: 2%
- Co-firing: 4%
- Gas: 0%

Given increasing energy prices, what are some of the options for these residues?
Potential options for excess residues

- Sell residues (business as usual)
- Electricity generation
  1. Stand alone gasifier + generator
  2. Cogeneration via high-pressure boiler + steam turbine (boiler replacement option)
- Wood pellet production
  3. On-site production using portion of sawdust and shaving residues
  4. Increased production using all sawdust and shavings and importing forest residues to fuel boiler

Gasifier + genset option

- Residues
- Gasifier+genset
- Steam for sawmill heat demand
- Boiler
- Electricity to meet sawmill base-load (10-15 c/kWh)

Sold ($1-15/t)
Cogeneration option

- Residues
- High-pressure boiler
- Steam turbine
- Steam for sawmill heat demand
- Electricity to meet sawmill base-load (10-15 c/kWh)
- Sold ($1-15/t)

Wood pellet option

- Residues
- Boiler
- Wood pellet plant
- Wood pellets ($200/tonne)
- Steam for sawmill heat demand
Increased wood pellet production option

Forest residues ($50/t) → Residues → All sawdust and shavings → Boiler → Steam for sawmill heat demand → Wood pellet plant → Wood pellets ($200/t)

Sawmill case study assumptions

• Processing: 100,000 m³ of sawlogs
• Current boiler: 7.5 MW boiler (low pressure, 75% efficiency)
• Kilns: 2 x medium temp (90/60), 1 x high temp (120/70)
• Product mix: 85% timber kiln dried: 35% to 16% m.c. (dry basis) and 50% to 30% m.c. (dry basis) for CCA treatment.
Residues: volume and current sales price

<table>
<thead>
<tr>
<th>By-product</th>
<th>Percentage</th>
<th>Value ($/t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chip</td>
<td>28%</td>
<td>58</td>
</tr>
<tr>
<td>Bark</td>
<td>2%</td>
<td>15</td>
</tr>
<tr>
<td>Sawdust</td>
<td>7%</td>
<td>2</td>
</tr>
<tr>
<td>Wet Shavings</td>
<td>4%</td>
<td>1</td>
</tr>
<tr>
<td>Dry Shavings</td>
<td>3%</td>
<td>1</td>
</tr>
<tr>
<td>Pins/Fines</td>
<td>2%</td>
<td>2</td>
</tr>
</tbody>
</table>

1 by solid wood volume  
2 sell price of residue (BAU)

Evaluating economic return from options

- Determine kiln heat demand
- Determine volume of residual biomass
- Determine return from option
- Residue, electricity or pellet sale price

Capital and operational Costs of option
Kiln heat demand modelling

- Need heat demand to evaluate options
- **Measurement difficult and expensive**
- Kiln heat demand can be calculated via Scion full stack model

Kiln heat demand profiles

Assumptions: 60 m³ charge, 50 mm thick timber, 150% (db) to 16% (db), heat up time 3 hours
Heat duration curve over one year

Heat demand: 24,000 MWh/year

Typical daily profile of electricity use

Avoided cost of electricity: 13.6 c/kwh

Base electricity load: 200 kWe from kilns

Residues to Revenues 2009
Comparison of options for sawmill case study

<table>
<thead>
<tr>
<th></th>
<th>Gasifier + genset</th>
<th>Wood pellet production (3000 t/year)</th>
<th>Wood pellet production (6700 t/year)</th>
<th>Cogeneration (HP boiler + turbine)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital</td>
<td>$1.1M</td>
<td>$2.1M</td>
<td>$2.9M</td>
<td>$1.6M+$1.2M</td>
</tr>
<tr>
<td>Operating costs</td>
<td>$60k/year</td>
<td>$250k/year</td>
<td>$270k/year</td>
<td>$20k/year</td>
</tr>
<tr>
<td>Net revenue above BAU</td>
<td>$120k/year</td>
<td>$300k/year</td>
<td>$600k/year</td>
<td>$140k/year</td>
</tr>
<tr>
<td>Internal rate of return</td>
<td>9%</td>
<td>13%</td>
<td>20%</td>
<td>4%</td>
</tr>
<tr>
<td>Payback time</td>
<td>9 years</td>
<td>7 years</td>
<td>5 years</td>
<td>13 years</td>
</tr>
</tbody>
</table>

*Compared to replacing current low-pressure boiler with equivalent (Capital cost: $750 k)

Conclusions

- Require site-specific data for accurate evaluation of options
- Electricity generation difficult at current prices
- On-site wood pellet production worth considering
- Scion has an approach to assist evaluation of options in specific cases