Biomass availability and supply for co-firing projects in Alberta

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About FPInnovations

- A private non-profit Canadian corporation
- Supports competitiveness of the Canadian forest sector through science, technology and innovation
- Facilitates collaboration between industry, government, suppliers and colleges/universities
- Focused on real business needs and opportunities, for today and for the future
- A proven track record of delivering bottom-line impact and positive return on investment
Supporting over 200 industry members and govt. partners from coast to coast
Canadian fiber supply

Canada:
- 400 million ha forest land
  - 8% private land
  - 78% Provincial Crown land
- 140 million m³/a annual cut

British Columbia:
- One of the largest public forests on earth
- Only 5% private ownership
- 10% protected areas
- 63 million m³/a annual cut

Finland:
- 21 million ha forest land
  - 70% private
  - 30% public
- 55 million m³/a annual cut
In Alberta, forest lands cover about 35 million hectares (Green Area).

Out of which, 13 million hectares (37.47%) are available for timber harvest.

Average AAC and annual timber harvest are 28.31 million m$^3$ and 22.54 million m$^3$ in the period of 2003-2013, respectively.
Mountain Pine Beetle in BC

- Approximately 18 million ha have been affected by MPB
- In the interior, MPB affected stands may mean lower harvest levels and lumber production and reduced sawmill residuals
- MPB stands have provided a new source of fibre from harvest residues
Industry transformation

The industry has transformed considerably of the last decade:

- 15 years ago most residues were burned in beehive burners
- BC was hit by the MPB
- The federal and provincial governments have done a lot to support the transformation of the industry
- Industry has and is investing to modernize their operations
- 300 MW of bioenergy added through the Pulp and Paper Green Transformation Program
- The pellet industry in BC was established as the pioneer of the bioenergy industry in Canada
- Today integrated companies have added bioenergy into their strategic portfolios across the country
- Residual forest biomass is starting to be recognized as a product - not waste
Bioenergy capacity in BC

- Pellets: 51%
- Co-gen at P&P: 33%
- Independent Power Producers: 13%
- Biodiesel: 2%
- Community Heating: 1%
- Biogas: 0%

There are currently 12 pellet plants in BC with the annual production capacity of 2.2 million tons.

The annual production level of wood pellets in BC is over 1.7 million tonnes.

Primary feedstocks for pellet production are mill residues (1,185,500 Odt) and low-grade logs (435,750 Odt).

Forest-origin Biomass Sources in Canada

- **Two main sources**
  - Harvest residues
  - Non-merchantable residuals (non-merchantable, insect- and fire-killed trees)
Feedstock cost is key to competitiveness

- Delivered wood cost to mill is the single largest component of final product cost (40 to 60%)
- Failures of bioenergy projects are often due to insufficient attention to the feedstock supply (volumes, costs, quality & fluctuations)
- Currently no high value product for biomass, therefore low cost is expected
Canada is the world leader in the large scale production of forest biomass

Grinding/chipping operations

Transport
Biomass price ranges

Sawmill Residues & hog fuel

Harvest Residues

Roundwood

CAD$/dry tonne

10 – 60

40 – 120

80 – 120

CAD$/GJ

0.5 – 3

2 – 7

4 – 7
Biomass type will greatly affect supply costs

From MWD to sawdust and bark to branches and tops to roundwood to small trees to ….
Supply chain costs
Residues from roadside stroke-delimber

Pre-piling
- Transport:
  - 120 km one-way, live-floor chip van
- Other:
  - roads, supervision, overhead, maintenance, compliance, stumpage

Comminution

$/ODt

$0.00
$10.00
$20.00
$30.00
$40.00
$50.00
$60.00
$70.00

$8.48
$21.58
$25.60
$6.30
Supply costs – Transport

- Transport constitutes often 40-60% of total delivered cost
- Distance to cut block
  - +/- 17 $/odt for the first 50 km
  - + 10 $/odt per additional 50 km

250 km
+/- 57 $/odt
Cost reduction strategies
The basic challenge

Transporting a low-value, low bulk-density material with a high moisture content over a long distance

after Hakkila 1999
Integration of operations
New technology development & implementation
Transport energy not water

55%

15 $/green tonne

Transport cost

9.50 $/MWh

4 $/MWh for transporting water

35%

5.50 $/MWh

Little incentive to improve practices with payment on a green tonne basis
Availability
• Seven large Timber Supply Areas of BC (52% of BC’s AAC) have been analyzed for availability of harvest residues
• Cost estimates are made by cutblock for grinding/chipping the residue and for transporting it to the nearest likely processing facility – bioenergy plant or mill
• Average delivered cost of forest residues could change in a range of $60-82/Odt for the 12 studied locations.
Fibre availability in BC

• There is a lot of biomass around but sustainable and economically-viable volumes need to be established
• Biomass Ratio is approximately 30-36% = biomass / merch roundwood (including MPB areas) at any price
• Biomass Ratio is 6-15% at a price of $60/odt
Biomass yield is 20-24 odt/ha in interior
Biomass yield is ~31 odt/ha in interior MPB areas
Biomass yield is ~31 odt/ha in coastal areas
Alberta biomass availability study

- 2013 FPInnovations study for CCPC – 300 MW Coal Power Plant
- 100 km and 150 km radius of Edmonton
- Availability based on Alberta Government information
- Whole tree wood chips from wood lots (50% owner participation assumed) PLUS unused AAC from FMUs.
- Forest residual wood chips (from FMUs)
  - ~ 400,000 ODt/year within 100 km
  - ~ 2.4 M ODt/year within 150 km

<table>
<thead>
<tr>
<th>Forest Biomass Source</th>
<th>Quantity (ODt)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 km Radius</td>
</tr>
<tr>
<td>Whole Tree Chips</td>
<td></td>
</tr>
<tr>
<td>Woodlots</td>
<td>216,526</td>
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<tr>
<td>FMU (unused AAC)*</td>
<td>110,542</td>
</tr>
<tr>
<td>Forest Residuals</td>
<td></td>
</tr>
<tr>
<td>FMU</td>
<td>76,655</td>
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<tr>
<td>FMU (over AAC)**</td>
<td>6,591</td>
</tr>
<tr>
<td>Total</td>
<td>410,314</td>
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</tbody>
</table>

*Unused Annual Allowable Cut (AAC) is the difference between the current AAC level and the historical harvesting level
**Over AAC is the amount of woody biomass not harvested within the current AAC
Alberta harvest residue availability

- 2016 FPInnovations study
- A representative site was selected for conversion of forest residues
- Located between Grande Prairie and Grande Cache
- Radius of ~ 100 km around chosen delivery point
Alberta harvest residue availability

- Biomass yield is 18.9 odt / ha
- Biomass ratio is 19.8% (biomass/merch roundwood)
- 2.4 M odt available at $90/odt
- At market rate of $50/odt:
  - 1.3M odt are available over 20 years
  - 65,000 odt/yr
- Average price is $51.11/odt for all biomass
Alberta harvest residue availability

- If 50% of hardwood stems in the area became available for biomass, total available jumps to 4.5 M odt, but amount at $50/odt remains the same – because of harvesting cost for full stem.
- Average price $81.72/odt
British Columbia & Alberta summary

- Depending on the region, there are large untapped volumes of harvest residues available.
- Certain areas have a tighter fibre supply.
- Existence of established supply chain.
- Existing rail network is a major advantage.
- Burning of harvest residue piles is becoming more challenging.
- Potential sources of residues may become available from thinnings, FireSmart treatments, right-of-ways, road sites, urban forestry.
Benefits for Alberta

- Provides energy with low carbon footprint
- CO\textsubscript{2} emissions offset
- Significantly reduced burning of harvest residues
- Opportunity for fire mitigation strategies
- New revenue stream for forest industry and contractors
- De-centralized economic benefits
- Utilizes local renewable resources
- Existing infrastructure and knowledge
- Improve forest health and offset reforestation activity costs
Conclusions

- There is lots of biomass but sustainable and economic volumes need to be established on a local case-by-case basis with major tenure holders.

- Development of residue recovery systems
  - Better integration with conventional harvest
  - Tailored biomass supply chains
  - Introduce new truck configurations with higher allowable GVWs

- Plenty of additional untapped resources
  - Harvesting of fire-killed stands
  - Stand conversions
  - Marginal Forest Opportunities

- New breakthrough technologies are coming:
  - Develop innovative logistic solutions
  - Create clean white wood from harvest residues