Wood pellet plant cost study for the forests of North Eastern Ontario

August 26, 2008
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1. Introduction
Introduction
Overview of the Deloitte Engagement

• Westwind Forest Stewardship Inc., in cooperation with six other Sustainable Forest License management companies (“SFL” or “SFLs”) in the Ontario Great Lakes / St. Lawrence (“GLSL”) region and the Ontario Ministry of Natural Resources (“MNR”), are exploring opportunities to utilize lower quality timber products available for harvest (biofibre including merchantable unmarketable wood and tops) within each of these forests.

• With rising fossil fuel prices and carbon emission policies being implemented by governments around the world, particularly in the EU under the Kyoto Protocol, there is a growing global demand for alternative, low carbon, renewable fuel sources.

• Wood pellets provide a clean, diversified energy solution and while Canada is already a major producer and exporter of wood pellets, Ontario, through its skilled forestry sector and underutilized biofibre, has an opportunity to be a significant contributor to this growing industry.

• Deloitte & Touche LLP has been engaged by Westwind Forest Stewardship Inc. as a coordinating body to carry out a cost study with regard to encouraging a wood pellet industry in the GLSL region, including an analysis of available fibre supply, potential plant locations, pellet plant capital outlays, operating costs, and financing costs.
Introduction
Purpose and limitations of this Report

• The purpose of this report is to:
  – Gather and analyze crown fibre supply data from the seven participating SFLs to determine potential wood pellet production levels;
  – Assess and recommend sites for wood pellet plants, including output levels; and
  – Develop a cost per tonne model for wood pellet plants based on recommended sites and production levels.

• Limitations of this Report:
  – Crown fibre supply is based on estimates of current availability as confirmed/adjusted by SFL managers. They include assigned but not utilized volumes in certain forests. None of the fibre supply being considered in this study is known to have been committed to wood pellet production as yet.
  – Available and accessible data on wood pellet plant costs is limited. This study provides a current and high level cost analysis. More detailed data can be found through carrying out a detailed business plan for a specific proposed pellet plant or group of pellet plants, including securing supply and equipment contracts and conducting a complete wood pellet market analysis.
  – This analysis has been conducted to FOB mill cost of production. Domestic and international wood pellet demand, market pricing, post manufacturing logistics and transportation costs, sale contracts, and other elements have not been considered and would be necessary for a detailed study on feasibility.
  – This report contains a high level assessment of cash flows for selected sites. These cash flows are not intended to be relied upon for investment purposes. Final investment decisions should be based on detailed business cases carried out on a site by site basis.
Introduction
Approach

• The study followed the approach laid out below, which carries through in the flow of this report. Details of each step can be found on the following slide:
Introduction
Methodology

Fibre Supply and Harvest Costs
- Review and mine MNR data on Crown fibre
- Provide SFLs with summary data for review and collect known private and First Nations volumes
- Follow up with SFLs and MNR regarding any discrepancies and confirm final volumes for this study

Plant Location Analysis and Recommendations
- Determine key needs and constraints, leading to criteria for long and short lists
- Interview SFLs and MNR to apply criteria and determine long list
- Review fibre supply findings and other considerations for short list and final site recommendations

Capital, Operating and Financing Costs
- Conduct extensive research on wood pellet plant process, components and costs
- Develop financial model and review for gaps and opportunities
- Customize model for each selected site
- Finalize model and conduct sensitivity analysis

Synergies and Other Considerations
- Review of broad infrastructure requirements
- Trends in market contracts
- Opportunities for synergies
- Review of refined pellet product and potential applications
- Moisture content considerations

Sources
- MNR and SFL managers
- SFL managers, MNR, industry sources, published reports and studies
- Industry sources, equipment and pellet manufacturers, published studies and reports
- SFL managers, industry sources, equipment and pellet manufacturers, published studies and reports

• This report sites a number of references throughout, details of which can be found in Appendix D.
2. Background
Background
SFLs participating in the wood pellet plant cost study
Background
Overview of the wood pellet industry

- Wood pellets are a near carbon neutral source of renewable bio fuel used for both heat and power generation:
  - Home and commercial heating systems can be easily fit or retrofit with pellet burning furnaces (small and medium scale use);
  - Existing coal fired power plants can be converted to fire or co-fire wood pellets with minimal capital investment (large scale use) and significant emissions reductions; and
  - Wood pellet manufacturing plants are being built in conjunction with Combined Heat and Power (CHP) plants in both Europe and North America that use a portion of the pellets produced to generate power, which is sold into the grid, use part of the power generated parasitically, and distribute the heat through a district heating system to local businesses and institutions.

- Wood pellets are readily transportable by sea, rail, and road. This leaves few markets, if any, inaccessible.

- As a clean, renewable, high energy density, portable, and easy to use energy source, wood pellet demand is expected to increase steadily over the next decade, including through the expansion of major potential markets such as Asia and Eastern Europe.

- A January 2008 Standard & Poor’s Industry Survey\(^1\) on the paper and forest products sector noted opportunities in biofuels and large scale production of biomass as “one of the more promising opportunities for the forest products industry,” particularly given rising fossil fuel prices and increasing environmental concerns.
Background
Wood pellet global production and markets

• A November 2007 IEA Bioenergy\(^2\) report on global wood pellet markets cites the largest producer of wood pellets globally as Sweden, followed by the United States and Canada, with the latter driven by export opportunities due to low domestic sales.

• Russia is noted as having the potential to be one of the largest exporters of wood pellets but its success will be largely dependent on economic and political considerations, including the issue of significant tariffs recently increased to 15% on wood exports to Europe.

• Major international wood pellet markets include Sweden, along with Austria, Italy, Germany, the Netherlands, Denmark and Belgium. Because biomass carbon credits follow the end user rather than the producer under the Kyoto Protocol, the report notes, these countries will likely continue to be predominantly importers of wood pellets.

• The chart on the right shows annual pellet consumption for Scandinavian, European and North American countries by end use.

• While Canada noticeably consumes very little, a June 2008 presentation by proPellets Austria\(^3\), concluded that "Canada is in a very good position to become an important player in the international pellet market."

![Chart showing annual pellet consumption for Scandinavian, European, and North American countries by end use. Source: proPellets Austria, October 2007](chart.png)
Background
The wood pellet price opportunity

• In a June 2008 presentation, Pinnacle Pellet Inc. described what it referred to as the Pellet Price Opportunity, which illustrates the equivalent price of one tonne of wood pellets, on an energy output basis, as compared to oil and natural gas.

• At current energy prices, there is a clear fuel cost advantage associated with the consumption of wood pellets versus oil and natural gas. A considerable drop in oil and natural gas prices would be required before price parity were reached. Similarly, wood pellets pricing has room to grow as it is increasingly integrated into energy markets.

<table>
<thead>
<tr>
<th>Oil Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>One tonne pellets = 3.36 barrels of oil</td>
</tr>
<tr>
<td>@ $125 per barrel of oil = $420 per tonne of pellets</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Natural Gas Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>One tonne pellets = 20.5 GJ of natural gas</td>
</tr>
<tr>
<td>@ $13.43 per GJ = $275 per tonne of pellets</td>
</tr>
</tbody>
</table>

(May 26th, 2008 market prices)
European imports of wood pellets from Canada are expected to continue to grow considerably over the next five to ten years.

With production capacity in Canada currently at close to 2 million tonnes per year and with an abundance of saw mill residue and biofibre, as well as the prospect of several hundred tonnes of annual output being added annually over the next several years, Canada is expected to keep pace with this growing international market and has an opportunity to stake its claim as the global leader supplying the industry.
Background
Opportunities to develop a wood pellet industry in GLSL Region

- Over the course of several decades, economic and non-economic forces have converged leading to mill closures, job losses and the underutilization of bio fibre in Ontario’s forests.

- As one Canadian attendee noted at the recent World Bioenergy 2008 conference in Sweden, "the wood and forestry sector is going broke by relying on conventional markets."\(^5\)

- A 2006 report published by the Canadian Council of Forest Ministers\(^6\) set out a series of observations where the Council saw opportunity in a forest industry restructuring, including:
  - Moving beyond being a “low cost producer” towards new “value added products that are increasing in demand and offer opportunities for healthy profit margins”;
  - Being in a position to "climb the learning curve quickly" on new products to "capture as much value as possible" early on; and
  - Being able to "pioneer the industry into some exciting new forest based specialty products."

- The report also recognized bio-mass fuels as a key value added product in the R&D/Introductory phase at the time. While the wood pellet industry has grown considerably since then, there remains an opportunity for Ontario’s forestry industry to be at the forefront in developing new technologies and products as the industry expands.
Background Opportunities to develop a wood pellet industry in GLSL Region

- Significant volumes of biofibre in Ontario’s forests are, for a variety of reasons, not currently being utilized.

- MNR recognizes this biofibre availability as both an economic and environmental opportunity for the province of Ontario, supporting rural and northern communities through job creation and tackling climate change through the encouragement of a clean, renewable source of energy.

- In a Directive issued on August 13th, 2008, MNR set out goals and objectives for a policy guiding the use of forest biofibre to help:
  - Create and support new opportunities for the forestry sector by supporting the development and use of new technologies and products to diversify Ontario’s economy; and
  - Encourage the use of biofibre to reduce Ontario’s dependence on fossil fuels while simultaneously reducing energy costs.

- The Directive also specifically notes the strong interest of the Ontario Power Authority in considering the potential of biopower to produce heat and electricity for the province’s energy needs.
Background
Wood pellet production process and key risks

- The wood pellet production process can be broken down into three elements: Raw material supply, production, and markets.

- While the production risks are mostly manageable, there are key external risks on opposite ends of the process that must be considered and addressed where possible.
## Background

### Wood pellet production process and key risks

<table>
<thead>
<tr>
<th>Process</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Grinding/Chipping** | • The wood chipper/grinder pre-processes the harvested wood  
      • The hammer mill reduces the size of the output to less than 6mm |
| **Screening**  | • The material is screened to remove stones, metal, or other similar material                                                                                                                                  |
| **Drying**     | • The material is dried to achieve the desired moisture content  
      • Drum driers are the industry standard for this process  
      • The use of waste wood (including tops and slash) as opposed to natural gas as a fuel for this process is becoming increasingly prevalent |
| **Pelletizing** | • Raw material is forced through the die hole of the pelletizing machine to produce pellets  
      • A great amount of pressure is required to ensure high pellet quality  
      • Pellets at this stage are both hot and soft |
| **Cooling**    | • Through an air cooling process, pellets are strengthened                                                                                                                                                   |
| **Packaging**  | • Where applicable (i.e. if bagging pellets), a palletizing machine is used to bag the product for distribution                                                                                               |
| **Distribution/Storage** | • To maintain their integrity, non-bagged pellets are stored in dry conditions  
      • Underground tanks, container units, and silos are all used for pellet storage  
      • Pellets are distributed in bagged or bulk form by truck, rail, or ship |
3. Fibre Supply
Fibre supply Methodology

- MS Access databases and GIS data provided were mined for relevant information
- Data was pulled and sorted by:
  - Forest
  - Species
  - Merchantable unmarketable round wood v. cut tops v. bypassed tops
- Excel file containing the above was distributed to SFL managers for each of the seven forests participating in the study
- SFL managers were asked to confirm data and/or provide any changes
- SFL managers’ responses were received electronically and confirmed verbally, with any significant anomalies from the data provided discussed
- Cubic metres (m³) were converted to oven dried tonnes (ODT) to determine approximate potential wood pellet production, net of dryer fuel supply (tops), per forest
The GLSL region has a wealth of tree species. Six species groups are being considered for the purposes of this study, including both merchantable unmarketable round wood, their tops, and bypassed tops (those left behind in the harvest of merchantable marketable round wood).

The chart below shows the breakdown of species across the seven studied forests with a detailed breakdown found in appendix B:

Each of the above species can be utilized in the pelletizing process. The only significant difference for pelletizing purposes is moisture content of the incoming fibre, which can be smoothed out by managing fibre intake and in the drying process.
The November 2007 IEA Bioenergy report on global wood pellet markets and industry notes that fibre supply is “one of the greatest areas of concern for a pelleting facility,” with availability “the main determinant of a plant's scale.”

Fibre Supply:
- Can be affected by stand accessibility, logging practices, top removal restrictions, etc.
- Does not include private forest or First Nations forest, both of which can have a significant impact on the recommended plant sizes and locations, except for:
  - Sudbury, where the N’Swakamok hold 17% of the Sudbury forest; and
  - Nipissing First Nation, which is estimated to have 16,516 m3 available annually.
- In the cases of Nipissing, Sudbury, and Temagami, 70% of the available fibre supply represents assigned but not utilized round wood volumes. Removing these volumes from the available annual fibre supply would leave the following:

<table>
<thead>
<tr>
<th>Forest</th>
<th>All In (m3)</th>
<th>Merchantable &amp; Unmarketable (m3)</th>
<th>Tops (m3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nipissing</td>
<td>196,825</td>
<td>150,820</td>
<td>46,005</td>
</tr>
<tr>
<td>Sudbury</td>
<td>113,762</td>
<td>78,255</td>
<td>35,507</td>
</tr>
<tr>
<td>Temagami</td>
<td>60,434</td>
<td>44,138</td>
<td>16,296</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>371,021</strong></td>
<td><strong>273,213</strong></td>
<td><strong>97,808</strong></td>
</tr>
</tbody>
</table>

- Based on information provided by wood pellet plant equipment manufacturers, between 15% and 20% of the total incoming fibre supply is required to fuel the dryer. An average of 17.5% has been applied for the purposes of this study.
Fibre supply
Fibre supply and pellet production

• Total annual available fibre, as provided by MNR and confirmed or adjusted by SFL management, is as follows:

<table>
<thead>
<tr>
<th>Forest</th>
<th>Total Fibre Supply (m³)</th>
<th>Merchantable Unmarketable (m³)</th>
<th>Tops (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bancroft-Minden Forest</td>
<td>67,708</td>
<td>49,910</td>
<td>17,798</td>
</tr>
<tr>
<td>French-Severn Forest</td>
<td>189,280</td>
<td>189,280</td>
<td>-</td>
</tr>
<tr>
<td>Mazinaw-Lanark Forest</td>
<td>112,051</td>
<td>64,757</td>
<td>47,294</td>
</tr>
<tr>
<td>Nipissing Forest (Incl. Nipissing First Nation)</td>
<td>608,121</td>
<td>419,123</td>
<td>188,998</td>
</tr>
<tr>
<td>Ottawa Valley Forest</td>
<td>40,668</td>
<td>15,066</td>
<td>25,662</td>
</tr>
<tr>
<td>Sudbury Forest</td>
<td>479,277</td>
<td>356,277</td>
<td>123,000</td>
</tr>
<tr>
<td>Temagami</td>
<td>179,952</td>
<td>126,686</td>
<td>53,266</td>
</tr>
<tr>
<td>Total</td>
<td>1,677,057</td>
<td>1,221,039</td>
<td>456,018</td>
</tr>
</tbody>
</table>

Fibre supply (tops) for dryer fuel (m³) @ 17.5% of total fibre supply

Fibre supply remaining for pelletization (m³)

Total pellet production (converted to ODT) = 712,540 = 628,835 + 83,705

• A conversion factor of 1:0.515 has been applied to convert green m³ to oven dried tonnes (ODT).

• Total potential pellet production of approximately 712,540 tonnes from available fibre supply is net of the tops required to fuel the dryers but includes the remaining available tops as calculated above.

• Note that only tops are used as fuel for the dryers. The above shows that more than 60% of tops are used for drying, with the balance put toward pellet production.
Fibre supply
Private forests

• Private forest fibre supply and availability is difficult to ascertain as most have not developed a Forest Management Plan (FMP) and are not required to do so.

• Efforts are continuously being made by both the federal and provincial governments to encourage land owners to develop an FMP in support of the forestry industry and forest renewal and sustainability. Programs include:
  – support from government and the private sector in developing FMPs on private land; and
  – special tax considerations for private landowners with sustainable FMPs in place.

• Depending on the location of private forest, its size, and use, estimates of what might reasonably be made available for harvest can vary significantly. For example:
  – Some forests have active cottage associations that are often against allowing their forests to be harvested for a variety of reasons, making private wood increasingly difficult to source;
  – Landowners in more rural areas often see their forests as a source of income and recognize the importance of a sustainable forest management plan and renewal program; and
  – Much of the private forest in the north is owned by forestry companies who have FMPs in place but whose wood is committed to their own operations in the areas.
## Fibre supply
### Private forests

- The following best estimates were gathered from participating SFL management and converted to tonnes of pellets, net the fibre required for fueling the drying process:

<table>
<thead>
<tr>
<th>Private Land</th>
<th>Round &amp; Tops (m³)</th>
<th>Fuel Required (m³)</th>
<th>Total Pellets (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bancroft-Minden</td>
<td>20,000</td>
<td>3,500</td>
<td>8,498</td>
</tr>
<tr>
<td>French-Severn</td>
<td>10,000</td>
<td>1,750</td>
<td>4,249</td>
</tr>
<tr>
<td>Mazinaw-Lanark</td>
<td>400,000</td>
<td>70,000</td>
<td>169,950</td>
</tr>
<tr>
<td>Nipissing Forest</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ottawa Valley Forest</td>
<td>81,336</td>
<td>14,234</td>
<td>34,558</td>
</tr>
<tr>
<td>Sudbury Forest</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Temagami</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>511,336</strong></td>
<td><strong>89,484</strong></td>
<td><strong>217,254</strong></td>
</tr>
</tbody>
</table>

- Due to the difficulty in ascertaining private forest fibre availability discussed on the previous slide, this study’s focus for plant recommendations is based solely on Crown merchantable unmarketable fibre (and tops) within the study area, except where otherwise noted.
Fibre supply
First Nations

• Many of the forest areas owned by First Nations do not have FMPs in place and as a result, official numbers are difficult to determine.

• The First Nations communities across Ontario are extremely interested in participating in the fostering of a sustainable and active forestry industry.

• First Nations communities are active with management boards of the SFLs for the forests in which they hold land.

• First Nations support can provide investment, fibre supply and a skilled work force for wood pellet plants.

• Estimated fibre availability in the GLSL region from First Nations includes:
  – French-Severn: 5,000 m3 per year
  – Nipissing: 16,516 m3 per year
  – Sudbury: 17% of the forest (included in Crown volumes for the purposes of this study)
Fibre supply
Harvest cost input assumptions

- Where harvest costs do not include slashing/bucking, a $4/m3 charge has been added for consistency.

- Haulage costs have been provided as approximates and for each forest are based on a varying range of distance, up to 150kms/one way/per m3. Where the haulage cost provided was for a significantly lower distance, it was increased proportionally to represent a 100-150km range for consistency.

- Renewal and Stumpage fees are as per MNR’s May 2008 document “Evaluation Process for Biofibre Volume and Value Calculations.”

- Where no administration cost is included, it has been embedded by the SFL in the harvest cost numbers.
Fibre supply
Harvest cost per m$^3$ by forest

- Fibre supply costs were assembled through a survey of forest managers who worked with SFL board members and industry participants operating in their respective forests to gather representative data.

- The resultant fibre supply cost by forest and major component are as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Bancroft Minden</th>
<th>French Severn</th>
<th>Mazinaw</th>
<th>Nipissing</th>
<th>Ottawa Valley</th>
<th>Sudbury</th>
<th>Temagami</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvest Cost</td>
<td>$ 24.50</td>
<td>$ 12.20</td>
<td>$ 21.00</td>
<td>$ 12.20</td>
<td>$ 17.00</td>
<td>$ 12.20</td>
<td>$ 12.20</td>
<td>$ 15.90</td>
</tr>
<tr>
<td>Slashing/Bucking</td>
<td>$ -</td>
<td>$ 4.00</td>
<td>$ -</td>
<td>$ 4.00</td>
<td>$ -</td>
<td>$ 4.00</td>
<td>$ 4.00</td>
<td>$ 2.29</td>
</tr>
<tr>
<td>Road Const. &amp; Maint.</td>
<td>$ 5.50</td>
<td>$ 6.00</td>
<td>$ 5.00</td>
<td>$ 6.00</td>
<td>$ 3.25</td>
<td>$ 6.00</td>
<td>$ 6.00</td>
<td>$ 5.39</td>
</tr>
<tr>
<td>Haulage ($m^3/ ~100 kms)</td>
<td>$ 16.00</td>
<td>$ 12.00</td>
<td>$ 16.00</td>
<td>$ 12.00</td>
<td>$ 12.50</td>
<td>$ 12.00</td>
<td>$ 12.00</td>
<td>$ 13.21</td>
</tr>
<tr>
<td>Renewal Fees</td>
<td>$ 0.25</td>
<td>$ 0.25</td>
<td>$ 0.25</td>
<td>$ 0.25</td>
<td>$ 0.25</td>
<td>$ 0.25</td>
<td>$ 0.25</td>
<td>$ 0.25</td>
</tr>
<tr>
<td>Stumpage Fee</td>
<td>$ 1.07</td>
<td>$ 1.07</td>
<td>$ 1.07</td>
<td>$ 1.07</td>
<td>$ 1.07</td>
<td>$ 1.07</td>
<td>$ 1.07</td>
<td>$ 1.07</td>
</tr>
<tr>
<td>Administration</td>
<td>$ 2.81</td>
<td>$ 5.31</td>
<td>$ 5.75</td>
<td>$ 4.81</td>
<td>$ 3.10</td>
<td>$ 4.81</td>
<td>$ 4.81</td>
<td>$ 4.49</td>
</tr>
<tr>
<td>Total delivered cost / m$^3$</td>
<td>$ 50.13</td>
<td>$ 40.83</td>
<td>$ 49.07</td>
<td>$ 40.33</td>
<td>$ 37.17</td>
<td>$ 40.33</td>
<td>$ 40.33</td>
<td>$ 42.60</td>
</tr>
</tbody>
</table>
4. Site selection
Site selection Methodology

• Three step process used:

   Deloitte based research
   (including input from MNR, SFLs, industry experts and research)

   Step 1: Identify Long List
   Apply broad identification criteria to determine long list

   Step 2: Identify Short List
   Apply narrowing criteria to determine short list

   Step 3: Identify Recommended Sites
   Analyze Short list

final list will consist of multiple sites with varying output levels
Site selection
Step 1: Identify long list

- Interviews conducted with:
  - MNR
  - SFL managers
  - Industry participants and experts

- Broad identification criteria applied included:
  - Cities or towns in or in the vicinity of the forests being considered in the study
  - Cities or towns with operational or recently operational saw, pulp, pole, etc. mills providing:
    - Infrastructure, utilities, etc.
    - Skilled / experienced labour
    - Access (e.g. roads, permitable sites etc.)

- Long list: 34 potential sites
  - Bancroft-Minden: 3
  - French-Severn: 5
  - Mazinaw-Lanark: 1
  - Nipissing: 3
  - Ottawa Valley: 13
  - Sudbury: 4
  - Sites outside study area: 5
Site selection
Step 2: Identify short list

• Further site criteria and consideration developed through:
  – Interviews with MNR and SFL managers
  – Industry experts
  – Published forestry reports, wood pellet reports and related studies

• Characteristics used to analyze long list include:
  – Proximity to rail lines (within 5km)
  – Proximity to operating or potential deep water ports
  – Opportunities for synergies (e.g. CHP, district heating, etc.)

• Short list: 17 potential sites
  – Bancroft-Minden: 0
  – French Severn: 5 (Huntsville, South River, Bracebridge area, Parry Sound, Britt)
  – Mazinaw-Lanark: 0
  – Nipissing: 3 (Mattawa, Sturgeon Falls, North Bay)
  – Ottawa Valley: 2 (Pembroke, Renfrew)
  – Sudbury: 2 (Sudbury, Nairn Centre)
  – Sites outside study area: 5 (Rossland, Peterborough area, Trenton, Bowmanville, Prescott)
Site selection
Potential ports

- Deep water ports are critical to the export of wood pellets to Europe, currently the world’s largest market. Proximity and accessibility to deep water ports is an important consideration in locating pellet plants to help reduce logistic challenges and transportation costs to market.

- The following deep water ports (at least 20-25 feet) were identified through discussion with MNR and the SFLs as potential ports (some currently operating at limited capacity) from which to ship wood pellets produced in the GLSL Region:
  - Bowmanville
  - Britt
  - Cornwall
  - Fisher Harbour
  - Owen Sound
  - Parry Sound
  - Prescott (active port with capacity and bulk handling facilities, direct rail access and operating ethanol plant)
  - Thessalon

- Each of the above along with the short list of pellet plant sites is identified in the map on the following slide.
Site selection
Short list of plant sites with potential ports
Site selection
Step 3: Identify recommended sites

- Based on the potential for approximately 712,540 tonnes of pellet production from available round wood and tops:
  - Six plants are recommended, with optimal efficient plant sizes ranging from 100,000 to 150,000 tonnes per year
  - Each plant will be located and sized based on the fibre supply basket within an approximately 150km range
  - This will allow for a small amount of excess capacity at each plant that can utilize fibre from:
    - Private forest;
    - First Nations forest;
    - Algonquin forest; and
    - Forests outside the study area in Ontario and/or Quebec.
## Site selection
### Final site recommendations

<table>
<thead>
<tr>
<th>Location</th>
<th>Key Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renfrew</td>
<td>- Operating mills and biochem plant, skilled work force&lt;br&gt;- Freight rail running through</td>
</tr>
<tr>
<td>South River</td>
<td>- Operating mills, skilled work force&lt;br&gt;- Freight rail running through&lt;br&gt;- Proximity to Algonquin park which currently harvests over 500,000 m³ per year (potential plant expansion opportunity)</td>
</tr>
<tr>
<td>Britt</td>
<td>- Freight rail running directly through non-operational mill&lt;br&gt;- Skilled work force throughout Parry Sound Area&lt;br&gt;- Potential deep water port revitalization being studied by Parry Sound Area Community Business &amp; Development Centre</td>
</tr>
<tr>
<td>Sudbury</td>
<td>- Several operating mills, skilled work force&lt;br&gt;- Freight rail running through&lt;br&gt;- Opportunities for co-gen / sale of district energy</td>
</tr>
<tr>
<td>Sturgeon Falls</td>
<td>- Operating mills, skilled work force&lt;br&gt;- Freight rail running through&lt;br&gt;- Able to capture fibre from each of Sudbury, Nipissing &amp; Temagami</td>
</tr>
<tr>
<td>North Bay</td>
<td>- Several operating mills, skilled work force&lt;br&gt;- Multiple freight rails running directly through it&lt;br&gt;- Opportunities for co-gen / sale of district energy</td>
</tr>
</tbody>
</table>
Site selection
Final site recommendations and output levels
Site selection
Final site recommendations and output levels

• Fibre Source and Pellet Fibre Supply refer to the originating forest and respective annual volumes.

• Pellet Output refers to the tonnes of wood pellets produced from the remaining Fibre Supply.

• Plants are sized with excess capacity that can be filled by a number of sources discussed earlier.

• In addition, if alternate sites or plant output levels are desired, Pellet Fibre Supply can be reallocated accordingly to accommodate.

<table>
<thead>
<tr>
<th>Site Location</th>
<th>Fibre Source</th>
<th>Pellet Fibre Supply (m3)</th>
<th>Pellet Output (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renfrew</td>
<td>Mazinaw-Lanark</td>
<td>92,442</td>
<td>47,608</td>
</tr>
<tr>
<td></td>
<td>Ottawa Valley</td>
<td>33,551</td>
<td>17,279</td>
</tr>
<tr>
<td></td>
<td>Bancroft-Minden</td>
<td>55,859</td>
<td>28,767</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>12,323</td>
<td>93,654</td>
</tr>
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<td></td>
<td>Plant size</td>
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<td>100,000</td>
</tr>
<tr>
<td>South River</td>
<td>French-Severn</td>
<td>78,078</td>
<td>40,210</td>
</tr>
<tr>
<td></td>
<td>Nipissing</td>
<td>122,019</td>
<td>62,840</td>
</tr>
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<td></td>
<td>Total</td>
<td>13,496</td>
<td>103,050</td>
</tr>
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<td></td>
<td>Plant size</td>
<td></td>
<td>110,000</td>
</tr>
<tr>
<td>Britt</td>
<td>French-Severn</td>
<td>78,078</td>
<td>40,210</td>
</tr>
<tr>
<td></td>
<td>Sudbury</td>
<td>59,311</td>
<td>30,545</td>
</tr>
<tr>
<td></td>
<td>Nipissing</td>
<td>73,211</td>
<td>37,704</td>
</tr>
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<td></td>
<td>Total</td>
<td>2,993</td>
<td>108,459</td>
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<td>Sudbury</td>
<td>Sudbury</td>
<td>276,782</td>
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<td>Sturgeon Falls</td>
<td>Nipissing</td>
<td>97,615</td>
<td>50,272</td>
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<td></td>
<td>Temagami</td>
<td>74,230</td>
<td>38,229</td>
</tr>
<tr>
<td></td>
<td>Sudbury</td>
<td>59,311</td>
<td>30,545</td>
</tr>
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<td></td>
<td>Total</td>
<td>1,854</td>
<td>119,045</td>
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<tr>
<td></td>
<td>Plant size</td>
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<td>120,000</td>
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<tr>
<td>North Bay</td>
<td>Nipissing</td>
<td>195,230</td>
<td>100,543</td>
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<tr>
<td></td>
<td>Nipissing First Nation</td>
<td>13,626</td>
<td>7,017</td>
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<td></td>
<td>Temagami</td>
<td>74,230</td>
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<td></td>
<td>Total</td>
<td>8,177</td>
<td>145,789</td>
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<tr>
<td></td>
<td>Plant size</td>
<td></td>
<td>150,000</td>
</tr>
</tbody>
</table>

Total Pellet Production from Fibre Supply | 712,540
Total Pellet Production Capacity     | 740,000

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Site selection
Additional considerations

• Further consideration for finalizing site recommendations should include:
  – Geographic distribution of accessible fibre supply within the forests participating in this study;
  – Consideration of available fibre supply outside the boundaries of the forests participating in this study as additional supply sources, potentially having an impact on plant size and quantity;
  – More detailed analysis of the private forest fibre potentially available as supply for pellet plants;
  – Consideration of pellet plants proposed outside of the forests participating in this study but close enough to utilize the same sources of fibre;
  – Existing potentially available sites (non operational mills, sites with existing permits, etc.) in the short listed cities and towns;
  – Ease of ingress (fibre supply) and egress (final product), including accessibility to rail line (each of the 17 short listed have a freight rail line running directly through or in close proximity); and
  – Potential tax and other financial incentives available from local and municipal governments.
5. Capital costs
Capital costs
Input assumptions

- Base capital cost: $125 per tonne output
  - i.e. 145,000 tonne per year plant = $18.125 million
  - Includes key equipment, building, site development and soft costs
  - Based on research indicating a range of $100-150 per tonne of output
    - ~$100 from equipment manufacturers, BC Biomass Energy Primer (not including building, site development, soft costs, etc.)
    - ~$127 from a 2005 study titled "Strategic Analysis of a Pellet Fuel Opportunity in Northwest British Columbia"
      - ~$100 to $150 from industry sources, dependent on experience of management and timing
- Additional capital costs included:
  - Grinding on site: $3-4 million
    - Grinder, log deck, handling and debarking equipment, etc.
    - Considerably cheaper to operate with electricity at plant than diesel at harvest site
    - Pellet market currently has some difficulty absorbing this additional cost but as the need to utilize round wood for pelletization increases, markets will be forced to adapt (available merchantable unmarketable in Ontario, Pine beetle infested wood in BC, etc.)
  - Enhanced emission controls: $500k-1 million
    - Including Electro Static Precipitator
    - Can reduce emissions from 120-150 tonnes per year to 1-2 tonnes per year
  - Pellet storage, rail car loading facility and equipment: $2 million
    - Based on information from wood pellet plant equipment manufacturers and industry sources
Capital costs
Optional items

- Optional capital costs, if applicable (not included):
  - Bagging equipment, if not selling all output in bulk:
    - $150,000 – Semi automated bagging system, hand stacking and palletizing
    - $500,000 – Fully automated bagging system, automated bagging, stacking and palletizing
  - Based on information from pellet bagging equipment manufacturer

- Rail spur if not adjacent to existing line or spur:
  - $2 million per km for single freight track line, basic signaling, flat geologically sound sparsely populated area, includes electrical & mechanical equipment
  - Based on information from Railway Finance - Railway Technical Web Spaces
6. Operating & maintenance costs
Operating and maintenance costs
Input assumptions

- Operating period:
  - 24 hours per day, 7 days per week (if need be, 5 or 6 days per week but always 24 hours per day)
  - 10% annual downtime for scheduled and unscheduled maintenance
  - Approximately 8,000 hours per year of operations

- Labour:
  - 8-12 staff per shift, plus administration, for an average of 25-30 jobs created per plant
  - Skilled labour rates ranging from $20 to $30 per hour
  - Price per tonne output varies with plant capacity (~$10 per tonne at 150,000 tonnes per year)
  - Based on information from pellet plant developer, BC Biomass Energy Primer and industry sources

<table>
<thead>
<tr>
<th>Estimated Labour Requirements</th>
<th>Staff per shift</th>
<th>Number of shifts</th>
<th>Total staff required</th>
<th>Rate per hour</th>
<th>Per employee</th>
<th>Total amount</th>
</tr>
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<tbody>
<tr>
<td>General Manager</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>$30</td>
<td>$78,840</td>
<td>78,840</td>
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<tr>
<td>Plant operators</td>
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<td>3</td>
<td>3</td>
<td>$25</td>
<td>$65,700</td>
<td>197,100</td>
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<tr>
<td>Mill wrights</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>$20</td>
<td>$52,560</td>
<td>315,360</td>
</tr>
<tr>
<td>Material handling</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>$20</td>
<td>$52,560</td>
<td>315,360</td>
</tr>
<tr>
<td>Logistics</td>
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<td>1</td>
<td>1</td>
<td>$20</td>
<td>$52,560</td>
<td>52,560</td>
</tr>
<tr>
<td>Maintenance</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>$20</td>
<td>$52,560</td>
<td>157,680</td>
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<tr>
<td>Electrician / Programmers</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>$25</td>
<td>$65,700</td>
<td>197,100</td>
</tr>
<tr>
<td>Finance &amp; Admin</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>$25</td>
<td>$65,700</td>
<td>197,100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,511,100</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Grinding:
  - Fibre supply for pellets (at plant): $5 per ODT equivalent
  - Fibre supply for dryer fuel (in bush): $10 per ODT equivalent
  - Based on information from forest industry participants and wood pellet industry sources
Operating and maintenance costs

Input assumptions

- **Energy:** $10 per tonne output
  - Includes electrical and natural gas requirements
  - Typically $12-15 per tonne output however adjusted in consideration of:
    - Decrease for replacement of natural gas with biofibre for dryer fuel; and
    - Increase for addition of whole log grinding operation on front end.
  - Roughly 25-30% of caloric value coming in is consumed in the pelletization process:
    - 5% in hammer mill
    - 10% in dryer
    - 10% in pellet press
    - 5% in material moving (can be reduced considerably if designed with gravity in mind)
  - Based on information from wood pellet plant equipment manufacturers and industry sources

- **Dryer fuel (tops):** $12.79 per tonne output
  - Tops going to dryer fuel have been separated out from fibre supply numbers and have had the average harvest cost less renewal fees, stumpage fees, slashing and half of the average harvest cost applied.
  - Approximately 17.5% the fibre supply is required to fuel the dryer to desired moisture levels
  - The remaining tops will be pelletized, making up ~12% of the total pellet production output
    - Tops typically contain higher ash levels but at these levels, should not impact the desired specification of <1%
  - Based on information from wood pellet plant equipment manufacturers and industry sources
Operating and maintenance costs
Input assumptions

- Materials and operational maintenance: $5
  - Includes the regular maintenance and replacement of knives, dyes, rollers, machine parts, etc.
  - Based on information from wood pellet plant equipment manufacturers and industry sources

- Repairs and lifecycle maintenance: $5
  - Includes shutdowns, maintenance and overhaul to extend the life of major equipment
  - Similar to pulp mills, with regular maintenance and upgrading (including updated programming and controls as they become available), pellet plants can run efficiently for several decades
  - Based on information from wood pellet plant equipment manufacturers and industry sources

- Loading onto rail for bulk shipments: $2.50
  - Includes costs associated with movement of finished product, logistics and loading onto rail cars for shipment to port or customer (if by rail)
  - Based on information from wood pellet plant equipment manufacturers and industry sources
7. Financing
Pellet plant financing
Input assumptions

- Pellet plants are built, financed and operated by private sector entities, sometimes in partnership with other forestry industry partners but most often as independents.

- Project timing
  - Planning to commissioning typically 12-18 months
  - Construction assumed to begin in 2009, lasting a period of 1 year

- Debt to equity ratios: 50:50
  - require the backing of well financed and highly experienced ownership

- Return on equity: 20%
  - Pellet plants require experienced management with specialized backgrounds. Given the risk involved and the amount of equity required to set up and operate a pellet plant, a reasonably high return will be required to attract willing parties.
  - For financial modeling purposes a terminal value equal to the initial equity investment is applied to the project in year 10

- Debt terms: 10 years
  - Debt can be financed by traditional banks at standard rates however terms beyond 10 years are unlikely to garner favourable rates, if accessible at all

- Rate of interest: 8.00%
  - Based on July 2008 Government of Canada benchmark bond yield, monthly series, 10 yr (V122543) at 3.81%
  - Risk premium of 4.19% based on Deloitte's current experience with projects of similar risk in the forestry sector
Pellet plant financing
Opportunities for financial assistance

- Government assistance programs can in some cases be accessed where applicable, for example:

  - Ontario MNR Forest Sector Prosperity Fund\(^{10}\)
    - Provides grants of up to 20% of project capital costs, to a maximum of $25 million
    - Increases to 30% of project value for electricity related projects (CHP opportunity)
    - Typical grants given are in the range of 10%

  - Ontario MNR Loan Guarantee Program\(^{11}\)
    - Provides loan guarantees for 2 to 5 years ranging from $500,000 to $25 million
    - Can be for up to 100% of the loan received for the project
    - Guarantee fees of 0.5% one time if Residual and 1% one time if 1\(^{st}\) call
8. Findings and analysis
Findings
Review of input assumptions

• Based on the fibre supply distribution, site recommendations and input assumptions, a cost per tonne has been calculated for each of the six recommended wood pellet plants.

• Cost per tonne is based on:
  – Maximum efficient plant size of 100,000 to 150,000 tonnes of pellets per year;
  – Final list of 6 plant sites, narrowed down from an initial list of 33 potential sites;
  – Disbursement of several forests' fibre supplies to multiple plants based on geographic distribution and average distance per forest to the recommended plant locations; and
  – Total proposed plant capacity, including excess beyond noted available fibre supply.

• After separating the required tops for dryer fuel, the remaining tops are pelletized and represent approximately 12% of the overall available annual fibre supply for pellet production. For simplification, these remaining tops have been combined with the merchantable unmarketable fibre supply and priced at their originating forests’ harvest cost.

• Taxes have not been accounted for in these models.
Findings
Cost per tonne per proposed plant

- The resultant costs per tonne are as follows and are presented in both 2008 (current) costs and 2010 (year of commissioning) inflation adjusted costs:

<table>
<thead>
<tr>
<th>Recommended site</th>
<th>Renfrew</th>
<th>South River</th>
<th>Britt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pellet tonnes per year</td>
<td>100,000</td>
<td>110,000</td>
<td>110,000</td>
</tr>
<tr>
<td>Year</td>
<td>2008</td>
<td>2010</td>
<td>2008</td>
</tr>
<tr>
<td>Fibre supply</td>
<td>$ 91.08</td>
<td>$ 94.76</td>
<td>$ 78.94</td>
</tr>
<tr>
<td>Dryer fuel (tops)</td>
<td>$ 12.79</td>
<td>$ 13.30</td>
<td>$ 12.79</td>
</tr>
<tr>
<td>Grinding</td>
<td>$ 7.12</td>
<td>$ 7.41</td>
<td>$ 7.12</td>
</tr>
<tr>
<td>O&amp;M + Lifecycle</td>
<td>$ 37.61</td>
<td>$ 39.13</td>
<td>$ 36.24</td>
</tr>
<tr>
<td>Total</td>
<td>$ 148.60</td>
<td>$ 154.61</td>
<td>$ 135.09</td>
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<tr>
<td>Financing</td>
<td>$ 35.73</td>
<td>$ 35.73</td>
<td>$ 34.57</td>
</tr>
<tr>
<td>Cost / tonne</td>
<td>$ 184.33</td>
<td>$ 190.34</td>
<td>$ 169.66</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommended site</th>
<th>Sudbury</th>
<th>Sturgeon Falls</th>
<th>North Bay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pellet tonnes per year</td>
<td>150,000</td>
<td>120,000</td>
<td>150,000</td>
</tr>
<tr>
<td>Year</td>
<td>2008</td>
<td>2010</td>
<td>2008</td>
</tr>
<tr>
<td>Fibre supply</td>
<td>$ 78.53</td>
<td>$ 81.70</td>
<td>$ 78.35</td>
</tr>
<tr>
<td>Dryer fuel (tops)</td>
<td>$ 12.79</td>
<td>$ 13.30</td>
<td>$ 12.79</td>
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<tr>
<td>Grinding</td>
<td>$ 7.12</td>
<td>$ 7.41</td>
<td>$ 7.12</td>
</tr>
<tr>
<td>O&amp;M + Lifecycle</td>
<td>$ 32.57</td>
<td>$ 33.89</td>
<td>$ 35.09</td>
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<tr>
<td>Total</td>
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<td>Financing</td>
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<tr>
<td>Cost / tonne</td>
<td>$ 162.47</td>
<td>$ 167.76</td>
<td>$ 166.94</td>
</tr>
</tbody>
</table>
Findings
Cost per tonne breakdown

• The 2010 inflation adjusted average cost per tonne on a base case 150,000 tonne per year plant, applying an average harvest cost to fibre supply, can be broken down as follows:

Three inputs of particular note are fibre supply, which represents 50% of the cost per tonne, equity draw, accounting for 10% of the cost per tonne, and dryer fuel at 8% of the overall cost per tonne.
The chart below shows the sensitivity of key, non-variable inputs to the 2010 base case cost per tonne of $172.12 ($166.66 in 2008), with equity return and debt term having the most pronounced impacts.
Analysis Sensitivity

- In addition to managing the aforementioned, reducing variable costs, particularly capital cost per tonne as the largest cost component, will yield significant reductions in overall cost per tonne. This can be accomplished through:
  - Government and industry grant programs;
  - An experienced managed team; and
  - Evolving wood pellet plant technologies allowing for cheaper and more efficient wood pellet production.

- As demand for wood pellets increases, markets will soon be forced to absorb the additional costs of harvesting and processing round wood to ensure sufficient supply, particularly as:
  - BC moves towards round wood pellet processing as it begins to utilize Pine Beetle infested stands in pellet manufacturing; and
  - Russian tariffs on wood exports put Russian fibre supply, one of the largest suppliers in the world, increasingly out of reach of European markets with the resultant shortage of supply to Europe allowing the higher priced Canadian whole log pellets to be sold profitably overseas.
**Analysis**

**Consideration of cost feasibility**

- Spot prices for bulk deliveries in Europe fluctuate widely by country and by supply and demand dynamics.
- A group of European industry participants has started the PELLETS@LAS Project whose goal is to create transparency in the European pellet market by addressing information gaps, removing supply bottlenecks, reducing fluctuations in spot prices, and addressing quality assurance and consistency.
- In a May 2008 report, PELLETS@LAS noted the following recent historic pricing:

  - January 2008 spot bulk prices at European ports range from €125 - €190 (~$196 - $298 CDN)
  - January 2008 loose delivery prices to European households range from €165 - €255 (~$259 - $400 CDN)
  - An August 2007 factsheet prepared by SenterNovem in the Netherlands noted CIF price per tonne to Rotterdam at €140 (~$219 CDN)
  - The European Pellet Centre noted prices of €180 (~$283 CDN) for large customers in Denmark, Sweden and Germany, delivery included.
Analysis
Consideration of cost feasibility

• According to the Pellet Fuels Institute April 2008 Market Update Industry Survey:
  – Market prices in Canada currently average $170-$180 CDN per tonne; and
  – Market prices in the North East US currently average $120-$179 CDN per tonne

• In order for a pellet plant to be feasible, transportation costs, logistics costs, and middleman or retailer markups must be recoverable in the spread between the cost per tonne to produce and the market price. Transportation cost considerations can include:
  – Hauling to local port for shipment and from port to purchaser in Europe or Asia
  – Shipping by rail to US market
  – Shipping by rail or transport to distributors or directly to power generating facilities in Ontario that have been retrofit to co-fire low carbon emitting wood pellets

• When compared to existing pellet plants, it is important to note that most current operations utilize sawmill residue and residue from other wood product processors/manufacturers, resulting in considerably lower fibre supply costs:
  – Fibre supply: no harvesting and lower transportation costs (often located near supply mills);
  – Capital: no need for chipping equipment; and
  – Operating: no labour or energy for chipping, less dryer fuel required per tonne of pellets.

• While the spread may initially appear close, further investigation into market prices, transportation and logistic costs to market are critical to determining feasibility. While there appears to be room between the cost of production and current market prices, both in Europe and North America, the unpredictability of the current spot markets make forecasting feasibility on tight margins particularly difficult.

• If demand continues to rise as predicted however, markets will find themselves either adapting to additional costs, such as whole log chipping and Russian tariffs, or accelerating the development of newer, more efficient technologies, and the Ontario forestry industry has the opportunity to be at the forefront in both respects.
8. Other considerations
Other considerations

• Broad infrastructure considerations
  – Access may be required to areas where harvesting has not previously taken place, requiring some road construction and access clearing;
  – Upgrades to roads, utilities, water, and sewer may be necessary depending on the condition of specific sites selected;
  – Short rail spurs may be required to connect pellet plants to the main rail line or nearby spurs if not located directly on them; and
  – Ports with suitable pellet storage facilities, loading and unloading equipment, dust and fire suppressant systems are required for shipment overseas.

• Contract structuring
  – Commercial sales contracts are trending towards pricing in BTU or MW value;
  – When priced in cubic metres or tonnes, moisture levels and HHV can be manipulated. These specifications should be noted in contracts only as minimum acceptable levels with the benefit of the same size and consistency for the end user; and
  – ISO Standard M28/95 has been established for thermal value measurement consistency and should be used as the standard in sales contracts.

• Harvest cost synergies
  – Harvesting merchantable unmarketable round wood and removing tops in conjunction with merchantable marketable wood harvests where applicable could lower overhead and other costs; and
  – Opportunities may exist to more economically chip whole logs at the harvest site if done in conjunction with larger harvesting operations. This will reduce both the capital and operating costs of new plants but must be included in fibre supply contracts where possible to avoid incurring unexpected and avoidable costs up front or down the road.
Other considerations

• Combined Heat and Power synergies
  – As new pellet plants are built in Canada, they are increasingly being considered as CHP facilities to produce up to 10 MW of power. While a higher initial investment will be required, the ability to sell power at renewable or clean energy prices into the power grid can help return the investment quickly and help with the economics of the pellet plant itself. Several opportunities for pellet plants with CHP in the forests under study including:
    – North Bay:
      – First Nations nearby have property adjacent to a hospital that they have been considering as a site for a CHP plant, which could be built in conjunction with a wood pellet plant.
    – Sudbury:
      – Significant private forest held by Inco and Falconbridge who have considered setting up a CHP plant, that could be built in conjunction with a wood pellet plant for maximum synergy opportunities.
    – Britt/South River:
      – Running along highways 11 and 69 respectively, heavy load carrying electricity lines would be ideal for a CHP plant to sell large amounts of electricity into the grid without the worry of network overload. Interest has recently been expressed in building a CHP pellet plant in South River, but has not been pursued further.
    – Cornwall:
      – Interest has been expressed in building a wood pellet manufacturing plant in Cornwall with a CHP component. Steam from the facility could be sold to any number of companies or institutions in Cornwall and pellets could be loaded directly onto ship for transport overseas.
Other considerations

- Torrefied pellets
  - According to the BC Biomass Energy Primer, torrefied wood pellets are an emerging technology developed in the Netherlands, with an energy density some 20% higher than commercial wood pellets and consuming only half the electricity in production.
  - Thermo chemically treated pellets, while not yet widely produced or used and still under study, are designed to:
    - increase energy density, reducing transportation costs;
    - reduce biological activity;
    - reduce smoke production;
    - withstand up to twice the crushing force of normal wood pellets; and
    - store longer and be more forgiving to fluctuating temperatures and humidity levels.
  - Topell, a torrefied pellet manufacturer in the Netherlands points out that "all fibrous biomasses are suitable for torrefaction resulting in a higher feedstock flexibility and thus in the opportunity to process low valued raw materials to a high value biocoal."
  - This would link well with the recent MNR directive encouraging the use of biofibres in creating renewable, carbon neutral fuel sources for power generation and further development of the technology might find support under programs contemplated by MNR stemming from this directive.

- Moisture levels (of <5%)
  - Lower moisture means higher density and higher energy value.
  - This provides benefits in shipping and logistics as more energy can be transported at a lower price.
  - The lower the moisture levels however, the greater the wear on pellet manufacturing equipment, leading to increased maintenance costs and wear on equipment, and in turn increased operating costs.
  - Moisture levels <5% may require treatment to reintroduce lignin and many buyers will not buy treated pellets.
  - Low moisture levels also require additional care in storage and transport due to risk of spontaneous combustion.
Appendix A: Premium pellet specifications
Premium pellet specifications (as per MNR Terms of Reference)

- All pellets are to be produced to meet current typical wood pellet specifications (all values, as received):
  - Gross Calorific Value (HHV): > 19MJ/kg
  - Moisture: < 5%
  - Ash < 1%
  - Bulk Density > 650 kg/m$^3$
  - Particle Size Distribution 100% < 3mm
    (dust in pellet) 95% < 2mm
    75% < 1.5mm
    50% < 1mm
  - Pellet Size < 10mm diameter
    < 40mm length
Appendix B: Fibre supply
Fibre supply
Breakdown of species by forest

- The following is a breakdown of Crown forest fibre supply by species considered for the wood pellet cost study, including round wood and tops, as confirmed by forest management:

<table>
<thead>
<tr>
<th>Forest</th>
<th>White Birch</th>
<th>Other Conifer</th>
<th>Poplar</th>
<th>White/Red Pine</th>
<th>Spruce-Pine-Fir</th>
<th>Tolerant Hardwoods</th>
<th>All In</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SFL Manager Estimates</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Bancroft-Minden Forest</td>
<td>3,879</td>
<td>2,398</td>
<td>17,424</td>
<td>9,527</td>
<td>5,255</td>
<td>29,225</td>
<td>67,708</td>
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<tr>
<td>French-Severn Forest</td>
<td>6,760</td>
<td>15,210</td>
<td>18,590</td>
<td>27,040</td>
<td>21,125</td>
<td>100,555</td>
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<td>Mazinaw-Lanark Forest</td>
<td>7,758</td>
<td>5,129</td>
<td>25,954</td>
<td>10,785</td>
<td>5,435</td>
<td>56,990</td>
<td>112,051</td>
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<tr>
<td>Nipissing Forest</td>
<td>63,024</td>
<td>18,569</td>
<td>180,481</td>
<td>32,714</td>
<td>166,841</td>
<td>129,976</td>
<td>591,605</td>
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<tr>
<td>Ottawa Valley Forest</td>
<td>6,174</td>
<td>696</td>
<td>5,543</td>
<td>2,523</td>
<td>1,589</td>
<td>24,144</td>
<td>40,668</td>
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<tr>
<td>Sudbury Forest</td>
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<td>7,580</td>
<td>119,590</td>
<td>79,408</td>
<td>190,896</td>
<td>18,506</td>
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<tr>
<td>Temagami</td>
<td>51,985</td>
<td>12,013</td>
<td>32,282</td>
<td>37,096</td>
<td>27,346</td>
<td>19,230</td>
<td>179,952</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>202,877</strong></td>
<td><strong>61,595</strong></td>
<td><strong>399,864</strong></td>
<td><strong>199,092</strong></td>
<td><strong>418,487</strong></td>
<td><strong>378,626</strong></td>
<td><strong>1,660,541</strong></td>
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</tbody>
</table>

**Breakdown of Fibre Supply by Species**

- White Birch: 12%
- Other Conifers: 4%
- Poplar: 23%
- White/Red Pine: 24%
- Spruce-Pine-Fir: 12%
- Tolerant Hardwoods: 12%
Appendix C: Fibre supply haulage distances
Fibre supply haulage distances

Deloitte was provided with average distances, based on GIS data, from each forest to cities throughout the GLSL Region.

This data was used to help determine site recommendations.

<table>
<thead>
<tr>
<th>Forest</th>
<th>City</th>
<th>Avg. Distance (km)</th>
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</thead>
<tbody>
<tr>
<td>Bancroft-Minden Forest</td>
<td>Britt</td>
<td>298</td>
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<tr>
<td>Bancroft-Minden Forest</td>
<td>Huntsville</td>
<td>160</td>
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<td>Bancroft-Minden Forest</td>
<td>Prescott</td>
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<td>Renfrew</td>
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<td>French-Severn Forest</td>
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<td>French-Severn Forest</td>
<td>South River</td>
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<td>Sturgeon Falls</td>
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<td>Nipissing Forest</td>
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<tr>
<td>Ottawa Valley Forest</td>
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<tr>
<td>Ottawa Valley Forest</td>
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<tr>
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<tr>
<td>Sudbury Forest</td>
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<td>Temagami</td>
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</table>
Appendix D: References
References

3. proPellets Austria, “Production and market trends – and EU perspective”, June 2008
8. IEA Bioenergy, see 2 above
References

15. Pellet Fuels Institute Newsletter, 2008 Issue #1, Page 6
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