Supporting Community-Driven Sustainable Bioenergy Projects

April 2013

Dovetail Partners / University of Minnesota / USDA Forest Service
Sponsors

• Cook County and Cook County Local Energy Project
• City of Ely Alternative Energy Task Force
• State of Minnesota Environment and Natural Resources Trust Fund / LCCMR
• USDA Wood Education and Resource Center
Study Teams and Steering Committee

Dovetail Partners, Inc.
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Gary Atwood, Local Coordinator
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Kathryn Fernholz, Executive Director
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Ann O’Neill  Jon Klapperich

Ely AETF Steering Committee
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Harold Langowski, City Engineer
Dave Olsen, Retired Engineer
Rebecca Spengler, Business Owner
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LHB, Inc.
Chuck Hartley, PE
Community-Driven Sustainable Bioenergy

Support community-led transitions to alternative energy by:

(1) developing high-quality objective information about pertinent topics and options related to bio-energy systems; and

(2) building strong communication structures to gather and disseminate information among project partners, stakeholders, and the larger public.
## Timeline

| Fall 2011          | ✓ Confirm community participation in study  
|                   | ✓ Hire staff, recruit participants  
|                   | ✓ Develop work plan  
| Winter / Spring 2012 | ✓ Identify and assess energy system options  
|                   | ✓ Assess and project local biomass supply  
|                   | ✓ Select preferred options and investigate concerns  
| Summer 2012       | ✓ Environmental / lifecycle impact assessment  
|                   | ✓ Public outreach on supply chain issues  
| Fall 2012         | ✓ Public outreach on supply chain and financing issues  
|                   | ✓ Community meetings on findings and recommendations  
| Winter 2012       | ○ Deliver final report  

Project Structure and Approach

- **Phase I**
  - Local steering committee and study team identify options
  - Assess financial viability and availability of fuel supply
  - Select best options for further investigation

- **Phase II**
  - Life cycle assessment review (focus on emissions)
  - Environmental impacts (MN Forest GEIS)
  - Biomass supply logistics (forest to customer)
  - Public education and input
  - Support next steps
Phase II Dovetail/UMN reports

• Pre-Feasibility Financial and Wood Supply Analysis for Biomass District Heating in Ely and Cook County, MN: University of Minnesota Report to Dovetail Partners, Inc

• Life Cycle Impacts of Heating with Wood in Scenarios Ranging from Home and Institutional Heating to Community Scale District Heating Systems

• Local Environmental Considerations Associated with Potential Biomass Energy Projects in Cook County and Ely

• Supply Chain Logistics and Concerns

• Fact sheets summarize findings for public

http://www.dovetailinc.org/content/lccmr-supporting-community-driven-sustainable-bioenergy-projects
Major Findings
I. Financial and Wood Supply Analysis

• Recent technological innovations greatly improve bio-energy performance (efficiency, practicality)
• Optimal sizing for district heat is crucial (central core + heat density per linear foot of piping)
• Sustainable biomass supply in 60-mile radii zone
  – Estimated demand: 390 DT to 2,559 DT (*per installation*)
  – Estimated biomass supply for Ely and GM:

<table>
<thead>
<tr>
<th>Resource</th>
<th>Ely</th>
<th>Grand Marais</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% timber residues</td>
<td>44,679 DT hogfuel</td>
<td>12,576 DT hogfuel</td>
</tr>
<tr>
<td>10% roundwood</td>
<td>34,309 DT clean chips</td>
<td>9,960 DT clean chips</td>
</tr>
<tr>
<td>Fuel treatment removal</td>
<td>Data not available</td>
<td>6,194 DT</td>
</tr>
</tbody>
</table>

• Additional engineering & business planning needed
II. Life Cycle Impacts

- Lower density of wood = higher emissions per unit of heat
- Direct emissions depend on feedstocks, boiler technology, and pollution controls
  - Clean, dry biomass feedstocks (pellets lower than chips)
  - Optimally sized, high-efficiency technology and automatic feeding
  - State of art emissions control
- Air emission estimates of the largest district heating options are below 10% of EPA/Clean Air Act thresholds, 2-14% of Minnesota Option D emission limits.
  - Air quality regulations for PM and other compounds could tighten.
- Indirect emissions (transportation & processing) can add 30 - 50% to non-local fuels (means pellets have higher emissions per unit of energy)
- Detailed information in fact sheets and reports
Total Pounds of Particulate per Year
normalized to the equivalent of the BTU from 1000 gallons of heating oil per year

- Fireplace: 3920.0
- Uncertified Wood Stove: 644.0
- EPA Certified Wood Stove: 196.0
- Pellet Stove: 68.6
- Modern European Pellet Fuel Boiler: 2.94
- Gas Boiler: 1.16
- Old Oil Boiler (pre-1990s): 10.08
- Modern Oil Boiler: 2.52
Figure 16
Fine Particle Emissions per Quad of Heat Delivered

Figure 6
Summary of GHG Emissions for Different Crude Oil Production Scenarios

Table 2. Estimates of direct, on-site air emissions¹ of biomass energy options (short tons/year) based on reported emissions per MMBtu. (Note: one short ton is equal to 2000 lbs.)

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>SO₂</th>
<th>NOₓ</th>
<th>PM₁₀</th>
<th>CO</th>
<th>CH₄</th>
<th>VOC</th>
<th>PAH</th>
<th>Fossil CO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regulatory thresholds</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Standard permit (PTE)²</td>
<td>50</td>
<td>100</td>
<td>25</td>
<td>100</td>
<td>---</td>
<td>100</td>
<td>---</td>
<td>100,000</td>
</tr>
<tr>
<td>Option D permit³</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>---</td>
<td>50</td>
<td>---</td>
<td>100,000</td>
</tr>
<tr>
<td><strong>Configurations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Five hundred supplemental single-family stoves, each 35 MMBtu⁴</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cordwood</td>
<td>0.36</td>
<td>1.81</td>
<td>13.59</td>
<td>127.29</td>
<td>14.95</td>
<td>62.93</td>
<td>0.69</td>
<td>---</td>
</tr>
<tr>
<td>Pellets</td>
<td>0.36</td>
<td>1.81</td>
<td>2.49</td>
<td>22.66</td>
<td>0.14</td>
<td>3.97</td>
<td>0.00</td>
<td>---</td>
</tr>
<tr>
<td>Option 1: Vermillion Community College. Annual heat load 7,227 MMBtu.</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Chips⁵</td>
<td>0.19</td>
<td>1.20</td>
<td>0.86</td>
<td>2.97</td>
<td>0.17</td>
<td>0.30</td>
<td>0.34</td>
<td>---</td>
</tr>
<tr>
<td>Pellets</td>
<td>0.19</td>
<td>0.81</td>
<td>0.47</td>
<td>1.63</td>
<td>0.07</td>
<td>0.10</td>
<td>0.04</td>
<td>---</td>
</tr>
<tr>
<td>Option 2: District heat for E-B Community Hospital, Sibley Manor, ISD 696. Annual heat load 16,235 MMBtu.</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Chips</td>
<td>0.43</td>
<td>2.71</td>
<td>1.93</td>
<td>6.67</td>
<td>0.38</td>
<td>0.67</td>
<td>0.75</td>
<td>---</td>
</tr>
<tr>
<td>Pellets</td>
<td>0.43</td>
<td>1.82</td>
<td>1.06</td>
<td>3.67</td>
<td>0.16</td>
<td>0.22</td>
<td>0.10</td>
<td>---</td>
</tr>
<tr>
<td>Option 3A: District heat for E-BCH, SM, ISD 696 (above) plus approximately 15 businesses along Sheridan Street. Annual heat load 21,553 MMBtu</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chips</td>
<td>0.57</td>
<td>3.60</td>
<td>2.57</td>
<td>8.86</td>
<td>0.51</td>
<td>0.89</td>
<td>1.00</td>
<td>---</td>
</tr>
<tr>
<td>Pellets</td>
<td>0.57</td>
<td>2.41</td>
<td>1.41</td>
<td>4.87</td>
<td>0.22</td>
<td>0.30</td>
<td>0.13</td>
<td>---</td>
</tr>
</tbody>
</table>
III. Environmental impacts

• Increased bio-energy could alter forestry practices positively and negatively in procurement zone
  – If bi-product of timber harvest, would reduce residuals at harvest site
  – If roundwood, increase timber harvest?
• Public concern expressed about impacts to water, air, habitat, aesthetic resources
• GEIS found no significant negative impacts at timber harvest rates that would adequately supply local bio-energy needs
• Application of MN Biomass Harvest Guidelines needed to avoid negative impacts to soils, forest structure, habitat values
• Training, consistent application, and monitoring needed to improve use of guidelines & better understand impacts
### Table 8. Summary of Minnesota’s Biomass Harvesting Guidelines

<table>
<thead>
<tr>
<th><strong>DO’S</strong></th>
<th><strong>DON’TS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>During Biomass Harvesting:</strong></td>
<td><strong>Avoid Biomass Harvesting:</strong></td>
</tr>
<tr>
<td>• Plan roads, landings and stockpiles to occupy a minimized amount of the site</td>
<td>• Within 25 feet of a dry wash bank, except for tops and limbs of trees</td>
</tr>
<tr>
<td>• Ensure that landings are in a condition to regenerate native vegetation after use, including tree regeneration</td>
<td>• On nutrient-poor organic soils deeper than 24 inches (<em>These sites typically have sparse (25-75%) cover that is predominantly (&gt;90%) black spruce and stunted (&lt;30 feet high).</em></td>
</tr>
<tr>
<td>• Avoid site re-entry to collect biomass after harvesting (<em>this reduces potential for soil compaction and damage to regeneration</em>)</td>
<td>• On aspen or hardwood cover types on shallow soils (8 inches or less) over bedrock</td>
</tr>
<tr>
<td>• Install erosion control devices where appropriate to reduce sedimentation of stream, lakes and wetlands</td>
<td>• On erosion-prone sites (e.g. steep slopes of 35% or more)</td>
</tr>
<tr>
<td>• Retain and scatter at least one third of the fine woody debris on the site</td>
<td>• In areas that impact sensitive native plant communities and where rare species are present</td>
</tr>
<tr>
<td>• Encourage native seed mixes and avoid introduction of invasive species</td>
<td>• In riparian areas or leave tree retention clumps</td>
</tr>
<tr>
<td>• Retain slash piles that show evidence of use by wildlife</td>
<td>• In a manner that removes the forest floor, litter layer or root systems; these resources</td>
</tr>
<tr>
<td>• Leave all snags, retain stumps and limit disturbance of pre-existing coarse woody</td>
<td></td>
</tr>
</tbody>
</table>


IV. Logistics / Supply Chain

• Public forest managers expressed interest in new tools (and markets) to support forestry activities

• Presence of active logging labor force is critical factor in local bio-energy expansion

• Continued dialogue is needed on viable business plans for harvest, handling, processing biofuels
IV. Logistics / Supply Chain, ii

- Numerous businesses have (1) near-term plans to replace furnaces and (2) interest in biomass DE
- Viability of downtown extensions depend on how many businesses decide to participate
Fact sheets summarize findings for public outreach.

Fact Sheet: Biomass Energy

Emissions and biomass energy in Northeast Minnesota

- Air quality impacts of biomass energy
- All energy production contributes to air pollution, but biomass energy has the potential to increase energy independence, lower carbon dioxide emissions, and reduce deforestation.

Forestry and biomass energy in Northeast Minnesota

- Forestry impacts: Forests are a renewable resource.
- Biomass energy impacts: Renewable energy from biomass sources can help reduce dependence on fossil fuels.

Northern forests ecosystem

- Muscle: Northern forests are a significant carbon sink.
- Sustainability: Biomass energy can help reduce greenhouse gas emissions.

Biomass harvest operations

- Challenges: Harvesting biomass can be a significant challenge.
- Benefits: Biomass energy can help reduce dependence on fossil fuels.

Table 1: Biomass Feedbacks

- Feedbacks: Feedbacks can help improve energy production and efficiency.
- Suggested actions: Suggested actions can help improve energy production and efficiency.
Next Steps

• Reports available on community and Dovetail websites

• Lessons learned, based on feedback from community meetings and partners, distributed statewide
Questions / comments?
Resource slides
Table 1. Modeled biomass systems and equipment specifications for Ely.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Heat demand (non-peak) (MMBtu/yr)</th>
<th>Building connections</th>
<th>Fuel type</th>
<th>Annual biomass demand dry tons (wet tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1: Vermillion Community College</td>
<td>7,680</td>
<td>0</td>
<td>Chips/Hog</td>
<td>527 (878)</td>
</tr>
<tr>
<td>Option 2: E-BCH, Sibley, ISD 696</td>
<td>16,235</td>
<td>3</td>
<td>Chips/Hog</td>
<td>1,754 (2,924)</td>
</tr>
<tr>
<td>Option 3A: Option 2 extension</td>
<td>21,381</td>
<td>18</td>
<td>Chips/Hog</td>
<td>2,559 (4,165)</td>
</tr>
</tbody>
</table>

1 Assumes 55-60% of heat load with peaking backup for coldest days. 2 District heating portion of a CHP system; a stand-alone district heating system was not analyzed in the LHB report.

Table 2. Financial performance of proposed options for Ely.

<table>
<thead>
<tr>
<th></th>
<th>Option 1:</th>
<th>Option 2:</th>
<th>Option 3A:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital costs including hookup ($)</td>
<td>$1,934,318</td>
<td>$3,783,002</td>
<td>$5,459,348</td>
</tr>
<tr>
<td>Annual electricity sales ($)</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>NPV project cost ($)</td>
<td>$2,601,514</td>
<td>$4,856,236</td>
<td>TBD</td>
</tr>
<tr>
<td>NPV savings (including PPA) ($)</td>
<td>$2,666,281</td>
<td>$5,996,704</td>
<td>TBD</td>
</tr>
<tr>
<td>Net Present Value ($)</td>
<td>$64,767</td>
<td>$1,140,469</td>
<td>$4,560,259</td>
</tr>
<tr>
<td>Simple payback period (years)</td>
<td>12</td>
<td>0</td>
<td>13.5</td>
</tr>
<tr>
<td>Biomass cost of heat ($/mmBtu)</td>
<td>$32</td>
<td>$26</td>
<td>$30</td>
</tr>
<tr>
<td>Current fossil fuel price ($/mmBtu)</td>
<td>$30</td>
<td>$29</td>
<td>$29</td>
</tr>
<tr>
<td>Maximum annual outlay ($)</td>
<td>$10,861</td>
<td>$0</td>
<td>TBD</td>
</tr>
</tbody>
</table>

1 Including Power Purchase Agreement (PPA) for electricity sold. 2 Cost of fossil fuel only; does not include the full cost of heating.