Heating The Midwest With Renewable Biomass

Urban Wood Procurement and Processing Strategies
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Saint Paul’s Community Energy System
Community Scale Heating and Cooling

- Underground network of pipes aggregate heating and cooling needs
- Aggregated thermal loads allows application of technologies and fuels not feasible for individual buildings
- Increases fuel flexibility, rate stability, and reliability
Integrated Energy System

flexible & renewable fuel sources

reliable and effective production & storage

hot & chilled water loops maximize energy conservation & reliability
District Heating
District Energy – How it Works
District Cooling
Thermal Storage

• 6.5 million gallons of storage capacity
• Chilled water storage reduces peak-electric demand
• Firm capacity for weather events
Solar Thermal Integration
Heating and Cooling Saint Paul
Importance of Renewables to Customers

- Very Important: 76%
- Somewhat Important: 22%
- Not Important: 2%
Combined Heat & Power

- 25 MW of electricity
- Renewable, clean, urban wood residue
- Greenhouse gas CO$_2$ reduced up to 280,000 tons per year
Integration of Biomass-Fueled CHP

Urban wood waste

Processed, stored & transported

Burned to make steam

Steam turbine power

Distribution to power grid

Local customers

“Waste” energy heats downtown

Water returned

Environmental Wood Supply

www.ever-greenenergy.com
St. Paul Cogeneration – Combined Heat & Power

- 25 MW of electricity
- Renewable, clean, urban wood residue
- Greenhouse gas CO$_2$ reduced by 280,000 tons per year
Fuel Diversification

Before and After Wood-Fired CHP Project

BEFORE
- RENEWABLE: 10%
- FOSSIL FUELS: 90%

AFTER
- RENEWABLE: 70%
- FOSSIL FUELS: 30%
Biomass Advantages

• Large quantities in metro area
• Wood waste diverted from landfills
• Economically viable
• Community based
Storm Damage
Wood Waste Processing
Biomass – Where it comes from?

- Wood residuals from a manufacturing process such as pallets
- Construction waste/clean dimensional lumber
- Urban and park tree trimmings
- Storm damaged trees
- Trees removed for urban development
- Trees removed as part of a timber management plan/restoration
- Trees grown for the purpose
Wood Waste Loader
Wood Waste Processing
Linking Habitat Restoration to Bioenergy

• In 2007, the Minnesota legislature appropriated $4,500,000 to study renewable energy options for RockTenn (major recycler in St. Paul)
• $500,000 for ecological restoration by removing ecologically inappropriate woody plant material
• DNR created small grants pilot project to cut, move and stage woody biomass material from public and private lands
• Project partner is District Energy St. Paul
Linking Habitat Restoration to Bioenergy

Goals:
- Facilitate habitat restoration efforts
- Provide a local source of energy
- Explore feasibility including cost/benefit
- Replicate

Benefits:
- Increase healthy native habitats
- Utilize traditionally discarded woody biomass as bioenergy
- Supplement landowner resources for habitat restoration
Linking Habitat Restoration to Bioenergy

The need:

- More than 7,000 acres of restorable habitat
- in need of tree and shrub removal
- have been identified on public and private land
- within 75 miles of St. Paul!
Linking Habitat Restoration to Bioenergy

Pilot Approach ➔ Develop Procedures and Criteria:

• Ecological value of the site – MCBS ranking
• Restricted to 75 mile radius of St. Paul
• Estimated volume at least 20 semi-truckloads
• Suitable roads/trails and staging area
• Current Management Plan (less than 10 years old)
• Capacity to manage project and write Harvest Plan
• Capacity and commitment for post-harvest management to achieve and maintain long-term restoration goals
Linking Habitat Restoration to Bioenergy

15 Pilot Projects Completed a/o January 2011:

- Pilot Knob Hill, **3 acres**, City of Mendota Heights
- Hastings Sand Coulee SNA, 7 acres, MN DNR
- Schuneman Marsh Preserve, 3 acres, **Izaak Walton League**
- Indian Mounds Park, 12 acres, City of St. Paul
- Bridgeview Park Reserve, 15 acres, **Sherburne County**
- Lake Edith (2 phases), **90 acres**, Belwin Conservancy
- Zumbro Falls Woods SNA, 29 acres, **MN DNR**
- Kelleher Park, 23 acres, City of Burnsville
- Fort Snelling WPA Camp, 17 acres, MN DNR
- Uncas Dunes SNA-South Unit (2 phases), 47 acres, MN DNR
- Alimagnet Park, 28 acres, City of Burnsville
- DNR St. Paul Hatchery A.M.A., 8 acres, MN DNR
- Stagecoach Prairie Natural Area, 12 acres, Belwin Conservancy
Linking Habitat Restoration to Bioenergy

Pilot Knob Hill - 3 acres of mixed hardwoods restored to oak savanna/prairie, 16 loads, 320 tons, $21.50/ton

Photos courtesy of MN DNR
Linking Habitat Restoration to Bioenergy

Schuneman Wildlife Preserve - 3 acres of pine plantation and invading hardwoods to oak savanna, 16 loads, 320 tons, $12.33/ton

Photos courtesy of MN DNR
Linking Habitat Restoration to Bioenergy

Lake Edith Prairie and Savanna Phase 1, Belwin Conservancy - 74 acres of mixed hardwoods, conifers and shrubs to prairie and oak savanna, 209 loads, 4,180 tons, $19.47/ton

Photos courtesy of MN DNR
Linking Habitat Restoration to Bioenergy

Fort Snelling WPA Camp, MN DNR - 17 acres of buckthorn with some mixed hardwoods to prairie and oak savanna, 19 loads, 380 tons, $28.37/ton

Photos courtesy of MN DNR
Linking Habitat Restoration to Bioenergy

Results:

• Nearly 300 acres treated on 15 project sites
  • Range = 3 acres to 50 acres
• Avg. cost/ac treatment = $1,447
  • Range = $346/ac to $2,308/ac
• 521 loads totaling 11,023 tons of biomass to DE
• Avg. cost per ton = $49.46
  • Range = $9.63/ton to $142.69/ton
• 6 DNR, 4 City, 4 NGO, 1 County
2010: Linking Habitat Restoration to Bioenergy and Local Economies

- In 2010, an additional $600,000 provided by the MN ENRTF
- Builds on the success of the pilot project
- Expands market opportunities for the biomass
- Will assess the feasibility of market-driven ecological restoration
- Funding available until June 2013
Example of Cost Tracking Data
## Data by Location

<table>
<thead>
<tr>
<th>Location</th>
<th>Average of miles to EWS</th>
<th>Average of Mobilization cost</th>
<th>Average of Trucking cost</th>
<th>Total Tons of wood</th>
<th>Average of Cost/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anoka</td>
<td>23.25</td>
<td>$412.00</td>
<td>$4,811.31</td>
<td>4202</td>
<td>$15.77</td>
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<tr>
<td>Dakota</td>
<td>23</td>
<td>$486.00</td>
<td>$7,908.00</td>
<td>2046</td>
<td>$12.96</td>
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<tr>
<td>Goodhue</td>
<td>32.5</td>
<td>$720.00</td>
<td>$15,730.00</td>
<td>2244</td>
<td>$21.27</td>
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<tr>
<td>Hennepin</td>
<td>17.25</td>
<td>$430.00</td>
<td>$7,116.88</td>
<td>3586</td>
<td>$14.20</td>
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<tr>
<td>Ramsey</td>
<td>11.38</td>
<td>$297.92</td>
<td>$3,411.19</td>
<td>13882</td>
<td>$6.49</td>
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<tr>
<td>Scott</td>
<td>43</td>
<td>$494.00</td>
<td>$5,504.00</td>
<td>528</td>
<td>$16.13</td>
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<tr>
<td>Chisago</td>
<td>47.8</td>
<td>$308.00</td>
<td>$6,398.40</td>
<td>3256</td>
<td>$15.52</td>
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<tr>
<td>Total/Avg.</td>
<td>19.6</td>
<td>$358.50</td>
<td>$5,008.77</td>
<td>29744</td>
<td>$10.70</td>
</tr>
</tbody>
</table>
# Grinder Type Data

<table>
<thead>
<tr>
<th>Row Labels</th>
<th>Average of Cost/ton</th>
<th>Average of Mobilization cost</th>
<th>Average of Net Fuel cost</th>
<th>Sum of Tons of wood</th>
<th>Count of Job#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal grinder</td>
<td>$11.30</td>
<td>$484.33</td>
<td>$1,375.02</td>
<td>10,648</td>
<td>18</td>
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<tr>
<td>Tub grinder</td>
<td>$10.35</td>
<td>$283.00</td>
<td>$1,338.51</td>
<td>19,096</td>
<td>30</td>
</tr>
<tr>
<td>Total/Avg.</td>
<td>$10.70</td>
<td>$358.50</td>
<td>$1,352.20</td>
<td>29,744</td>
<td>48</td>
</tr>
</tbody>
</table>
# Wood Source Data

<table>
<thead>
<tr>
<th>Wood Source Type</th>
<th>Average of Cost/ton</th>
<th>Sum of Tons of wood</th>
<th>Count of Job#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trees removed as part of timber management</td>
<td>16.27</td>
<td>1,408</td>
<td>1</td>
</tr>
<tr>
<td>Urban/park tree trimmings residuals</td>
<td>10.23</td>
<td>26,136</td>
<td>44</td>
</tr>
<tr>
<td>Wood from trees down from storm</td>
<td>16.35</td>
<td>1,298</td>
<td>2</td>
</tr>
<tr>
<td>Wood from storm damage</td>
<td>14.82</td>
<td>902</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total/Avg.</strong></td>
<td><strong>10.70</strong></td>
<td><strong>29,744</strong></td>
<td><strong>48</strong></td>
</tr>
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QUESTIONS?

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