Local Energy

Sustainable Biomass Heat and Power Systems at the Community Scale

Presentation to:
ENVIRONMENTAL AND ENERGY STUDY INSTITUTE
Congressional Briefing

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Biomass Energy Resource Center (BERC)

BERC is a national not-for-profit organization working to promote responsible use of biomass for energy.
BERC’s mission is to achieve a healthier environment, strengthen local economies, and increase energy security across the United States by developing sustainable biomass systems at the community level.

Biomass Feedstocks

Forest Residues
• Timber harvesting
• Forest thinning
• Wood processing

Agricultural Residues
• Farms (corn stover)
• Agricultural processing (sugarcane bagasse)

Energy Crops
• Hybrid poplar
• Switch grass
• Willow

Other Biomass Feedstocks (urban waste, animal manure, waste vegetable oils, etc.)

Source: Roger Taylor, NREL Presentation at BIA Conference, 2005

Local Energy –
A new way to look at the relationship between communities and forests
What Are the Characteristics of Local Energy?

- Uses community-scale technology
- Replaces fossil fuels with local biomass, for heat and power
- Uses efficient, clean technology
- Has strict requirement for sustainable fuels

What Does Local Energy Look Like?

- Community district energy (using wood fuel)
- School and other institutional wood heating
- Wood-fired campus energy systems
- Small-scale power generation and CHP

What Are the Benefits of Local Energy?

- Keeps local energy dollars circulating in the community
- Displaces expensive fossil fuels and increases security
- Scaled to link community energy economy with local resources
- Acts as a force for sustainable forestry
- Uses manageable volumes of biomass for each project
- Supports forest-products industry and creates jobs

Why Woody Biomass is a Good Energy Choice for the Northeast
Heating with biomass is less expensive than heating with fossil fuels.

Biomass: A Cost-Effective Fuel

Wood fuel comparison:
Woodchips
- Direct sourced fuel
- Green, 25-50% moisture content
- Variable particle size
- Tricky to convey automatically
- Relatively low bulk density
- Inexpensive

Wood fuel comparison:
Wood Pellets
- Manufactured, value-added solid fuel
- Dry, 5-10% moisture content
- Uniform particle size (3 grades)
- Relatively easy to convey automatically
- Relatively high bulk density
- Inexpensive (but less than oil and propane)

Comparative Cost of Heat - Various Fuels

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Unit</th>
<th>Cost/unit</th>
<th>Average Efficiency</th>
<th>$/MMBtu Delivered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating Oil</td>
<td>gallons</td>
<td>$2.40</td>
<td>80%</td>
<td>$21.74</td>
</tr>
<tr>
<td>Propane</td>
<td>gallons</td>
<td>$2.20</td>
<td>85%</td>
<td>$28.13</td>
</tr>
<tr>
<td>Cordwood</td>
<td>cords</td>
<td>$200</td>
<td>60%</td>
<td>$15.15</td>
</tr>
<tr>
<td>Woodchips</td>
<td>tons</td>
<td>$50</td>
<td>65%</td>
<td>$7.63</td>
</tr>
<tr>
<td>Wood Pellets</td>
<td>tons</td>
<td>$220</td>
<td>75%</td>
<td>$18.28</td>
</tr>
</tbody>
</table>

Assumes bulk delivery to institutional scale applications
Conversion efficiency determines how much energy can be produced from a given amount of wood harvested.

- High efficiency means getting the most out of the forest resource
- Low efficiency means wasting the forest resource

About how much wood might the potential Uses consume?

**Industrial Uses:**
- Bio-oil: 50-100,000 tons/plant
- Cellulosic ethanol (at scale): 50-100,000 tons/plant?
- Power plants: 200-600,000 tons/plant

**Community Uses:**
- One school: 200-1,000 tons
- 30 Schools: 15,000 tons
- All schools in Maine: 250,000 tons
- Middlebury College: 30,000 tons
- Vermont state office complex: 5,000 tons
- Crotched Mountain Rehab Ctr. (Hospital): 3,000 tons
- Public housing (50 units): 450 tons

Vermont Wood and Oil Energy Price History

Schools paid an average of:
- 2003-04: Wood $32/green ton, #2 Oil $1.01/gal
- 2004-05: Wood $36/green ton, #2 Oil $1.40/gal
- 2005-06: Wood $40/green ton, #2 Oil $1.56/gal
- 2006-07: Wood $43/green ton, #2 Oil $2.29/gal
What about wood pellets?

- One house (stove) 1-4 tons
- One house (central heat) 4-6 tons
- A small school 50-150 tons
- All schools in Maine 125,000 tons
- Small Commercial building
  - Heat: 100 tons
  - CHP: 300 tons
- Seniors housing (30 units) 150 tons

Bagged residential and bulk-delivered pellets

What Are “Modern” Biomass Heating Systems?

- Increased efficiency
- Lower emissions
- Lower time requirements
- Reliable operation
- Automated fuel handling
- Hot water boiler and heat distribution

 Universe of Technology Options for Biomass Heating Systems

<table>
<thead>
<tr>
<th>Biomass Feedstocks</th>
<th>Storage of Feedstock</th>
<th>Distribution of Heat</th>
<th>End Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodchips (hardwood/softwood/bole tree chips)</td>
<td>Below Grade Bin</td>
<td>Hot water</td>
<td>Hot water</td>
</tr>
<tr>
<td>Pellets (Wood, Grass, saw dust, agricultural residues)</td>
<td>Above Grade Bin</td>
<td>Steam</td>
<td>Steam</td>
</tr>
<tr>
<td>Cordwood</td>
<td>Silo (inside or under a roof of outside)</td>
<td>Hot air</td>
<td>Hot air</td>
</tr>
<tr>
<td>Agricultural Crop (corn)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Components of Biomass Systems

- Fuel Sources
- Fuel Transport and Delivery
- Fuel Storage
- Fuel Handling
- Combustion System
Wood-Chip Combustion

Best applications for woodchips
- Larger facilities
- Where fuel cost savings are very important
- Larger schools (over 40,000 sq. ft.)
- Where there's room for: new boiler room, fuel storage bin, tractor trailer access
- In/near forested areas with active forest products industry

Wood fuel comparison:

Pellet Boilers

Best applications for wood pellets
- Residential use (stoves & central heat)
- Small commercial facilities
- Small schools (under 40,000 sq. ft.)
- Locations with limited space
- Sites not far from a pellet plant

Wood fuel comparison:
Applications
Fuels for Schools

Darby, Montana
First School Wood System in the West - US Forest Service “Fuels for Schools”

School Case Study
Barre Town Elementary School
Barre, Vermont

- Size: 160,000 sq. ft. / 1000 students
- Heating System: Wood chips, converted from electric heat
- Fuel Use: 650 tons/year
- Annual Heating Cost: $19,000
- Annual Savings: $100,000 per year (1997)

Public Buildings
Emery Hubbard State Office Building
Newport, Vermont
State Capitol and Office Complex
Community Energy
Montpelier, Vermont

Multi-Building Heating
Mt. Wachusett
Community College

Campuses
University of Idaho, Moscow
Maryville College, Tennessee

District Heating - Campus
Middlebury College, Middlebury, Vermont
Case Study – Pellets
Commercial Heating

NRG Systems, Hinesburg, Vermont

Fuel Cost Savings

For heating, one ton of wood pellets equals...
- 120 gallons of heating oil
- 170 gallons of propane
- 16,000 kWh of natural gas
- 4,775 kilowatt hours (kWh) electricity

Current oil price: $2.30
Oil-pellet equivalent price: $1.67
Estimated Savings: $0.63
(per gallon oil offset with wood pellets)
Percent Savings: 27%
($2,700 saved on a $10,000 fuel bill)

Sustainable Fuel Supply

- Core to BERC’s Mission
- Manage Forest Resources for Multiple purposes
  – More than Net Growth - “Sustained Yield”
  – Habitat, Conservation and Wilderness
  – Recreation
  – Forest Resource Mgt and Products
- Carbon Neutrality or Storage
- Rural Economic Support
- BERC has developed NALG Model as Tools
  – Vermont Wood Fuel Supply Study
  – Adaptable to other states

Statewide Wood Fuel Supply Studies
Vermont -
Vermont Wood Fuel Supply Study

An Examination of the Availability and Reliability of Wood Fuel for Biomass Energy in Vermont

Above-ground biomass examined:
- Live trees 5” DBH and greater
- Above a one foot stump excluding foliage
- Includes "growing stock" trees, "cull" trees, and non-commercial species

Current Market Demand for Low Grade Wood from Vermont

- Biomass Power (BED and Ryegate) 750,000 tons
- Pulp and Paper (outside VT) 600,000 tons
- Firewood Heating 600,000 tons
- Woodchip Heating 35,000 tons
- Total 1,985,000 tons

Conclusion

Local Energy, making the energy connection between rural communities and their forest resources, brings together climate change, renewable energy, and sustainable forestry at the right scale.

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