Perspectives on Wood-fired CHP

Alaska-Yukon Wood Energy Conference

Adam Sherman
About VEIC

• Mission-driven nonprofit
• 30+ years reducing economic & environmental costs of energy
• 300 staff in Vermont, Ohio, & Washington DC
• Design and deliver:
  - Energy efficiency
  - Renewable energy
  - Transportation efficiency
• We “think and do”
  - 30 Consultants
  - 60 Engineers and TA experts
  - 10 Data analytics and EM&V experts
  - 8 Financing strategy experts

• Clients
  - Utilities
  - Government
  - Regulators / Consumer Advocates
  - Environmental Organizations
  - Foundations
Major Initiatives

- Efficiency Vermont
- DC Sustainable Energy Utility
- Efficiency$MART
- BERC Biomass Energy Resource Center
- Renewable Energy Resource Center
- Drive Electric Vermont
- Commons Energy
- Sustainability Benefits
- Sun Shares

VEIC
Biomass Energy Resource Center (BERC)
Advancing the use of Local Wood Heat and CHP in North America

Technical Consulting
• Project feasibility studies
• Fuel supply assessments and procurement
• Third-party expert review
• Develop and review of standards
• Market assessments

Program Design & Implementation
• Wood heat market expansion potential assessments
• Program design and implementation support
• Training and advisory support services

Advocacy
• Showcasing “best practices” and case studies of successful projects
• Tracking market growth and impacts

BERC is a program of VEIC
A mission-driven non-for-profit whose mission is to reduce the economic and environmental impacts of energy production and consumption
Presentation Outline

• Thermal led CHP
• Electric led CHP
• Boiler coupled technology
• Steam vs. ORC
• System sizing to thermal loads
• Grid connected or “behind the meter”
• Economics
• Market opportunities
Boiler coupled energy options

- Large steam or hot water boilers
- Steam or Hot Water for Space Heat & DHW
- Absorption Chillers for Cooling
- Back-pressure Steam Turbines for On-site Electric Generation
Energy Loads of an Example Commercial Building

- **Space Heating Demand**
- **Electrical Load MMBTU Equivalent**
Steam Boiler CHP Options

Biomass-Fired Steam Boiler(s)

Fuel 100%

Heat losses 25-30%

Steam Output 70-75%

Back-Pressure Turbine

6-9% electric output

Serving 10-40% of facility’s electric load

Redirected Steam

Steam to serve heating and DHW load

Serving 90 – 100% of facility’s heating, DHW loads

Absorption Chiller

Serving 20-100% of cooling loads

Chilled Water

Serving 10 - 40% of facility’s electric load

Serving 90 – 100% of facility’s heating, DHW loads
<table>
<thead>
<tr>
<th>Installed Projects</th>
<th>Location</th>
<th>Generation Connection to Utility?</th>
<th>Wood-Fueled Boiler Capacity (MMBtu/hr.)</th>
<th>Turbine Capacity (kW/h)</th>
<th>MBtu per kW Capacity Ratio</th>
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Other Technology Innovations - CHP

- Pellet boiler + Sterling engine
- Down-draft gasifier coupled with IC engine
- Organic Rankine Cycle (ORC) system
Thank you!

Adam Sherman

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Extra Slides
Automated Wood Heating System Configuration

Fuel Storage
- Pellet Silos
- Slab chip bins
- Below grade chip bins

Combustion Equipment
- Stoker/fixed grate
- Stoker/moving grate
- Pneumatic/suspension
- Fluidized bed

Emissions Control Equipment & Stack
- Single cyclone
- Multi-cyclone
- Baghouse
- ESP
Under-sizing Wood Boilers

Typically:
- A boiler sized to meet **50%** of peak load conditions will cover **84%** of annual heat load
- A boiler sized to meet **75%** of peak load conditions will cover **96%** of annual heat load