Overview of Biomass Energy and Economic Development Opportunities

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Tribal Leader Forum Series
Biomass Renewable Energy Opportunities and Strategies
July 9, 2014
Bonneville Power Administration, Portland, Oregon
President’s Executive Order 13624: 40GW of new CHP by 2020

• CHP TAPs are critical components of achieving the goal:
  – Regional CHP experts
  – Provide fact-based, un-biased information on CHP
    • Technologies
    • Project development
    • Project financing
    • Local electric and natural gas interfaces
    • State best practice policies
  – Vendor, fuel, and technology neutral

http://eere.energy.gov/manufacturing/distributedenergy/chptaps.html
CHP Technical Assistance Partnerships

Key Activities

• Market Opportunity Analysis.
  Supporting analyses of CHP market opportunities in diverse markets including industrial, federal, institutional, and commercial sectors

• Education and Outreach.
  Providing information on the energy and non-energy benefits and applications of CHP to state and local policy makers, regulators, end users, trade associations, and others.

• Technical Assistance.
  Providing technical assistance to end-users and stakeholders to help them consider CHP, waste heat to power, and/or district energy with CHP in their facility and to help them through the development process from initial CHP screening to installation.

http://eere.energy.gov/manufacturing/distributedenergy/chptaps.html
What Is Combined Heat and Power?

CHP is an integrated energy system that:

• Is located at or near a factory or building
• Generates electrical and/or mechanical power
• Recovers waste heat for
  ➢ heating,
  ➢ cooling or
  ➢ dehumidification
• Can utilize a variety of technologies and fuels
CHP Recaptures Much of that Heat, Increasing Overall Efficiency of Energy Services……

Power Plant
32% efficiency
(Including T&D)

Onsite Boiler
80% efficiency

CHP
75% efficiency

Total Efficiency
~ 75%

Total Efficiency
~ 50%

94 units Fuel

56 units Fuel

30 units

45 units

75 units

100 units

150 units

U.S. Department of Energy
CHP Technical Assistance Partnerships
What Are the Benefits of CHP?

• CHP is more efficient than separate generation of electricity and heat.

• Higher efficiency translates to lower operating cost, (but requires capital investment).

• Higher efficiency reduces emissions of all pollutants.

• CHP can also increase energy reliability and enhance power quality.

• On-site electric generation reduces grid congestion and avoids distribution costs.
Biomass CHP - Presentation Overview

- Biomass CHP’s energy fit to biomass products
- Economic development & the rural economy
- Fuel drying impacts costs
- Feedstocks impact operating costs
- Environmental considerations
- Design lessons to avoid costly changes & project examples
- Conclusion & next steps
- U.S. Department of Energy CHP Technical Assistance Partnership services
Biomass CHP - The Energy Fit

Biomass CHP smoothly fits with a wide variety of wood and other products with differing sizes – They all need power and heat

- Forest products mills – Lumber and plywood
- Pulp & paper
- Wood pellets
- District energy
- Greenhouses
- Biochar (co-product)
- Cellulosic biofuel
- Pasteurized firewood
Biochemistry is opening the door to a wide variety of products – Often competing with petrochemicals – Are there unique biochemistries in the feedstocks that have value?

- Nutraceuticals
- Fragrances – Essence of pine
- Dyes
- Sugars
- Cellulose
- Example – Yakama Nation: Heritage College & Biochemistry

Conclusion: These woody biomass products need heat and power
Biomass CHP & Rural Economics

The U.S. has two energy economies: Where we do and don’t have natural gas for thermal energy
1) Biomass enables CHP in areas of U.S. without natural gas & using fuel oil or propane—Rural U.S (rural industrial & agriculture)
2) Rural CHP payback compares well to fuel oil or propane – Improves economic potential
3) Rural grid interruptions are more common – WWTFs/hospitals are critical facilities & interruptions impact industrial production – Economic drivers to proceed with CHP
4) Two examples: 1) Drying craisins (fuel oil & another Pacific storm); and 2) Alaska Gateway School District in Tok, AK

Conclusion: Biomass CHP can be very helpful for economic development
Why is Fuel Drying Important?

Not required for direct combustion, but:

• Drying significantly improves the efficiency of the boiler system when flue gas is used for drying energy
  • For boiler:
    – (+)5% to 15% improvement in efficiency
    – (+)50% to 60% more steam production
• Improves combustion efficiency and control
• Reduces air emissions
• Reduces ancillary power requirements
• Reduces feedstock (fuel) costs

Source: Dr. Carolyn Roos, Northwest CHP Technical Assistance Partnership
Drying from 60% to 10% Moisture Content

Moisture Removed: 0.555 lbs

Source: Northwest CHP Technical Assistance Partnership
Feedstock Perspectives & Economics

• Think creatively – What is available locally?
  • Transportation costs can kill a project. 50-mile radius is a typical rule of thumb maximum distance

• Feedstock Sources?
  ▪ Overgrown forests – Fire hazard reduction
  ▪ Urban wood waste

• Biomass feedstocks – How reliable is the source? Price?
  ▪ Due diligence is needed for a long-term supply contract
  ▪ Do a biomass availability assessment
  ▪ Don’t assume it’s there because there is plenty to see – Reliable gathering
  ▪ It may be necessary to start a company with hands-on management to develop skills
Feedstock Perspectives (continued)

• What if we lost the supply? How do we manage seasonal variation? Have alternatives.

• Amount stored – How long a supply?

• Feedstock competition is coming as bioenergy technology advances.

• What is the moisture content? It makes a difference in system design.

• What is the quality of the feedstock? Wood chips by hammermill or knife – avoid clogging of auger (moisture impacts auger design)
Environmental Considerations

• Think through environmental aspects early and deeply – there are a wide variety of topics: Air Quality, water quality, over harvesting the forest, and ash disposal

• Compared to what? This is a basis for showing improvements: Example: Nippon Paper: Fuel oil versus wood waste

• Air emissions – biomass portion of boiler MACT (not CISWI if no MSW)

• Forest Health concerns can be an environmental plus to aid forest health treatments
Environmental Considerations (continued)

• Solid waste avoidance – uses for the ash. What are the nutrients?

• Carbon footprint and greenhouse gas reductions: Biogenic carbon (not fossil carbon)

• Water use and quality impacts

• Capture lessons learned and the story behind them
EPA & Biomass

• A number of revised rules are in the works or recently completed:
  • GHG and biogenic carbon (in process)
  • Boiler MACT
  • CISWI (Reconsideration 12/2/11 & Final 12/21/12)
• Biomass GHG: How carbon neutral is it? What do you measure? Time span? A tree or a forest?
• Clean cellulosic biomass: Hog fuel, wood pallets, wood pellets fall under CAA section 112 boiler regulations
• Biomass CHP does not fall under the CISWI incinerator rules (Commercial/Industrial Solid Waste Incinerators) unless MSW included in the feedstock
Biomass CHP Design Lessons

• Ensure all parts of the system are properly sized
  • Don’t undersize the feed auger
  • Ensure boiler sized for both thermal energy and power generation needs
• If twin augers, ensure they rotate counter clockwise to each other – Solves moist wood clumping to one side and the feed rate cut in half
• Does the thermal energy demand vary over time? Use extraction/condensing turbine for thermal flexibility as opposed to a back pressure turbine
• Wood ash settling – Needs a quiet place to settle (no venting)
• Avoid pressure relief valves – Wastes energy
• When power prices are high, avoid thermal energy only systems (do both: CHP)
Biomass CHP Project Profiles

CHPTAPs inform and connect

National Database on DOE AMO site
http://www1.eere.energy.gov/manufacturing/distributedenergy/chp_projects.html
Example of Biomass CHP System

Cooley Dickinson Hospital in Maine with 140 patient beds 600,000 square feet

- Feedstock: Wood chips
- 500 kW system (2 steam turbines) & 2 boilers with 75 psig for steam distribution throughout the hospital
- Cooling via an absorption chiller
- Reasons to choose CHP: Eliminate fuel oil use and improved reliability
- Link:
Steam Boiler/Extraction Condensing
Steam Turbine Generator – 60 MW

• Feedstock: Spent liquor, wood chips/hog fuel with storage
• Steam boiler, recovery boiler (both at 875 psig), steam turbine (triple extraction condensing) & generator
  
• Power sold to California
• 300,000 tons/yr CO2 reduction
• Steam extracted at 3 different psig
• Fuel flexibility

• RockTenn Tacoma Kraft – See case study www.northwestchptap.org
Steam Boiler/Backpressure Steam Turbine Generator  1.5 MW

- Cave Junction, OR
- Feedstock: Hog fuel, forest thinnings & logging debris
- Steam boiler (300 psig), steam turbine & generator

- PPA to local utility
- Electrostatic precipitator
- 7,182 MT/yr CO2e reduction
- Thermal: Kiln dried lumber

Rough and Ready Lumber, Cave Junction, OR - See case study  www.northwestchptap.org
Conclusion & Next Steps

• Economic advantage – make your own power for on-site use or sell it/wheel it

• Long-term feedstock supply is crucial

• A long-term power purchase agreement is helpful

• Quality design is essential

• Use the feedstock efficiently

• BIOMASS CHP: Make good use of the thermal energy and power generation

• The CHP TAPs help with next steps
  – CHP screenings (go/no go scan of potential)
  – Technical assistance
Screening and Preliminary Analysis

Quick screening questions with spreadsheet payback calculator.

Feasibility Analysis

Uses available site information. Estimate: savings, installation costs, simple paybacks, equipment sizing and type.

Investment Grade Analysis


Procurement, Operations, Maintenance, Commissioning

Review specifications and bids, Limited operational analysis.

CHP TAP Technical Development Assistance

U.S. Department of Energy
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Questions & Contact Information

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