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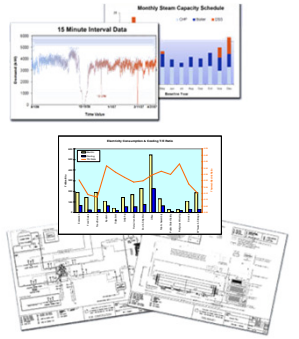
Mid-Atlantic Clean Energy Application Center
Promoting CHP, District Energy, and Waste Heat Recovery

CHP & Woody Biomass

Design Considerations

Topics

- Goals
- Qualifiers
  - Size/Energy Costs
- Considerations
  - Space
  - Fuel Supply
  - Distribution Systems
  - Electric Considerations
  - Permitting
- Application



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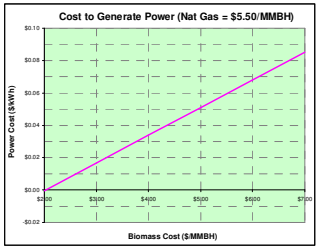
CHP Project Goals

- Increase Energy Efficiency
- Reduce Energy Costs
  - High Thermal Load Factor
- Minimize Operational Risk
- Reduce Carbon Footprint
- Other Issues
  - Reliability, Expansion, etc.



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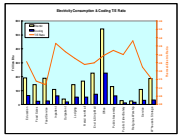
General CHP Qualifiers

- Substantial Energy Costs – Gas/Thermal & Electric
  - > $100,000 per year you can consider CHP
  - > $1 million per year you should consider CHP
- Substantial Operating Hours
  - > 5,000 hours/year system operation at Full Load
- Coincident Thermal & Electric Loads
  - Thermal Distribution System required
  - Thermal Loads must be Compatible with CHP outputs
- Corporate Willingness & Desire for Benefits



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General CHP Qualifiers

- **Industrial Users**
  - > 1 MW peak demand with process thermal loads
- **Commercial Users**
  - Office Buildings over 50,000 SF
  - Enclosed Shopping Malls with central utilities
  - Hotels with over 100 rooms
- **Institutional Users**
  - Colleges over 5,000 full time students
  - Hospitals over 100 beds
  - Multifamily Residential over 100 units

* *Thermal distribution system required for all applications*

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Design & Project Considerations

- All biomass is local – Transportation costs can kill a project.
  - 50-mile radius (rule of thumb maximum distance)
- Biomass feedstocks – How reliable is the source? Price?
  - Due diligence is needed for a long-term supply contract. Do a biomass availability assessment.
- What if we lost the supply? How do we manage seasonal variation? Have alternatives.
- Feedstock competition is coming as bioenergy advances.
- What is the quality of the feedstock?
  - What is the moisture content? It impacts system design.
  - Wood chips by hammermill or knife – avoid clogging of auger.

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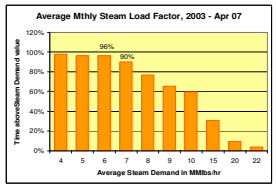
Design & Project Considerations

- Physical Location & Space Availability
  - Fit equipment with service access
  - Generation and Heat Recovery should be close
  - Easier to transmit steam or water than exhaust
  - Proximity to Switchgear & Thermal Loads Cost issue
- Thermal Distribution System
  - Type and quality of thermal load
  - Tie-in point at return line
  - Maximize load for all 12 months
  - Thermal Use all Operating Hours



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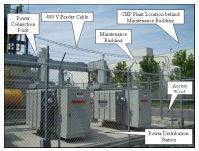
Design & Project Considerations

- Vary Power Production according to Thermal Load
- Interconnection
  - The local utility should be contacted early to clarify interconnection and distribution issues
- Facility Power Architecture
  - Tie-in prior to distribution
  - CHP output at 480 – 13,000 V
- Fuel Availability, Pressure & Quality
  - Combustion Turbines require high pressure
  - Fuel quality can have significant impact



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Design & Project Considerations

- Electric Issues
  - 'Black Start' Capability – Emergency Circuits
  - Generator Block Loading Capability
  - CHP System Parasitics
- Emissions
  - EPA Title 5 or Local Authority
  - Residue Disposal
- Noise
  - Mitigated with Enclosures & Silencers
- CHP System Control & Metering
  - Integrate with component controls, utility meters & BAS

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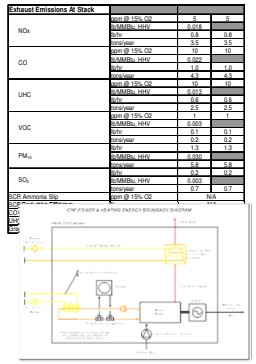
Design & Project Considerations

- Operating Air Permit
  - Size may Dictate Requirements
  - Exhaust Treatment Options
- Electrical Interconnection
  - Distribution Utility Issue
- City/State Construction Permits
- Operating Personnel
- Incentive Program Requirements
  - Efficiency/Emissions
  - M&V



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Design & Project Considerations

- County/City Planning Boards: Land use and noise ordinances.
- Building & Fire Code Departments: Exhaust temperatures, venting, gas pressure, space limitations, vibration, steam piping and structural issues.
- Environmental/Public Health Department: Public health and safety issues, hazardous materials and waste management.
- Water/Sewer & Public Works Authorities: Water supply and discharge issues.

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What Makes a Good CHP Project?

- Know your loads - 12 months per year
- Select equipment with correct T/E Ratio
- Target max Load Factor not efficiency
- Long-term Fuel Supply is Critical
- Proper planning by qualified personnel
  - Monetize all benefits – energy, emissions, reliability
  - Include all costs – fuel, maintenance & emissions controls
  - Understand permit requirements and schedule
- Get corporate "buy-in"

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Rough & Ready Lumber, OR

- In order to dry more lumber, Rough and Ready Lumber, located in Josephine County, Oregon, could no longer rely on air-drying. They needed greater boiler capacity to heat their kilns and decided to replace their 30-year old boiler.
- In addition, increased emphasis on thinning nearby national forests to reduce wildfires and insect infestations meant the federal government would be supplying a lot more wood than they could burn in their existing plant.
- In February 2008 Rough and Ready began commercial operation of a new 1.5 MW wood-fired combined heat and power (CHP) plant.

www.NorthwestCleanEnergy.org

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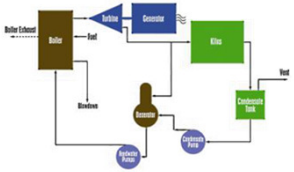
CHP System Description

- 40,000 PPH, 300 psig water tube steam boiler
- 1.5 MW backpressure steam turbine generator
- Discharge steam is reduced to 20 psi and used to heat 12 double-track dry kilns. Kiln condensation is then returned to the boiler to be reheated.



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Project Economics

Total installed cost = $6 million

- 4 year Payback with incentives (15 years with no incentives)

Incentives:

- $2,350,000 USDA Rural Development Section 9006 Loan Guarantee
- $500,000 USDA Rural Development Section 9006 Grant
- $243,000 Woody Biomass Grant from U.S. Forest Service
- $1,700,000 grant from the Energy Trust of Oregon, paid out over a minimum of four years based on forecasted energy production. This averages out to approximately $42/MWh.
- $210,000 Federal production tax credit (35% credit for pollution control equipment)
- $1,350,000 Oregon Business Energy Tax Credit

Revenue streams:

- Approximately 10 million kWh/yr sold to the local utility at $65/MW

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Project Benefits

- Mill survival and creation of up to 12 jobs
- Will help the company stay competitive
- Mitigation of potential gaps in sawmill production caused by different drying schedules of ponderosa, sugar pine and Douglas fir
- Additional revenue streams: custom-drying for other lumber producers and sale of electricity
- Contribution to forest health (thinning the forest reduces wildfires and insect infestations)
- Adds renewable energy to Oregon's electrical grid
- Public perception of biomass plants has improved

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