



Biomass Energy Production

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Agenda

Overview of Biomass Technologies and Applications

- Key Definitions
- Commercially Available Technologies
- System Applications and Application Considerations
- What is the Industry Doing with Biomass?

Key Definitions

RENEWABLE ENERGY

“Any naturally occurring, theoretically inexhaustible source of energy, as biomass, solar, wind, tidal, wave, and hydroelectric power, that is not derived from fossil or nuclear fuel.”

- *Dictionary.com*

BIOMASS FUEL

“Renewable organic materials, such as wood, agricultural crops or wastes, and municipal wastes, especially when used as a source of fuel or energy. Biomass can be burned directly or processed into biofuels such as ethanol and methane.”

- *Dictionary.com*

COGENERATION

“The production of electricity using waste heat (as in steam) from an industrial process or the use of steam from electric power generation as a source of heat.”

- *Merriam-Webster Dictionary*

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Commercially Available Technologies

- Equipment and Processes that are common in the institutional and commercial industry which are competitive and reliable.

Commercially Available Technologies



- **Stoker Combustor (Mass Feed or Suspension Firing)**
 - 100 BHP to 1,200 BHP (Packaged Equipment)
 - 50,000 PPH and Larger (Custom Field Erected)
 - Steam or Hot Water
 - Pellets, Wood Residue, Oat hulls, Grasses, Bagasse, etc.



Commercially Available Technologies



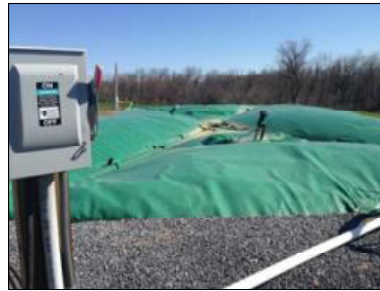
- **Gasification Combustor (Mass Fired)**
 - 100 BHP to 1,200 BHP (Packaged Equipment)
 - 50,000 PPH and Larger (Custom Field Erected)
 - Pellets, Wood Residue, Oat hulls, Grasses, Bagasse, etc.
 - Can be used to produce Syngas (Biogas)



Commercially Available Technologies

mtf Energy Systems Inc.

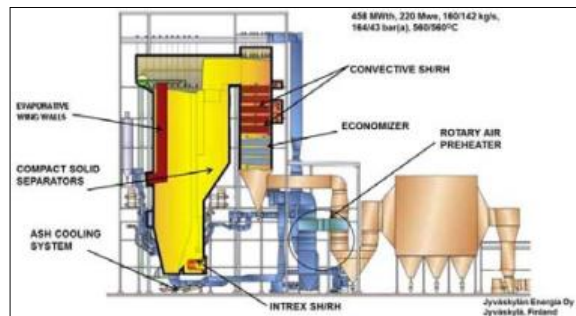
- **Reciprocating Gas Engine**
 - 50 kW to 2,000 kW
 - Requires Gas Production System or Source
 - Waste Heat Recapture (Steam or Hot Water)
 - Biogas, Landfill Gas, and Wood Gas



Commercially Available Technologies

mtf Energy Systems Inc.

- **Fluidized Bed (Circulating or Bubbling)**
 - 5-10 MWe and Larger
 - Improved Emissions
 - Difficult Fuels (Irregular, Problematic)
 - Typically used for District Energy and Cogeneration Systems



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System Applications

- How can biomass be applied in current energy production systems?

System Applications

- Thermal Energy
 - Steam / Hot Water
 - Chilled Water (Absorption /STG)
 - High Summer Loads
- Electricity Generation
 - Local Process Loads
 - District Energy Systems
 - High Electric Rates
 - Demand Response (Requires Heat Rejection)
- Cogeneration



System Applications

- Dartmouth College Sachem Village Apartments



System Applications

- Mineral Community Hospital, Superior, VT



Images Courtesy of Precision Energy Services, Inc.

System Applications

- Slate Ridge Dairy Farm, St. Thomas, PA



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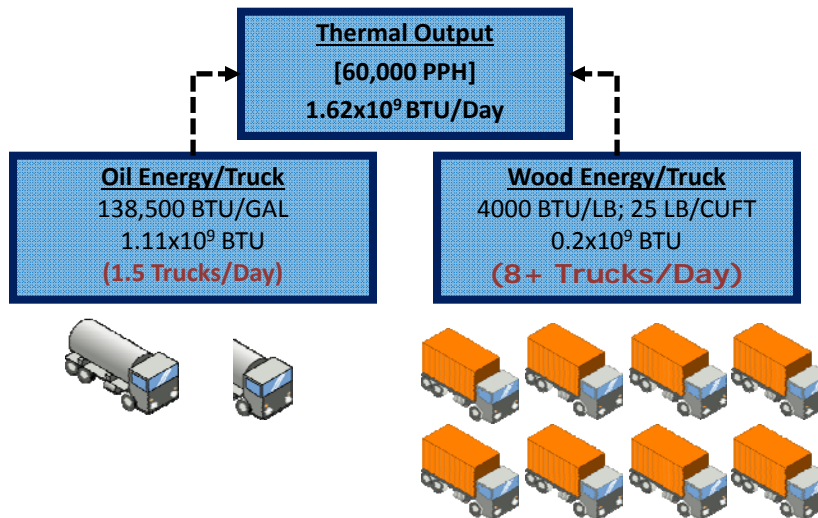


Application Considerations

- System Load (Constant or Seasonal)

Application Considerations

- Energy Density / Fuel Delivery



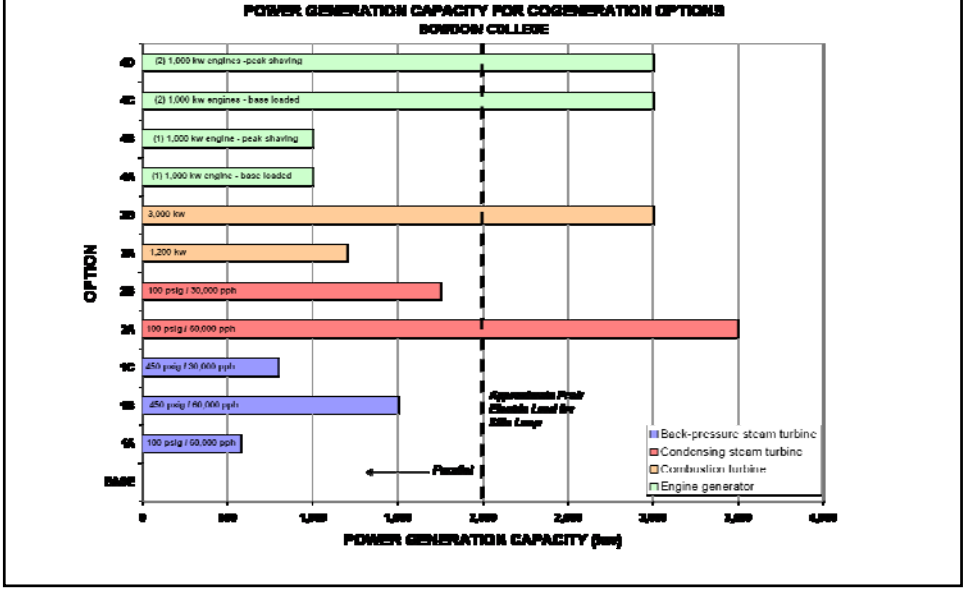
Application Considerations

- Fuel Size, Type, Unwanted Materials



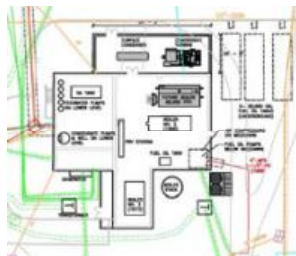
Application Considerations

- Compare Your Options

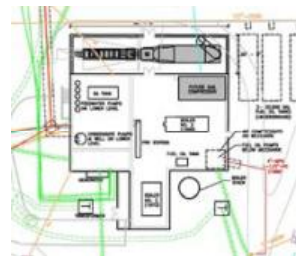


Application Considerations

- Layout Your Options



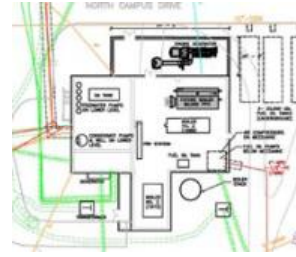
3600 kW Condensing Turbine



1200 kW Combustion Turbine



3000 kW Combustion Turbine



1000 kW Engine Generator

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What is the Industry Doing with Biomass?

VA Medical Center

Chillicothe, OH



- 600HP wood fired boiler, 450 psig
- Supplies steam to a 350kW steam turbine generator
- Capable of burning a multitude of wood residues
- Fully automatic ash extraction system

Images Courtesy of Wellons FEI Corp

VA Medical Center

Chillicothe, OH

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2010 Program Inc.
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- 8 Rake moving floor storage bin with fuel handling
- Stepped grate combustion system with automatic ash extraction
- Electrostatic Precipitator Emissions Control
- Test results on particulate emissions less than half of what is normally produced by a natural gas burner



Colby College

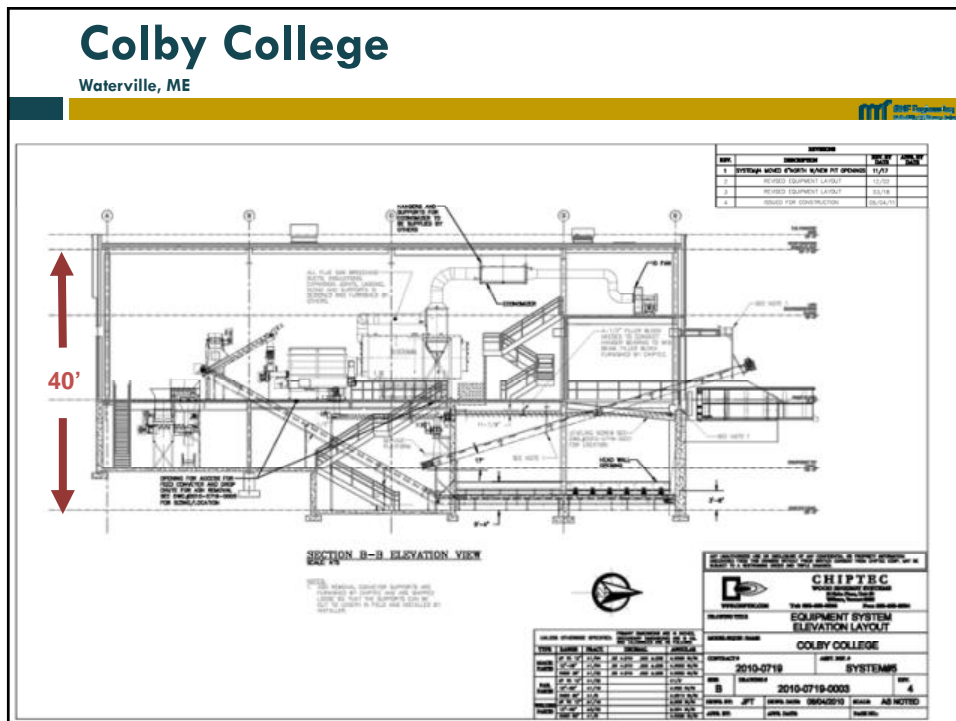
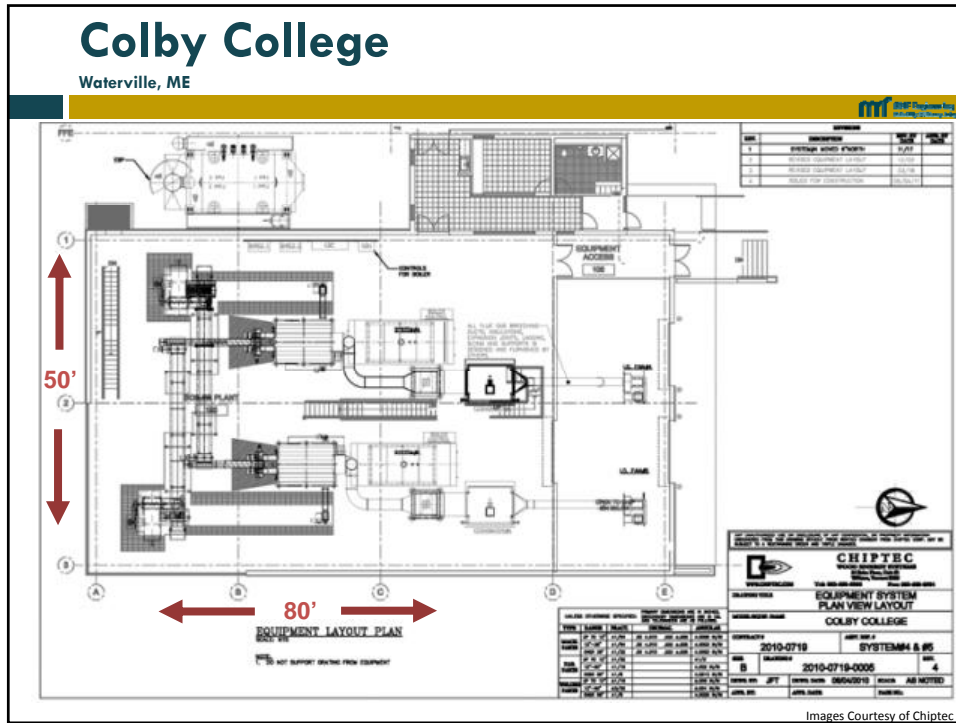
Waterville, ME

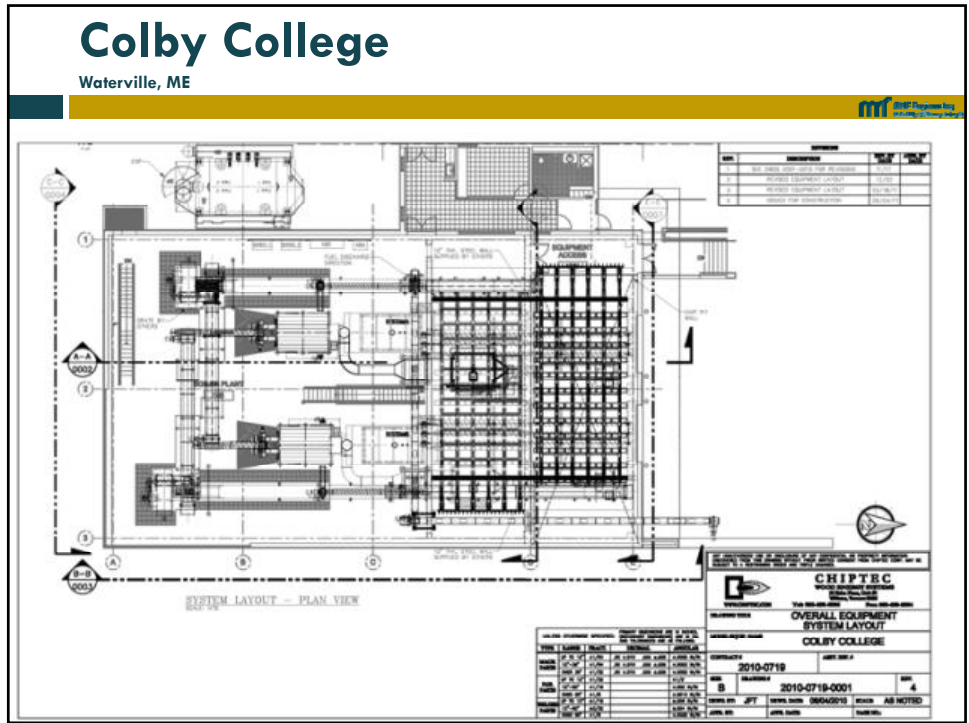
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- (2) 400 hp high pressure boilers
- Combined steam production: 26,000 lbs per hour @ 300psig
- Consumes 22,000 tons of locally sourced woodchips annually
- Fuel sourced within a 50 mile radius from Sustainable forest operations
- 90% reduction in #6 fuel oil annually (1 million gallons)
- Entire plant LEED Gold Certified
- CO emissions: less than 0.1 lbs/MMBTU, average Particulate emissions: 0.01 lbs/MMBTU, average



Images Courtesy of Ghinter





University of British Columbia

- Commitment to reduce GHG's by 100%
- Syngas fuels a 2MW generator, eliminates new electrical transmission line
- Create Living Laboratory





Images Courtesy of Nexterra

Quick Thoughts



- Study the System Prior to Design
- Biomass Energy Can Be Cost Effective and Reliable
- Every Application is Unique
- There are Considerations Specific to Biomass
- Consider Cogeneration to with Economics



Thank You

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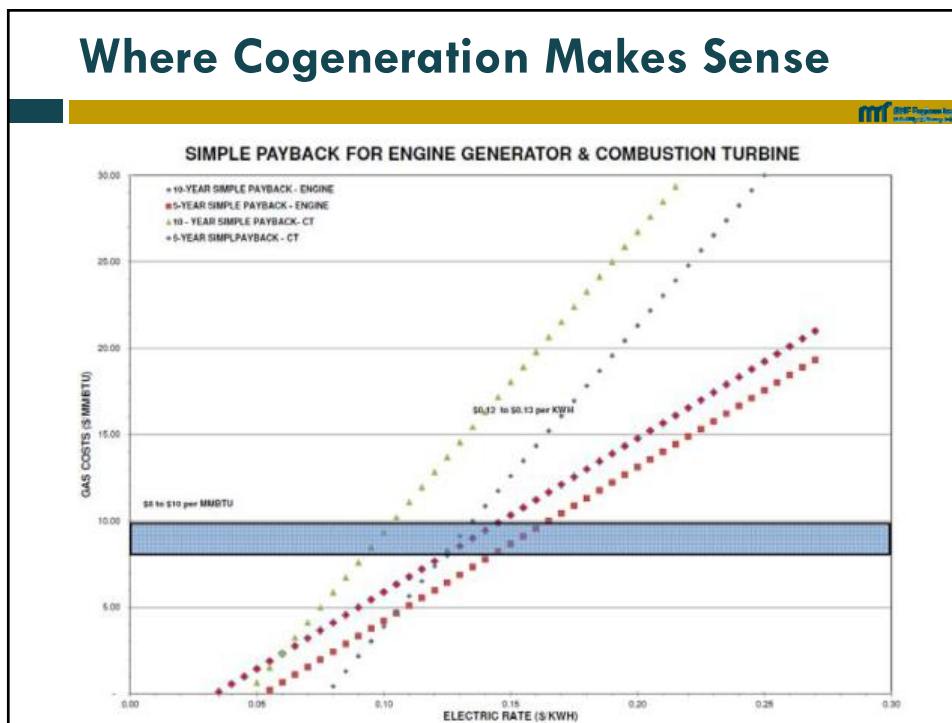


Types of Cogeneration Equipment

- **Backpressure Steam Turbine**
 - High Throughput (Flow), High Pressure and Temperature
 - Temperature (Superheat Results in Highest Benefit)



Where Cogeneration Makes Sense



Sizing the System

- **Determine Electric and Thermal Load Profiles**
 - Boiler Logs, Electric Bills, and Fuel Bills, Historical Trending
 - Summer Load Profile
 - Minimum Electric Load (< 2 MW or > 2 MW)
- **Establish Performance Conditions**
 - Steam Pressure (Generation and Distribution)
 - Hot Water Temperature
 - Chilled Water
- **Develop Conceptual Options with Construction Costs**
 - Include Auxiliary Equipment and Building Modifications