



Commercial Scale Bioenergy Technology



**Biomass Utilization
Workshop**

Auburn, California

May 20, 2008



Presentation Overview

- Introduction
- Bioenergy Technology
- Bioenergy Advantages
- New Influencing Factors
- Sourcing Wood Fuel
- Project Development





What is Biomass?

- **Biomass** – any solid, nonhazardous, cellulosic material derived from: forest-related resources, solid wood wastes, agricultural wastes, and plants grown exclusively as a fuel.*

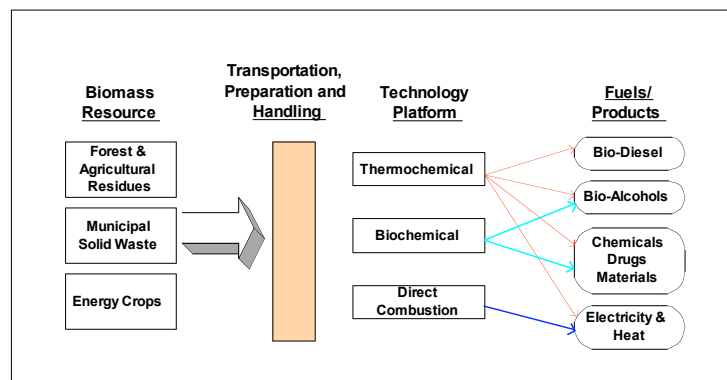


*based on the definition of biomass in the 2005 Energy Act

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Bioenergy Power and Fuels



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Combustion Technology

Typical EPI Energy System

The diagram illustrates a typical EPI (Energy Processing Industry) energy system. On the left, a cross-sectional view of a biomass boiler shows various components: a Mixing Bin, Fuel Feed, Overfire Air, Shakers, FD Air, Startup Preheater, Bed/Electrostatic Cleaning System, Circ. Pumps, Feed Water, Air Preheater, Baghouse, Ash System, ID Fan, and Stack. On the right, a process flow diagram shows the following steps: wood, agricultural wastes, MSW enter a fuel storage and pretreatment stage, which produces particulate matter, odor, and liquid waste. The remaining material goes to a combustion stage, which produces gaseous emissions, particulate matter, and ash. The combustion stage feeds into a boiler, which also receives water and chemicals, producing wastewater. The boiler produces steam, which is then used in a turbine generator to produce mechanical energy, heat, and electricity.

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Gasification – The Future?

The diagram shows a gasification system. Biomass fuel feeding enters a gasifier, which also receives gasification air. The gasifier produces ash and gas. The gas goes to a gas burner, which feeds into a gas boiler. The gas boiler is connected to a steam cycle, which includes a feed water tank, a condenser, and a steam turbine. The steam turbine produces power and heat. The heat is used in the condenser, which feeds back into the feed water tank. The steam cycle also produces electricity/heat. A stack is shown for emissions. The diagram is labeled with 'Biofuels Potential' and 'Electricity/Heat'.

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Other Utilization Opportunities – Ethanol and Biofuels

- Cellulose to biofuels is coming - technologies appear promising.
- Transportation fuel diversity and security
- Value-added use for forest biomass



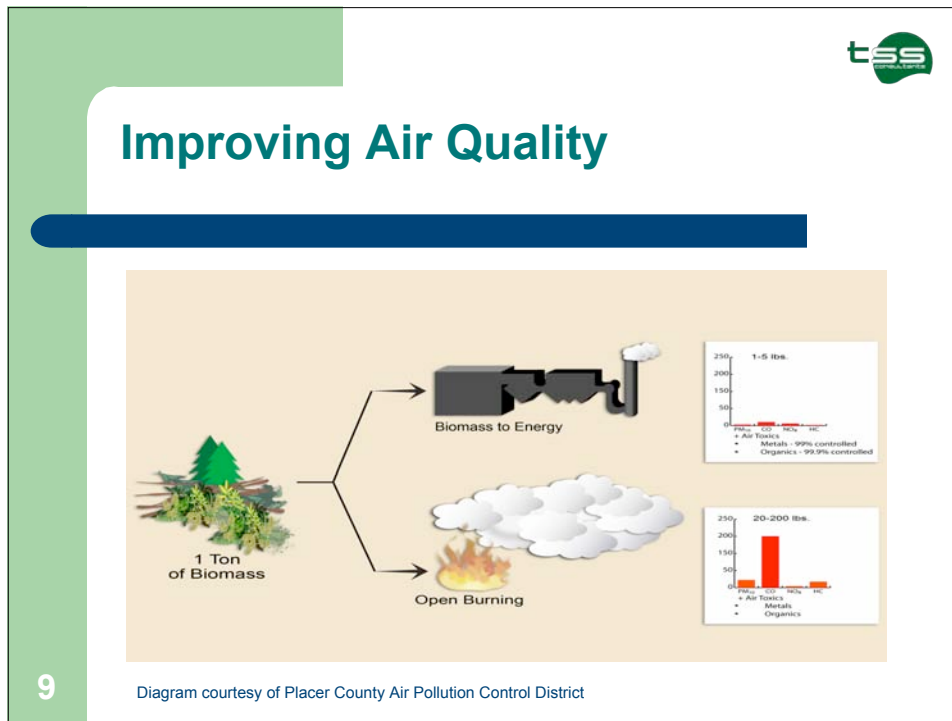
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Advantages of Biomass When Compared to Wind and Solar Energy

- Provides baseload renewable energy (24/7) on a cost effective basis.
- Has numerous societal benefits:
 - Supports hazardous fuels reduction and healthy forests
 - Provides employment (4.9 jobs/MW)
 - Greenhouse gas reduction displacing fossil fuels
 - Reduces waste material destined for landfills
 - Net improvement in air quality

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- Improving Air Quality (cont'd)**
- Over 97% (and more) of all pollutants can be removed by converting the woody biomass to energy over current open burning practices
 - And this is with older technology
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New Influencing Factors Effecting Biomass Plants (old and new)

- Growing waste disposal issues/opportunities
- Renewable energy gov't mandates/incentives
- New financial and owner groups looking for renewable energy business deals
- Fossil fuel pricing – abrupt current and future price increases
- Acceleration in the development of new biomass to energy conversion technologies
- Greenhouse gas reduction opportunities

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Bioenergy Power in North America Current Industrial Technology



- Nearly 10,000 U.S. megawatts
- Almost all systems are combustion / steam turbine
- Most are grate stokers.
- 5-110 MW (avg. 20 MW).
- Heat rate 11,000-20,000 BTU/kWh.
- Installed cost \$1700-\$3500 per kW.

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Bioenergy Power Facility Example

- 20 MW plant produces enough power for about 20,000 homes
- New plant construction cost = \$50 to 60 million +
- Consumes about 160,000 BDT/yr (1BDT/MW/hour burn rate)
- Biomass transported up to 50 miles (maybe farther)
- Delivered Biomass valued at \$15 - 50 per BDT
- Average electrical energy production cost
~ \$0.07 - \$0.10/kWh

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Three Major Components For a Viable Bioenergy Project

- Supply
- Market
- Financing

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Woody Biomass Supply Sources

- Timber harvest residuals
- Forest fuels treatment residuals
- Forest products manufacturing residuals
- Urban wood waste
- Agricultural byproducts



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Potential Power/Heat Purchasers

- Regulated utility – SCE, PG&E
- Unregulated utility - Municipals
- Forest products manufacturing facility
- Oil Fields
- Others



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Bioenergy Project Development - Deal Killer Issues to Consider

- Fuel/Feedstock Supply
- Community Support
- Project Economics
- Appropriate Technology
- Siting/Infrastructure & Permitting



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Fuel/Feedstock Supply

- Sustainable long term supply located within close proximity (25 to 50 mile radius)
- Economically available
- Environmentally available
- Meets quality specifications
- Available in quantities and from diverse sources that support project financing:
 - Minimum 10 year supply, 70% under contract
 - At least 2.5 – 3 times facility usage (fuel supply coverage ratio)

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