Woody Biomass Utilization for Power/Heat

Woody Biomass to Energy Workshop, Oroville, California

September 14, 2010

Presentation Overview

- Introduction
- Woody Biomass Utilization
- Conversion Technologies
- Biopower Advantages
- California Biopower Facilities
- Project Development Considerations

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.*

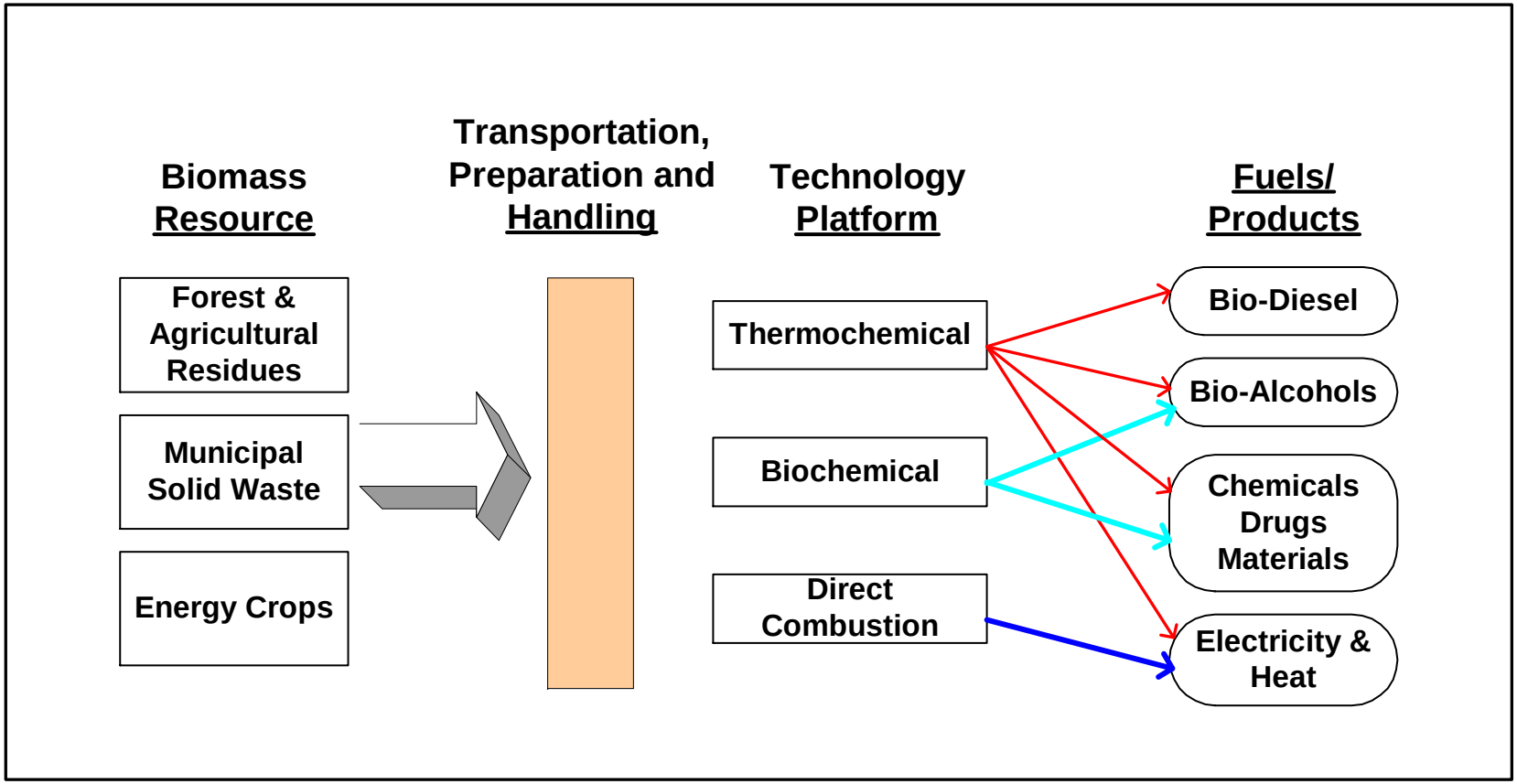
*based on the definition of biomass in the 2005 Energy Act

Woody Biomass Utilization

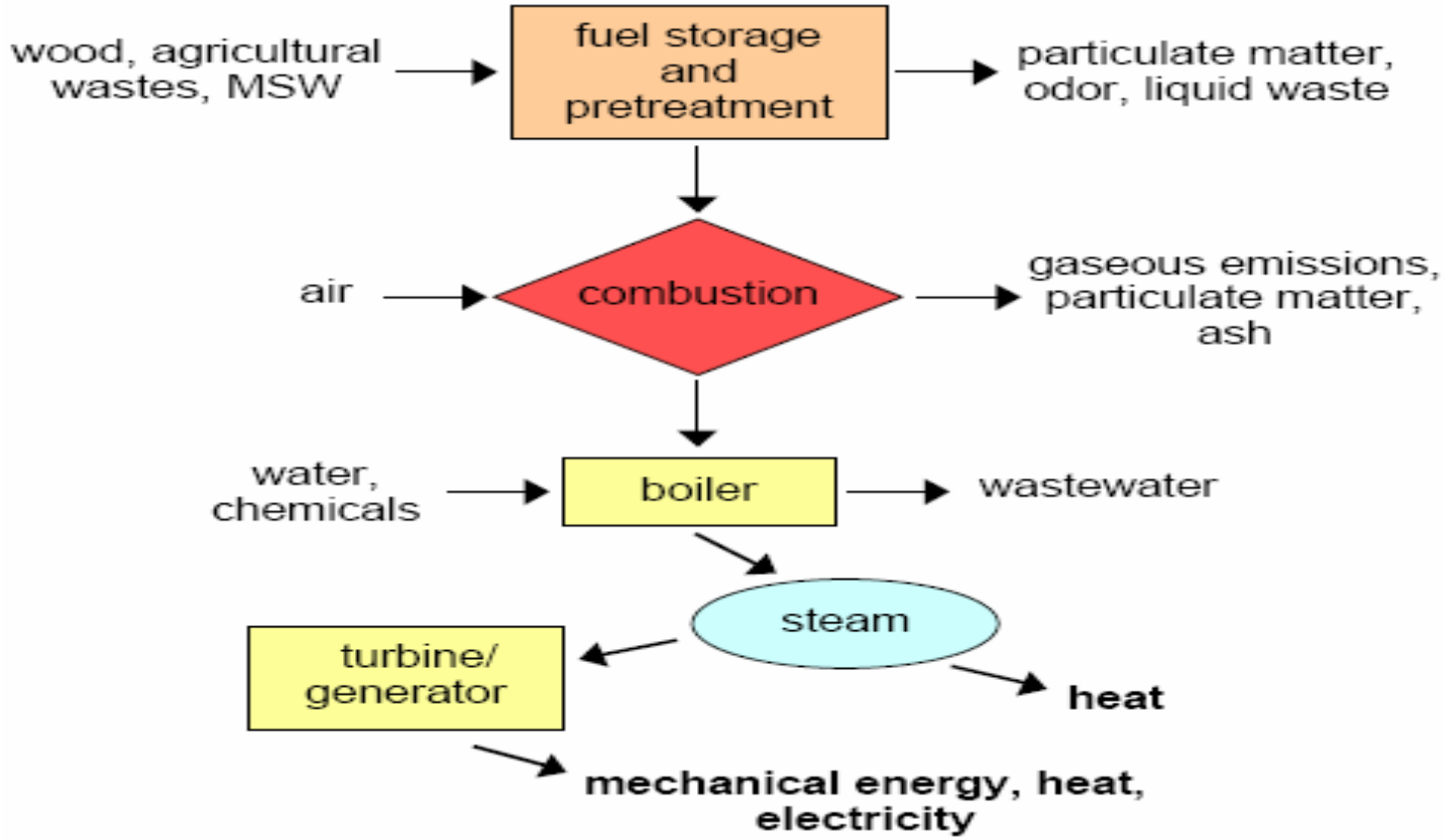
A variety of value-added end uses have evolved over time – Some are commercially proven and some are still in the RD & D Phases.

- Lumber products, composite panels, pulp
- Soil amendments
- Densified fuel pellets
- Animal Bedding
- Landscape cover
- Biofuels (ethanol, renewable diesel)
- Biomass power (generation or cogeneration)

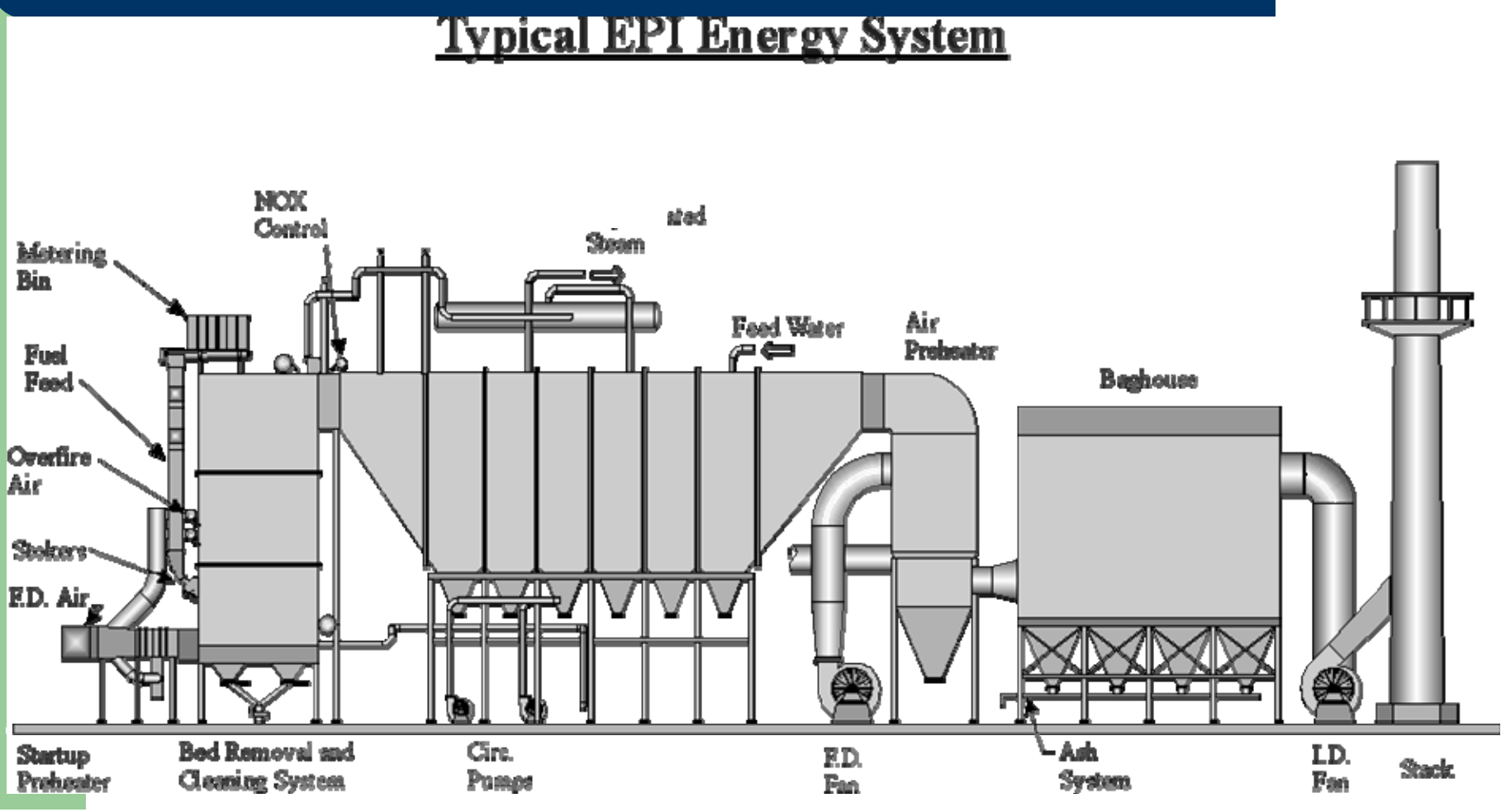
Conversion of Woody Biomass to Power and Fuels



Combustion Technology- Part 1



Combustion Technology- Part 2



Scale of the Technology

Industrial:

5 MW+

Commercial:

.5 to 4 MW

Small:

100 to 499 kW

Micro:

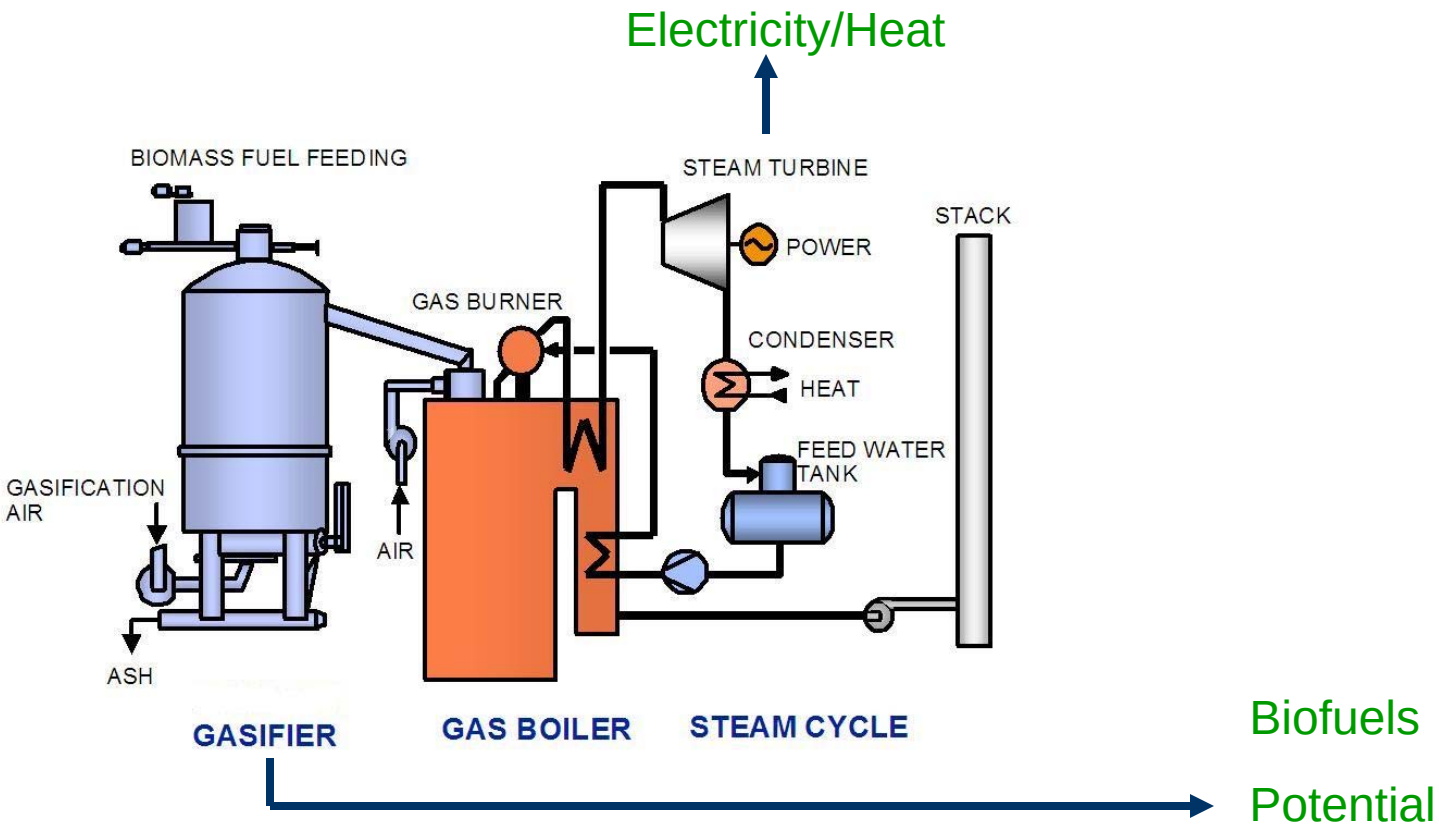
15 to 99 kW

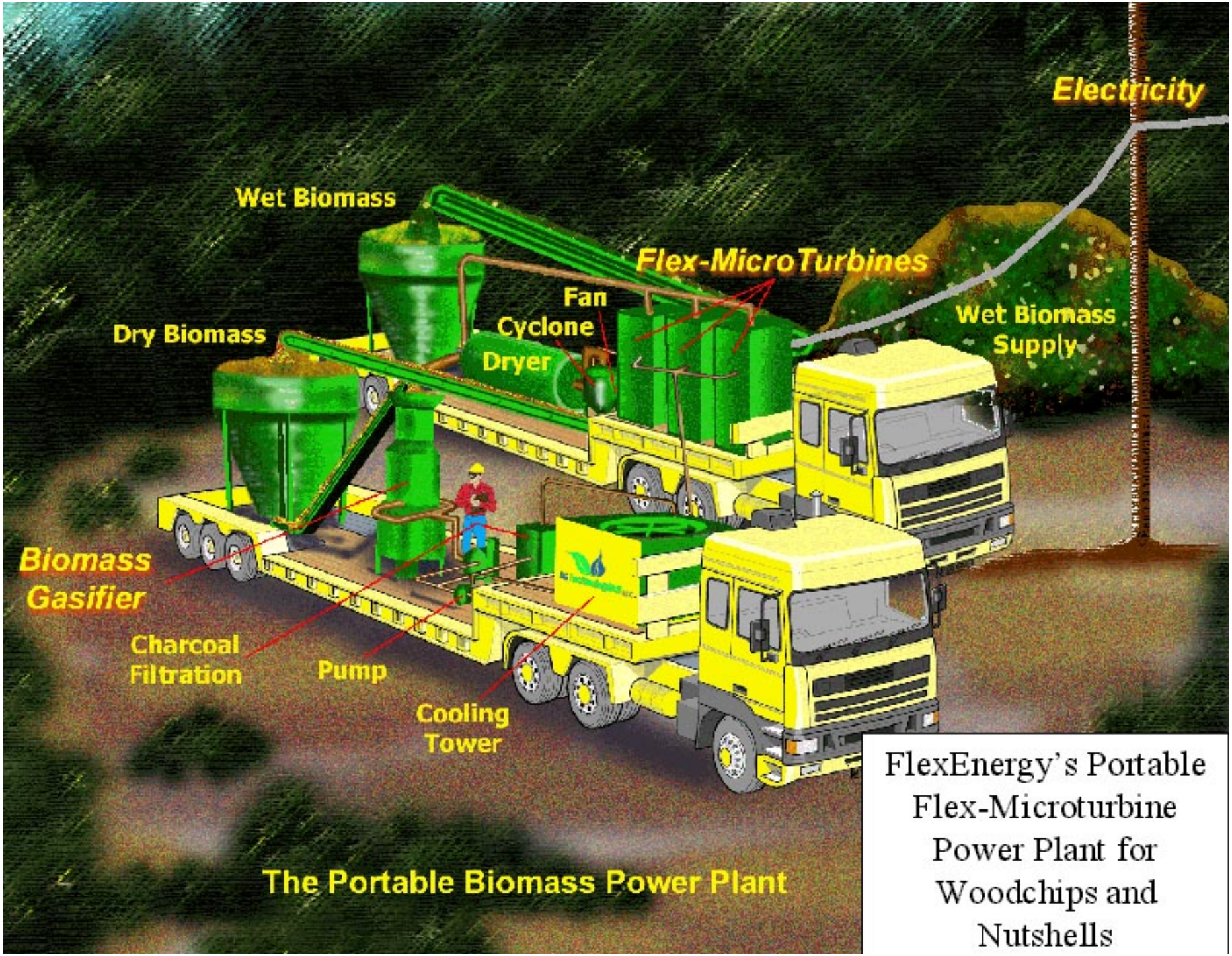
Community Power Corp Gasifier - 12.5 KW, Philippines

Community Power Corp BioMax 50 kWh CHP at
Dixon Ridge Walnut Farm, Winters

Phoenix Technologies Biomass 500 kWh
Gasification Unit at Madera

Gasification – The Future?





FlexEnergy's Portable Flex-Microturbine Power Plant for Woodchips and Nutshells

DG Fairhaven Power 18 MW CHP at Fairhaven

Burney Forest Power 31 MW CHP at Burney

Wheelbrator Shasta Energy Company 50 MW Generation facility at Anderson

Biomass Energy – Some Rules of Thumb

- 1 MW (1,000 kW) is enough power for 800 to 1,000 homes.
- Biomass fuel is purchased on a Bone Dry Ton basis.
- Typical amount of biomass recovered during fuels treatment is 10-14BDT/acre.
- Typical “burn rate” is 1 BDT/MW hr.
- 10MW plant consumes 10 BDT/hr.
- Assuming that 12 BDT/ac is recovered, a 10 MW plant would procure biomass from fuels treatment on approximately 7,000 acres/year.

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

Improving Air Quality

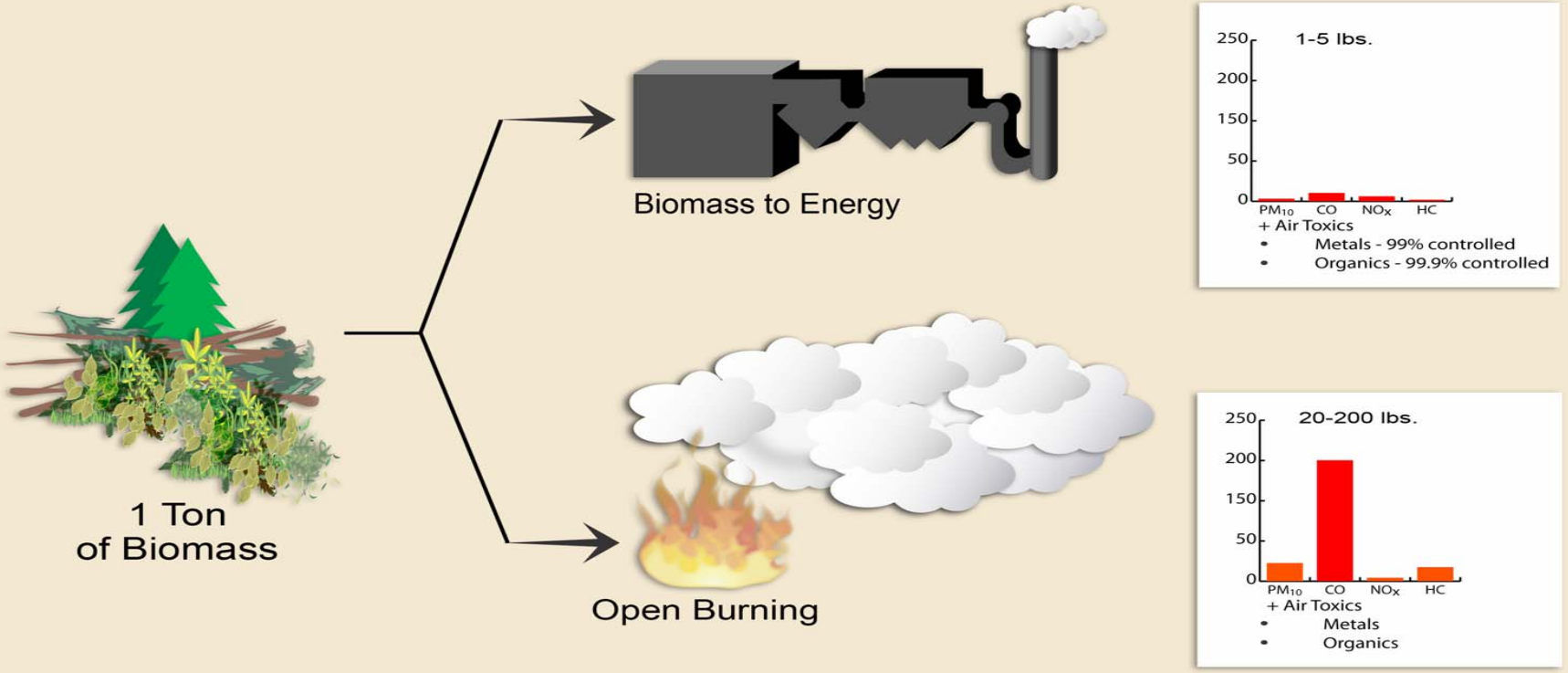


Diagram courtesy of Placer County Air Pollution Control District

California Biomass Power and CHP Overview – Part 1

- Biomass power generation contributes about 2% of California's total power demand.
- California has the highest concentration of biomass power facilities of any state. Maine is # 2.
- About 30 operating facilities with total capacity of approximately 600 MW of generation. About 25% of these facilities are CHP.
- Several facilities are currently idle.
- Several facilities are currently for sale.

California Biomass Power and CHP Overview – Part 2

- Two coal fired units are currently co-firing with woody biomass fuel.
- Eight biomass projects are in some stage of project development:
  - Three of these are green-field projects.
  - Three are coal or lignite conversions.
  - Two are re-powering efforts to re-start idle facilities.

Biopower in North America
Current Industrial Technology

- Nearly 10,000 MW of generation capacity.
- 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 $1,700-$4,000 per kW.

Biopower Facility Example

- 20 MW plant produces enough power for about 18,000 to 20,000 homes
- New plant construction cost = $60 to $80 million
- Consumes about 160,000 BDT/yr (1BDT/MW/hour burn rate)
- Biomass transported up to 50 miles (maybe farther)
- Delivered Biomass valued at $20 - 55 per BDT
- Average electrical energy production cost

  ~ $0.07 - $0.10/kWh

Three Major Components For a Viable Bioenergy Project

- Fuel Supply
- Off-take Market (power and/or thermal)
- Financing

Woody Biomass Supply Sources

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

Potential Power/Heat Purchasers

- Regulated utility – PG+E. SoCal Edison
- Unregulated utility – Munis, PUD's
- Forest products manufacturing facility
- Agricultural processing
- Oilfields
- Others

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