Woody Biomass Utilization, Emerging Technologies and Biopower Project Development Considerations

Northern Sierra Biomass Task Force

December 1, 2010 Meeting

Nevada City, California

Presentation Overview

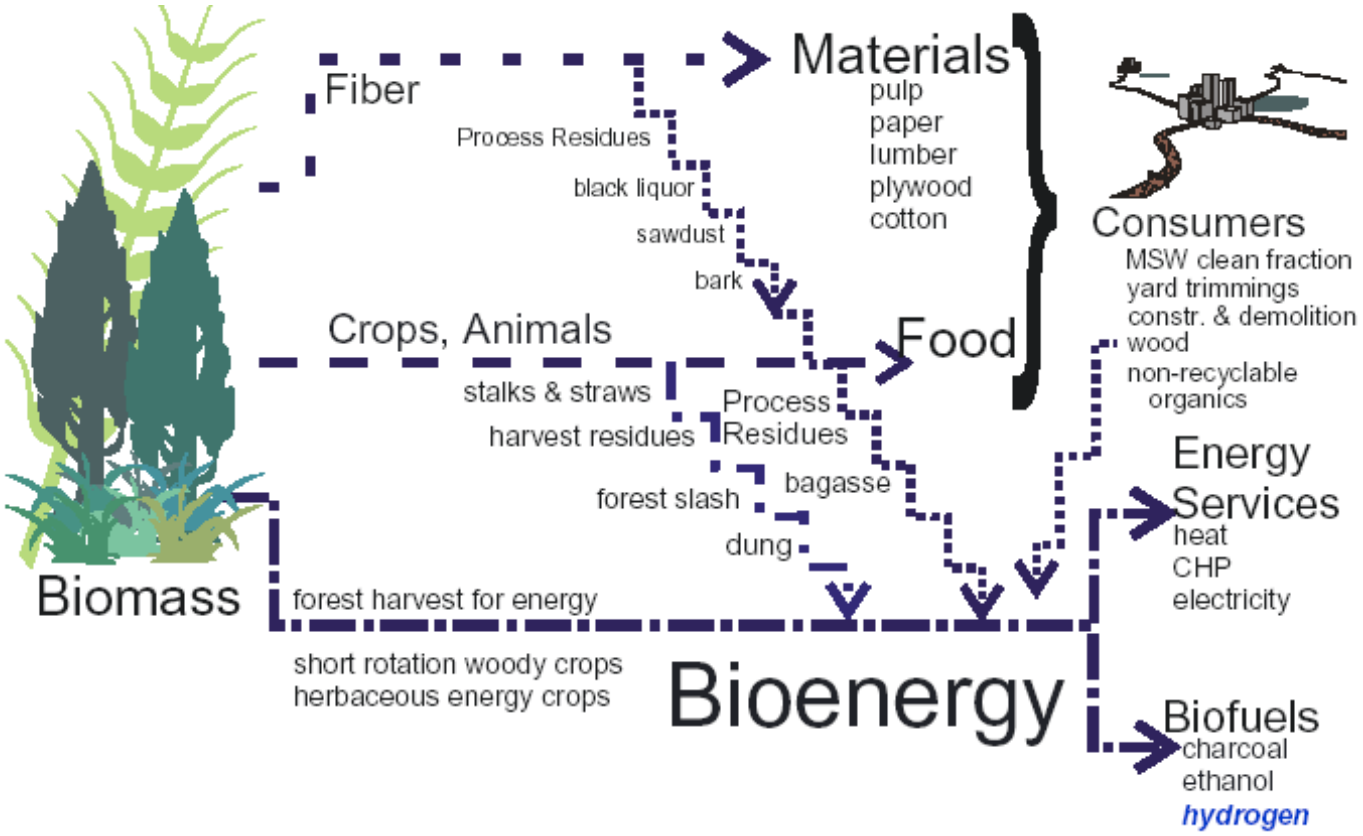
- Introduction
- Bioenergy Technologies
- Biopower Advantages
- New Influencing Factors
- Biopower Facilities & Siting/Infrastructure
- Project Development

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

Using Biomass

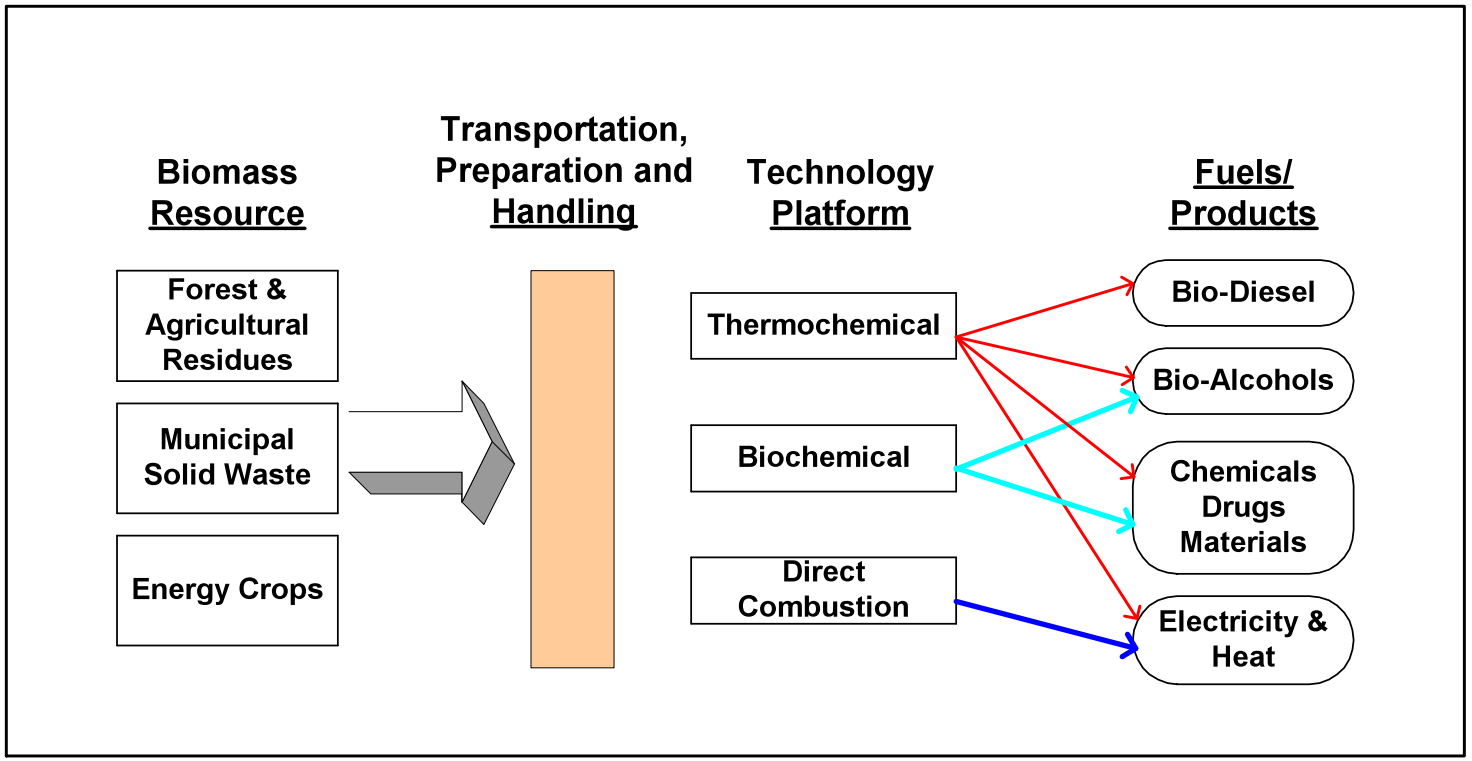


Woody Biomass Utilization

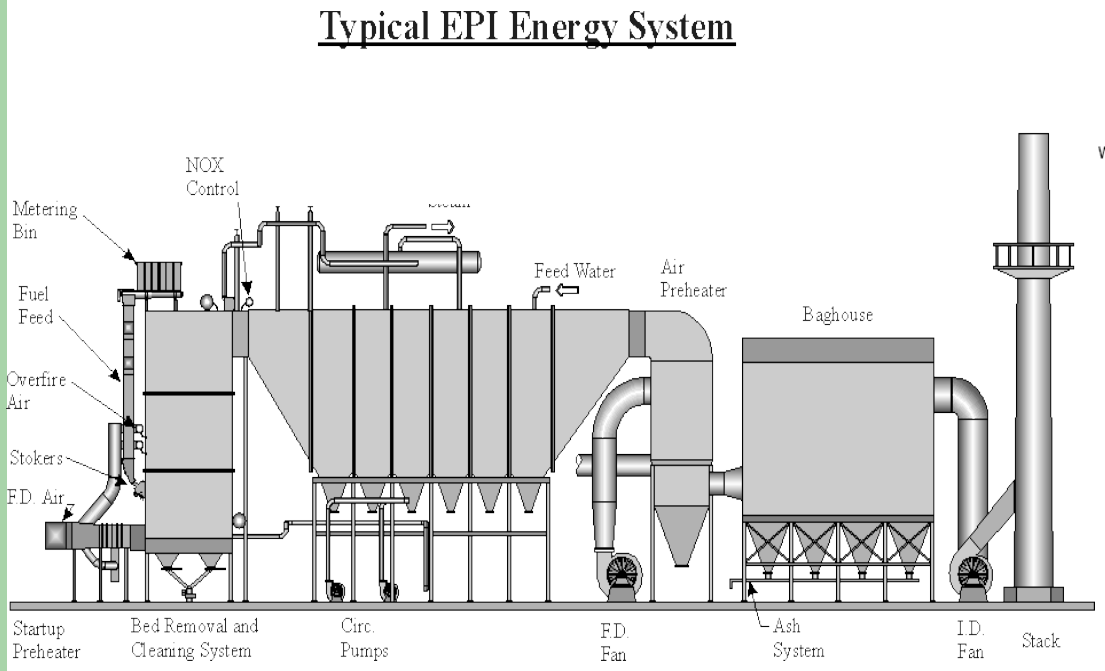
A variety of value-added end uses have evolved over time – Some are commercially proven and some are still in the RD & D Phases

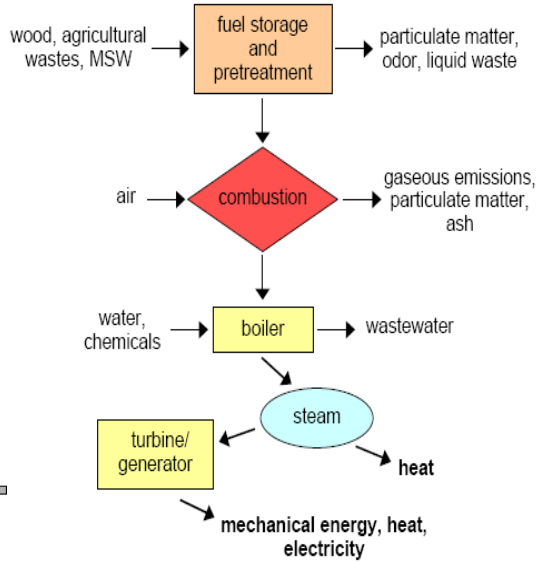
- Lumber products, composite panels, pulp
- Soil amendments
- Densified fuel pellets
- Animal Bedding
- Landscape/landfill cover
- Biomass power (Biopower)
- Bio-based products (plastics, solvents, etc.)
- Biofuels (pyrolysis oil, ethanol, renewable diesel)

Power and Fuels



Combustion Technology





Scale of the Technology

Industrial:

5 MW+

Commercial:

.5 to 4 MW

Small:

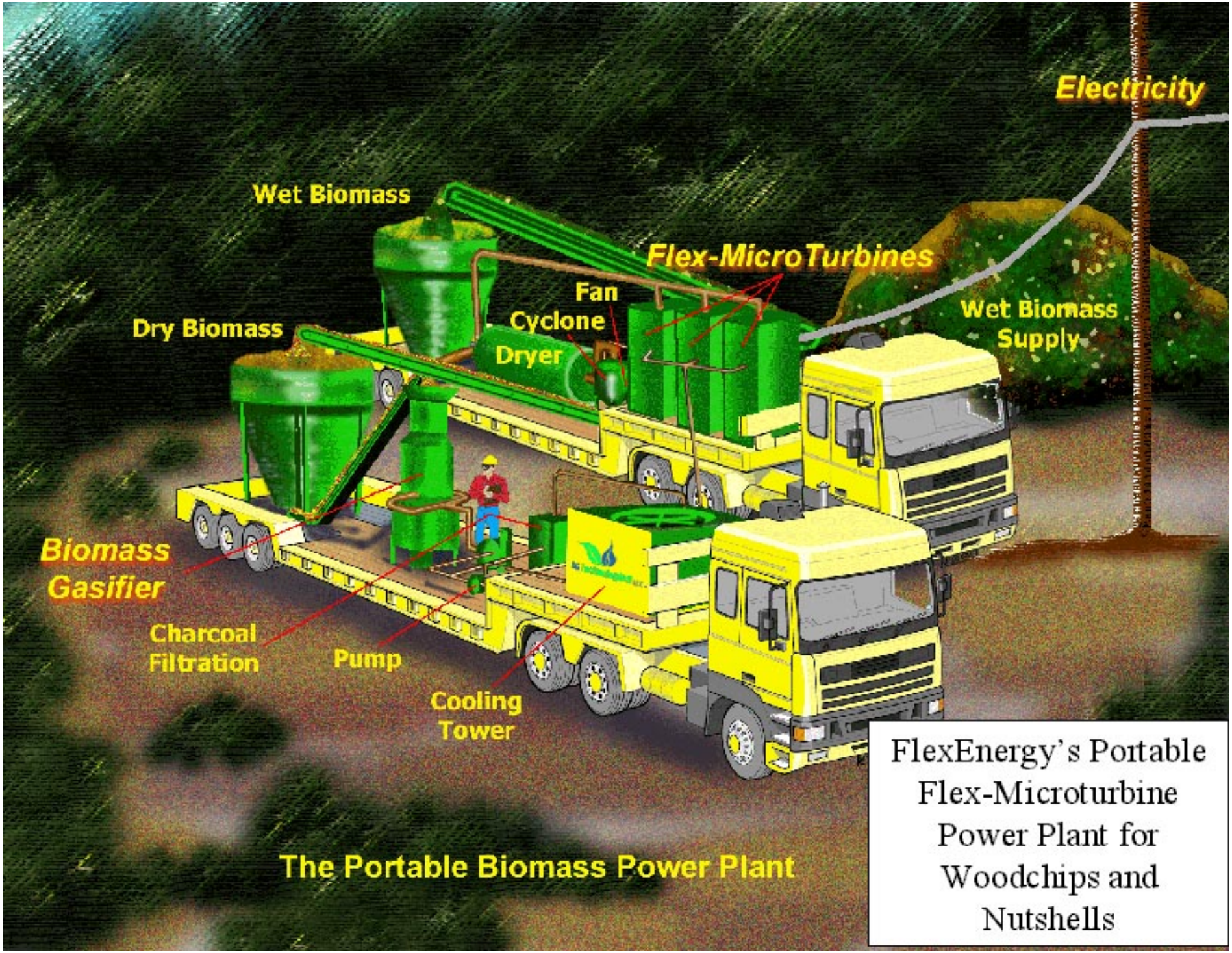
100 to 499 kW

Micro:

15 to 99 kW

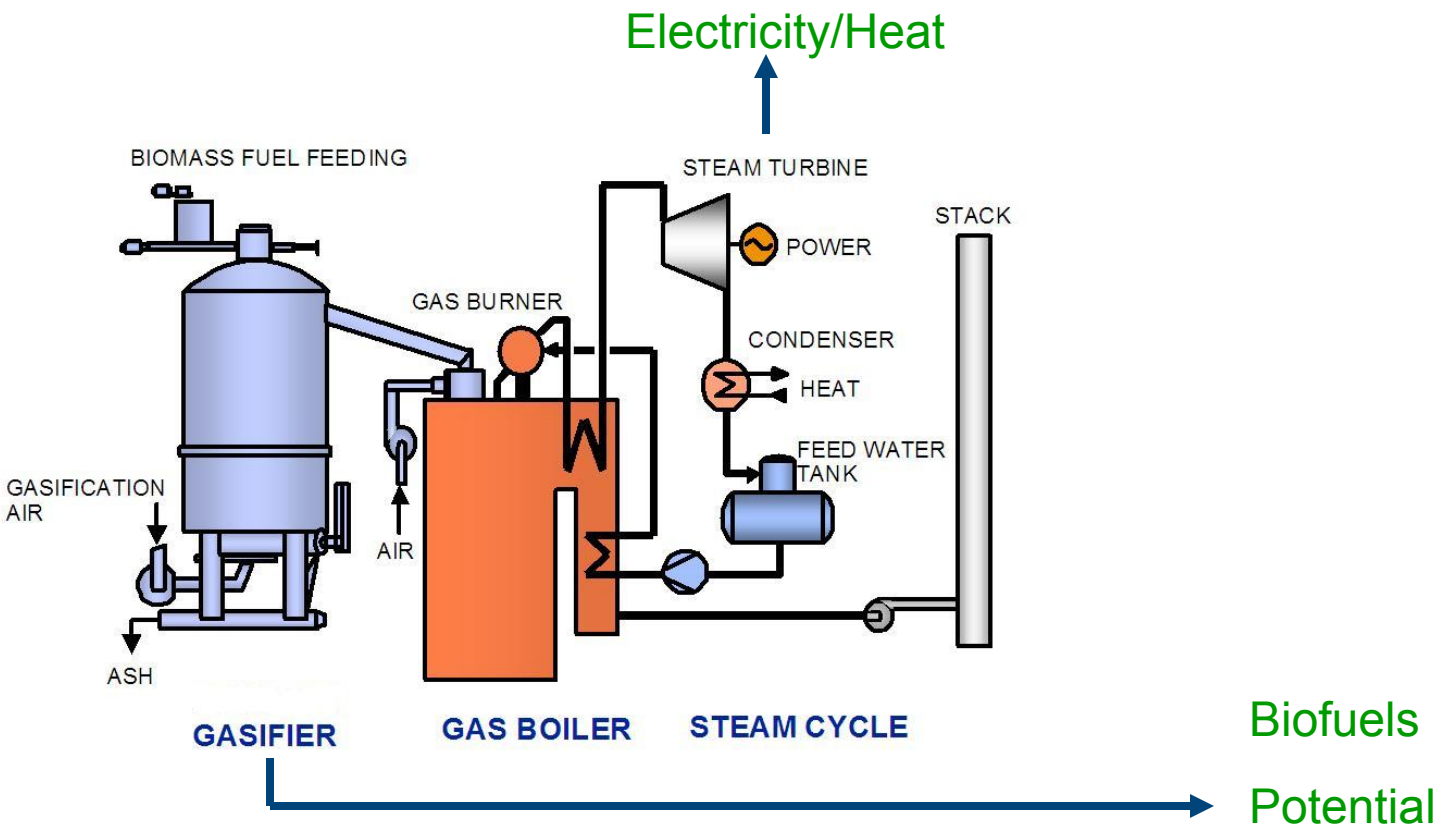
Biomass Energy – Some Rules of Thumb

- 1 MW (1,000 kW) is enough power for 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.



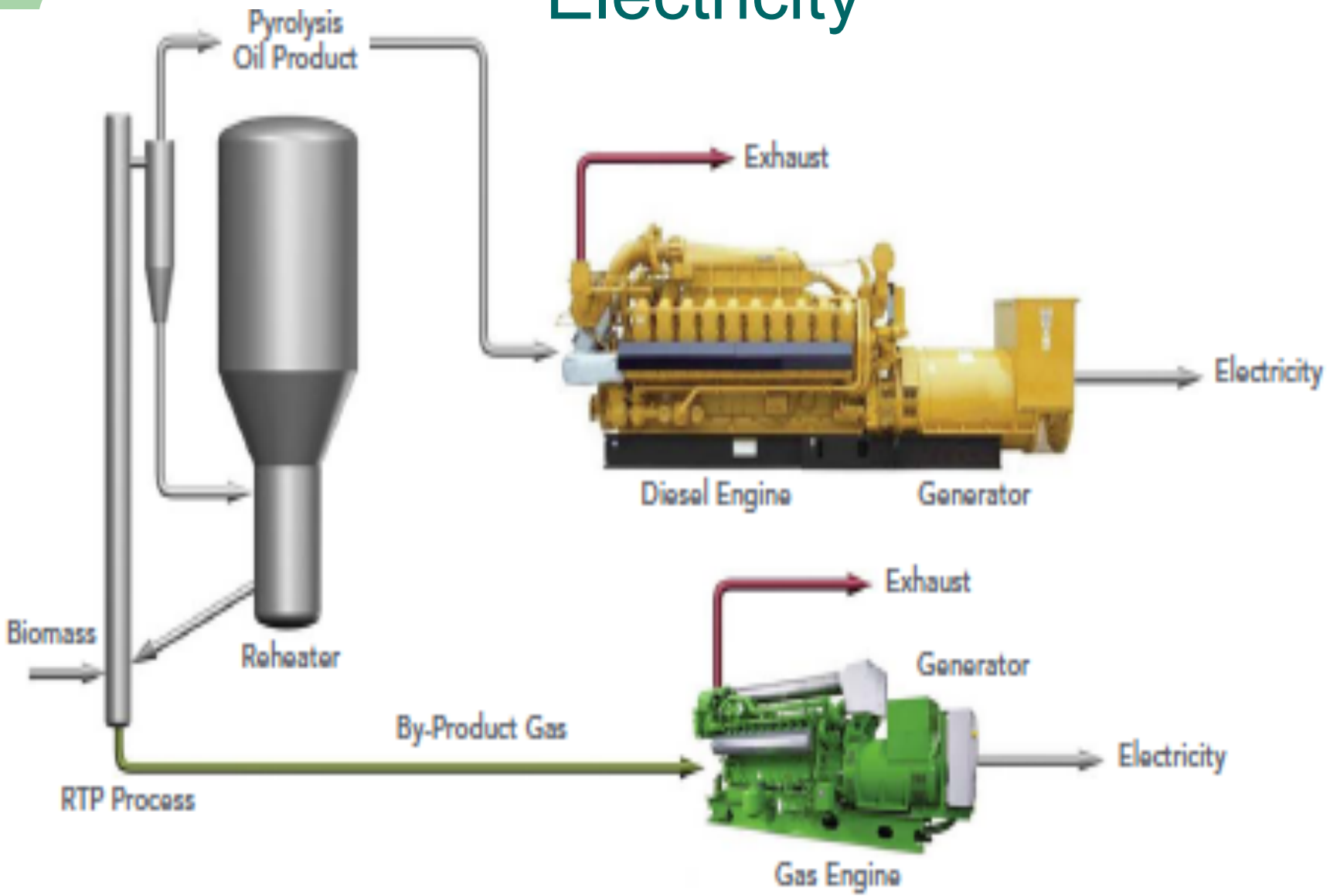
FlexEnergy's Portable Flex-Microturbine Power Plant for Woodchips and Nutshells

Gasification



Community Power Gasifier: 12.5 KW

Envergent - Pyrolysis Oil to Electricity



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

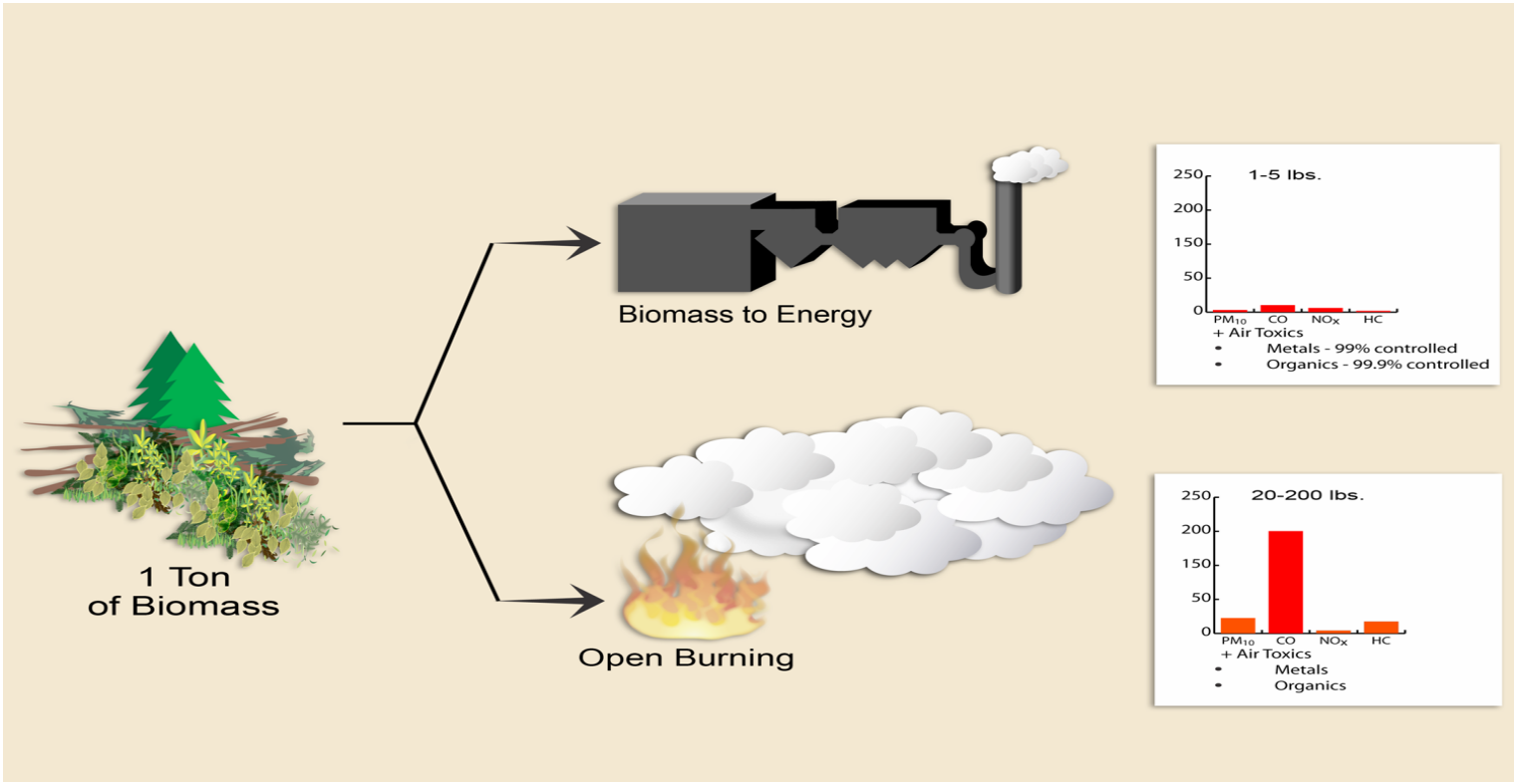
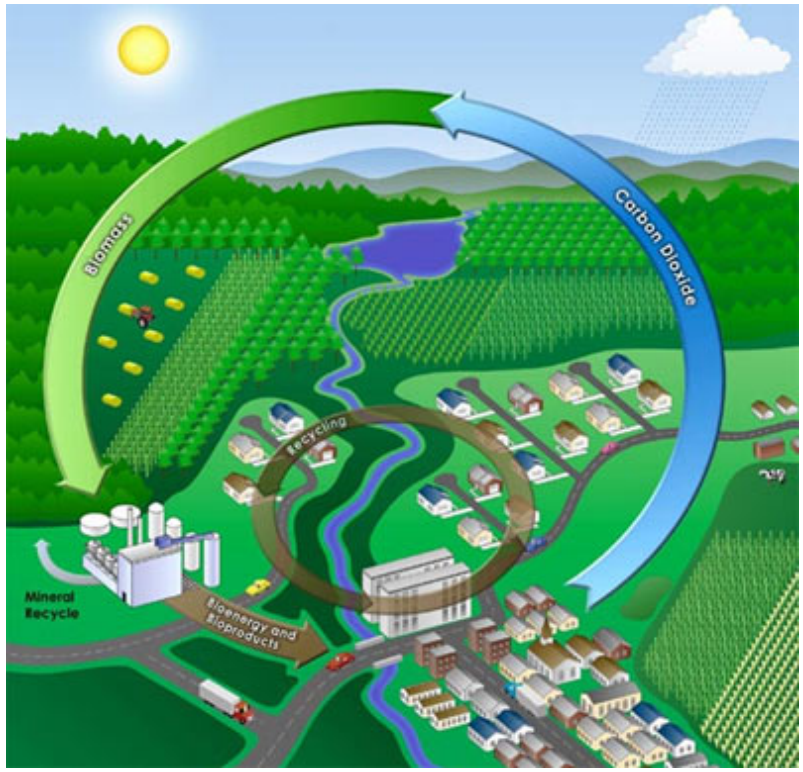


Diagram courtesy of Placer County Air Pollution Control District

Carbon “Neutral”

- Biomass absorbs carbon dioxide during growth of wood and green materials, and emits it during conversion
- It recycles the carbon and does not add to the greenhouse effect
- It displaces fossil fuel



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

Biopower 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-$4000 per kW.

Biopower Facility Example

- 20 MW plant produces enough power for about 18,000 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 - 55 per BDT
- Average electrical energy production cost

  ~ $0.08 - $0.10/kWh

DG Fairhaven Power 18 MW Generation Facility at Fairhaven, California

Three Major Components For a Viable Bioenergy Project

- Supply
- Market
- Financing

Woody Biomass Supply Sources

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

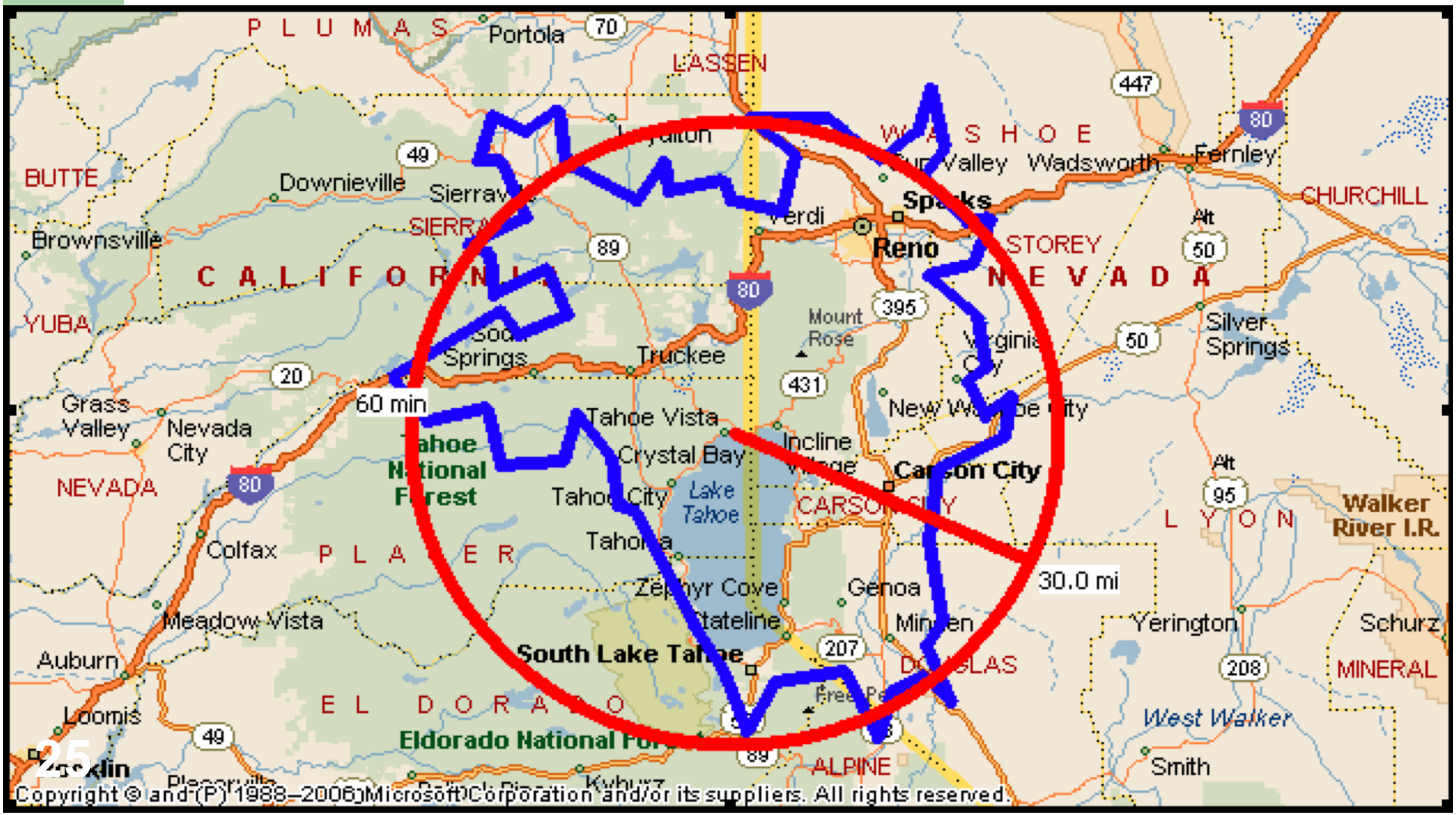
Fuel/Feedstock Supply

- Sustainable long term supply located within close proximity (50 to 75 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)

Target Study Area

- Define feedstock availability – Target Study Area based on economic haul distances required to source fuel/feedstock.
- Typical radial distances from the targeted site are 30, 50, 75, or 100 miles. Larger scale projects require larger supply areas.

Lake Tahoe Basin Biomass Energy Project Target Study Area



Assessment Filters

Three filters used to confirm availability of fuel/feedstock resource:

- **Potential** – Gross estimate.
- **Technical** – More refined based on physical recovery and resource policy factors.
- **Economic** – Very refined using current competition/demand, potential competition, community support and actual costs to harvest, collect, process and transport.

Current Competition

- Assess current uses/competition for fuel/ feedstock.
- Examples include:
  - Other bioenergy projects.
  - Furnish for composite panel manufacturing.
  - Raw material for soil amendment/landscape cover.
  - Feedstock for densified fuel pellet facility.

Potential Competition

- Assess potential uses/competition for fuel/ feedstock.
- Examples (same as those listed on previous slide) include:
  - Other bioenergy projects.
  - Furnish for composite panel manufacturing.
  - Raw material for soil amendment/landscape cover.
  - Feedstock for densified fuel pellet facility.

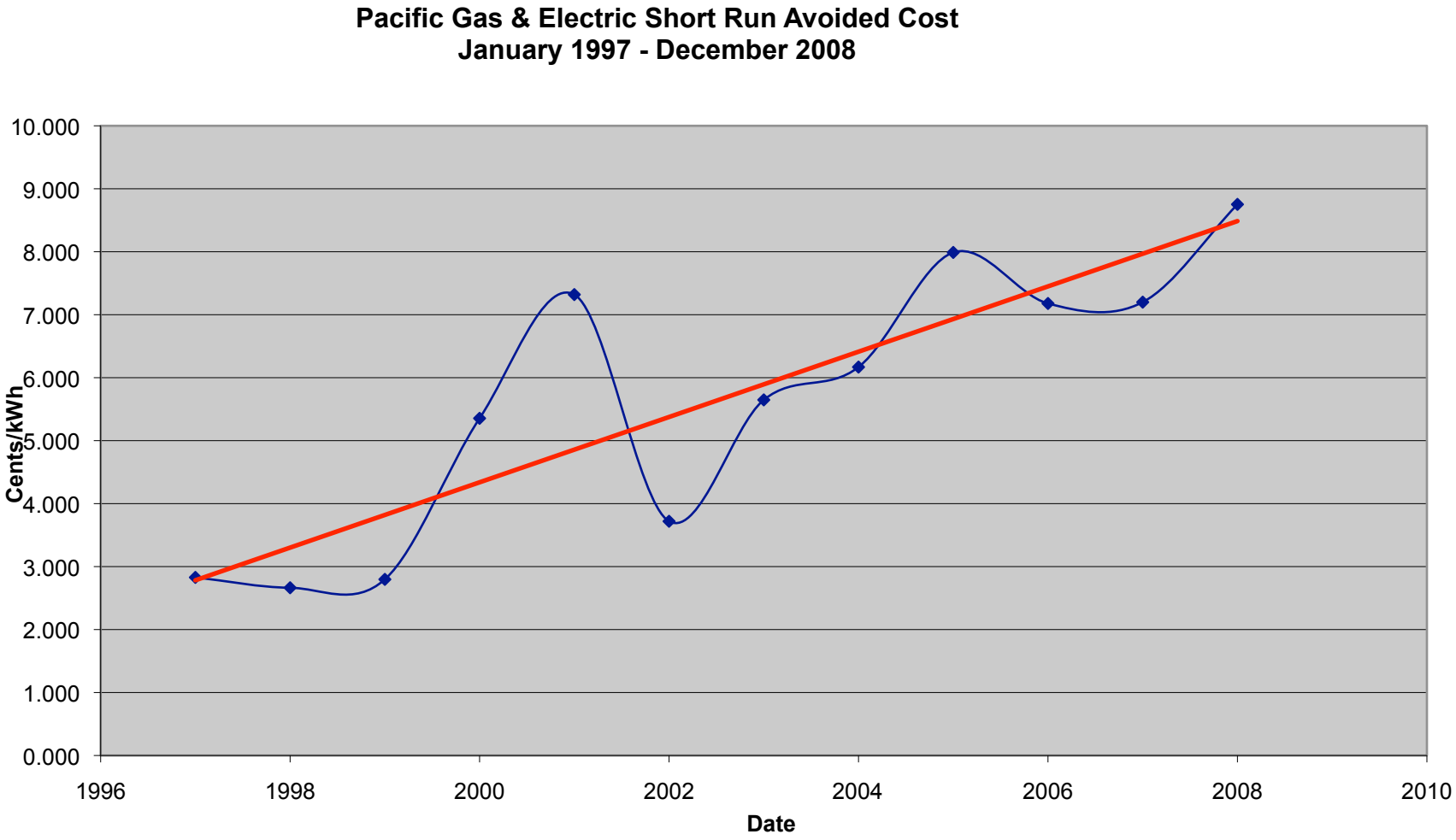
Key State and Federal Policies

- Consider existing policies that impact fuel/ feedstock availability and pricing. Some may only be available for defined time periods or are currently in draft discussion phase:
  - Federal - Biomass Crop Assistance Program
  - Federal – Stewardship Contracting authority on public lands
  - State (Washington) – Initiative 937
  - State (Minnesota, Michigan) – Forest biomass retention guidelines

Potential Power/Heat Purchasers

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

Wholesale Electricity Prices



Biopower Project Development - Deal Killer Issues to Consider

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

Community Support

- Best to have grass roots support
- Poll key stakeholders:
  - County Commissioners
  - Tribal Councils
  - Chamber of Commerce
  - Conservation Community
  - Local, State and Federal agency representatives
  - Private sector resource managers, landowners

Project Economics

- Sustainable and economical fuel supply
  - Fuel/feedstock supply typically represents the highest variable cost for a biomass facility
- Existing incentives
  - Production Tax Credits
  - Investment Tax Credits
  - 30% Grant in lieu of Investment Tax Credits
- Markets for heat and power
  - Market support justifies capital investment
- Return on investment
  - Minimum ROI of 20%+

Appropriate Technology

- Search for most appropriate technology considering project location and fuel supply
  - Ability to convert local fuel supply into heat/power
  - Must meet local permitting specifications
- Technology must be proven:
  - Commercially available
  - Operates efficiently on available fuel supply
  - Operates cleanly on available fuel supply
  - Appropriate for site and local resources

Siting/Infrastructure

- Co-locate with existing commercial or industrial project
  - Forest products manufacturing facility that has on site demand for heat and power
- Adjacent to power transmission/distribution system
- Typical project requires at least 8 acre site

Siting/Infrastructure (cont'd)

- Water readily available (10+ gpm minimum)
- Location incentives – Enterprise zones
- Transportation system
  - Highway
  - Rail
- Ash/waste water disposal
- Public concerns & environmental impacts
  - Fugitive emissions
  - Noise
  - Odor
  - Traffic

Environmental Concerns & Permitting

- Air Quality
- Water Use & Discharge
- Land Use
- Transportation
- Biological Resources
- Noise
- Cultural Resources
- Visual/Aesthetics

Project Development Steps

- 1 - Conduct preliminary feasibility study
- 2 - Confirm community support
- 3 - Assess fuel resource availability
- 4 - Consider siting and infrastructure issues, including environmental permit review
- 5 - Complete due diligence feasibility study
- 6 - Secure developer and/or investment banker

Project Development Steps

- 7 - Complete power purchase/thermal delivery agreement
- 8 – Complete permitting
- 9 - Enlist equity partners
- 10 - Secure financing
- 11 - Select EPC firm
- 12 – Design/engineer/ construct
- 13 - Generate renewable power

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