Biomass Power Plant Development in California, Overview and Lessons Learned

Renewable Energy Conference for California Tribes, January 22, 2008

Tad Mason, TSS Consultants

Pioneering Efforts – Biomass Utilization for the Production of Energy Products

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

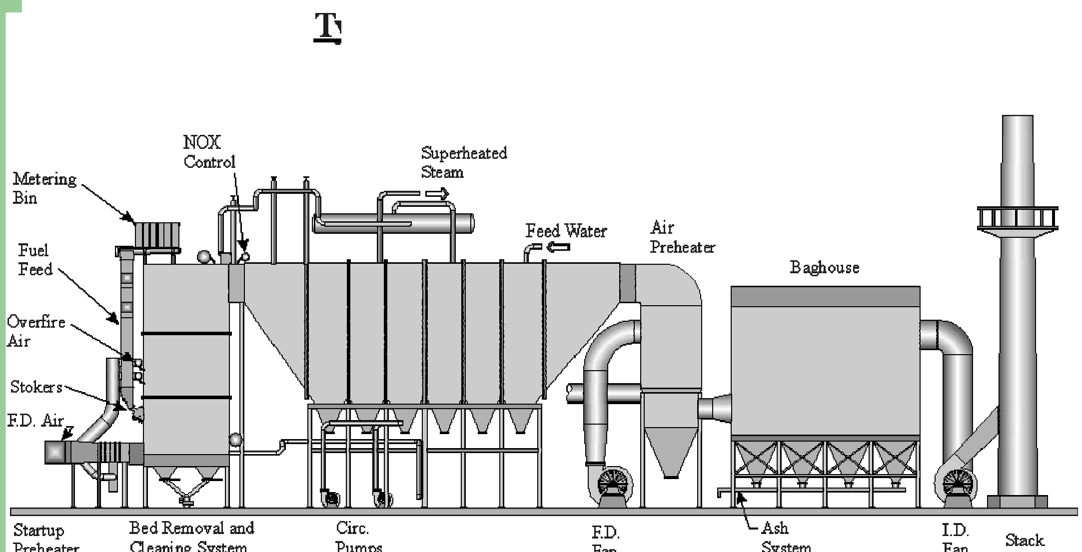
- Lumber products, composite panels, pulp
- Soil amendments
- Landscape/landfill cover
- Bio-based products (plastics, solvents, etc.)
- Biofuels (ethanol, renewable diesel)
- Biomass power

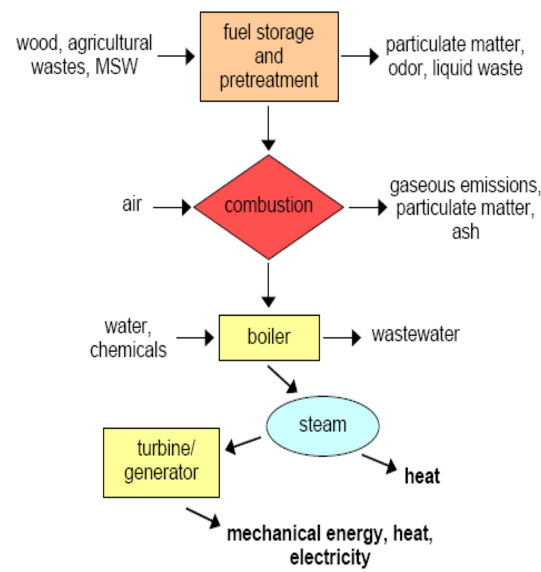
Biomass Power Technology

Two main components:

- An energy conversion system that converts biomass to useful steam, heat, or combustible gases
- A prime mover that uses the steam, heat, or combustible gas to produce power

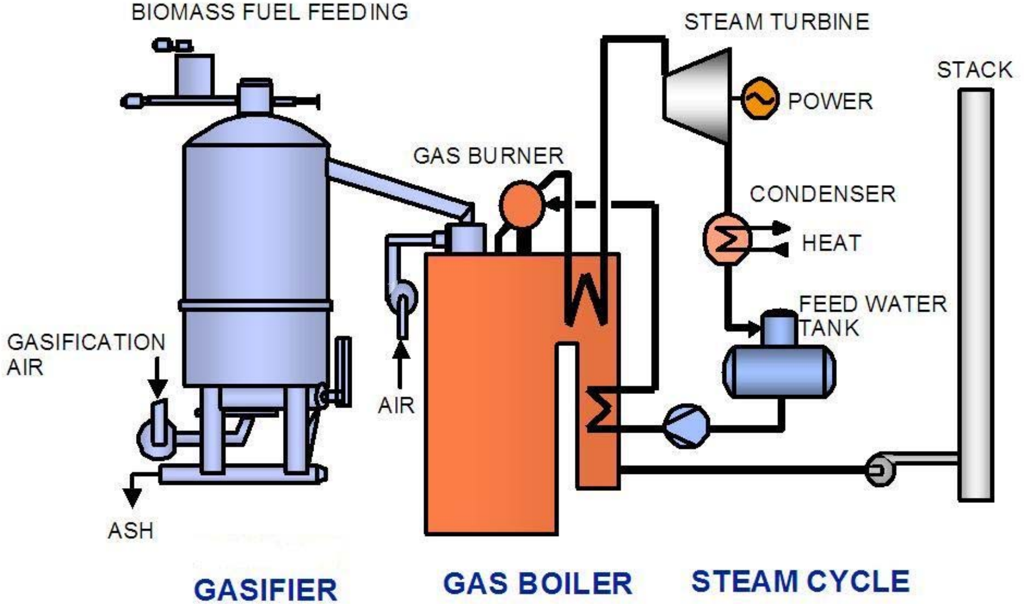
Combustion Technology





Gasification – The Future?

Electricity/Heat



Biofuels

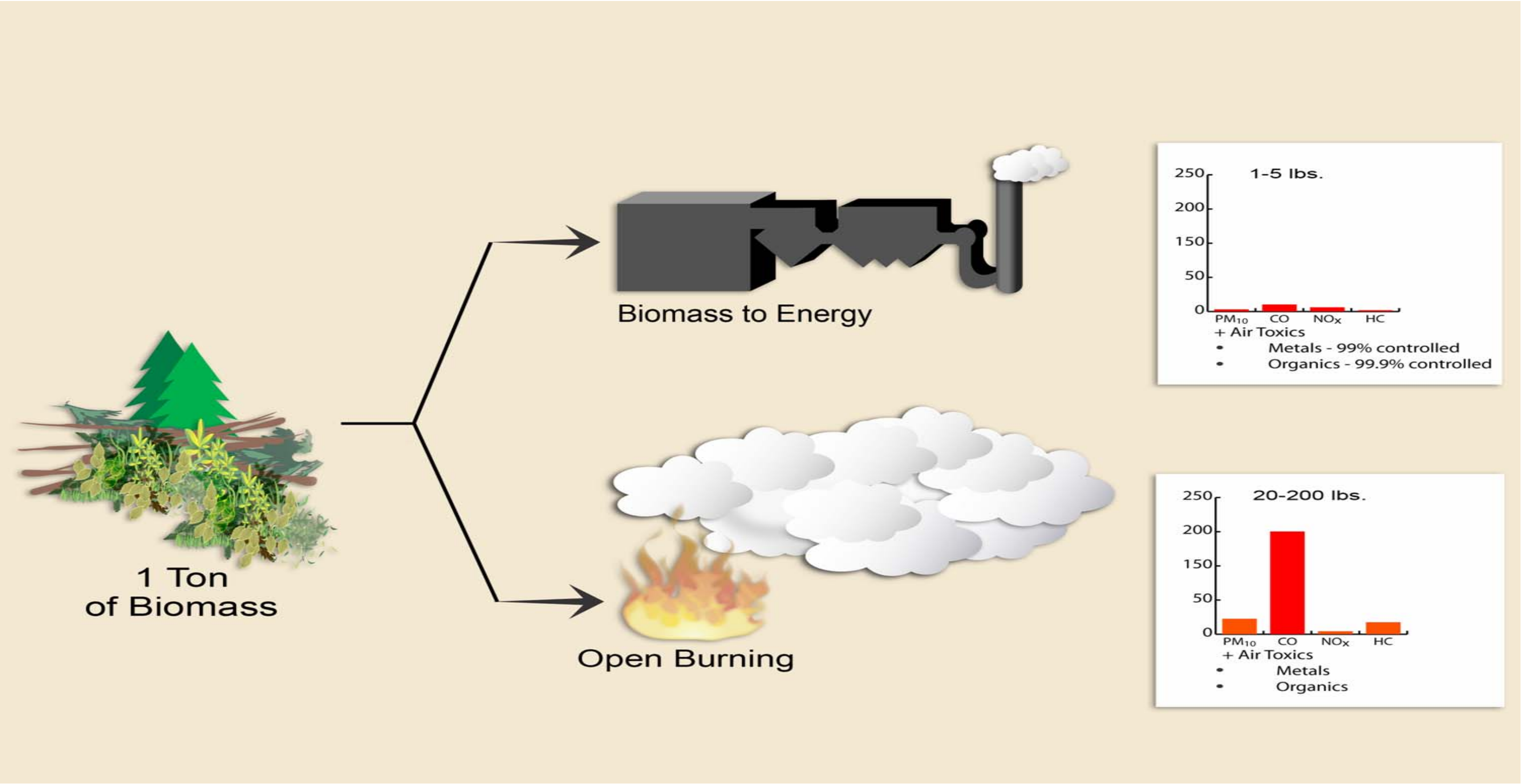
Potential

TSS Consultants

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
  - Net improvement in air quality
  - Provides employment (4.9 jobs/MW)
  - Reduces waste material destined for landfills

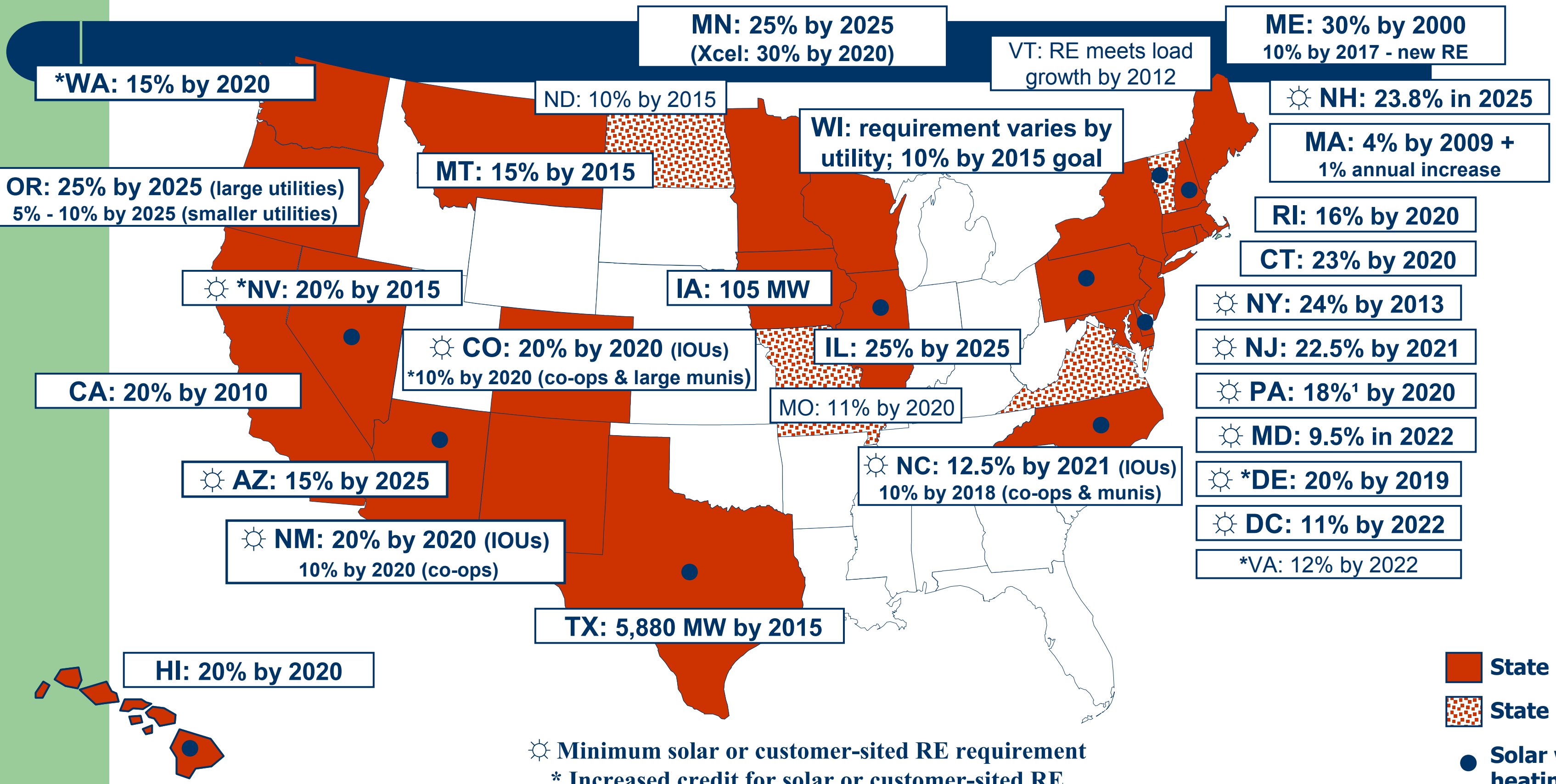
Improving Air Quality



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

Incentives - Renewable Portfolio Standards



☼ Minimum solar or customer-sited RE requirement
* Increased credit for solar or customer-sited RE
¹PA: 8% Tier I / 10% Tier II (includes non-renewables)

TSS Consultants

California Experience – Early Days

- Initial biomass plants developed in response to air quality/waste management issues.
- All biomass plants were co-located and generally operated as CHP.
- Most biomass waste was deposited in landfills and burned in the open.

Along Comes PURPA

- Public Utilities Regulatory Policy Act of 1978:
  - Requires that investor owned utilities must purchase privately produced power at “avoided cost” rates.
  - Created the market context that stimulated the development of the independent power industry in the US.

Other Incentives

- Renewable energy incentives of 1970's and 1980's caused renewed interest and development:
  - Investment tax credits
  - Energy tax credits
  - CA tax incentives

California Private Sector Response

- Within 15 years approximately 1,000 MW of biomass power was developed and brought into service. Enough renewable energy for about 750,000 homes.
- Consumed biomass fuel at the rate of around 15,000,000 GT/year:
    - Forest products manufacturing residuals
    - Forest sourced biomass
    - Agricultural waste
    - Urban wood

PURPA Contracts – Standard Offer 4 and the Boom Years

- 30 year contracts.
- First 10 years at fixed rates ($.07 -.13/kWh).
- Year 1- 10 rates based on energy forecasts with prices escalating well into future.
- Year 11 – 30, rates are based on wholesale energy rates (most floated based on natural gas rates).
- Power producers need to meet certain firm delivery standards to be considered a qualifying facility (QF).

Then Came the Bust

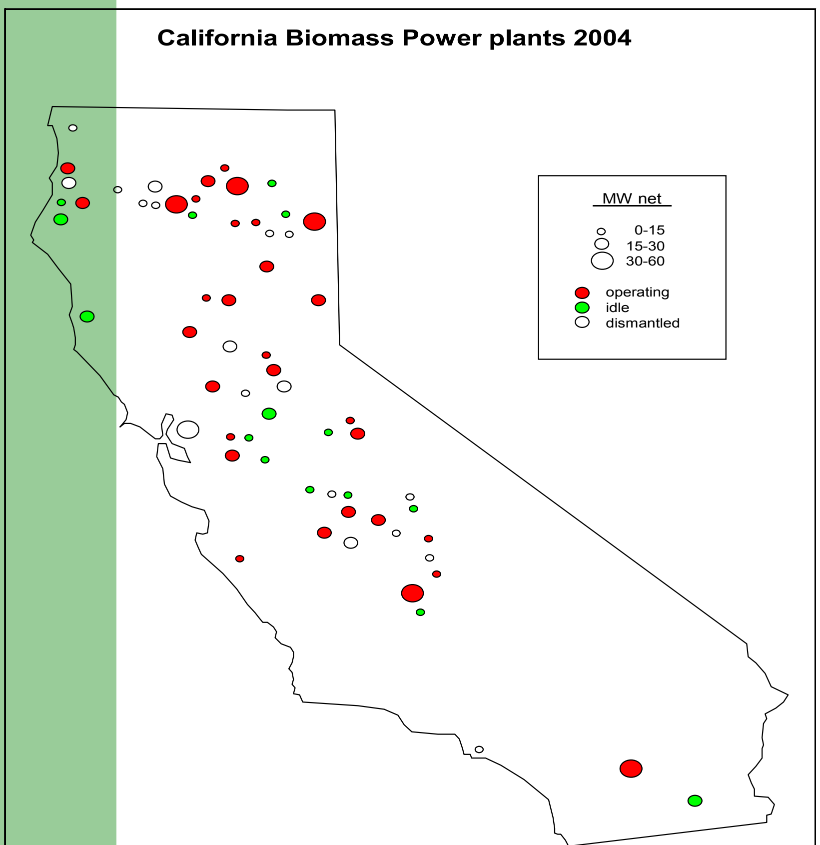
- With the 1986 world oil market crash of 1986, SRAC prices fell to half their previous levels.
- Standard Offer 4 contract rates fell.
- Few SO 4 contracts let after 1985.
- Deregulation of electric power markets loomed large.

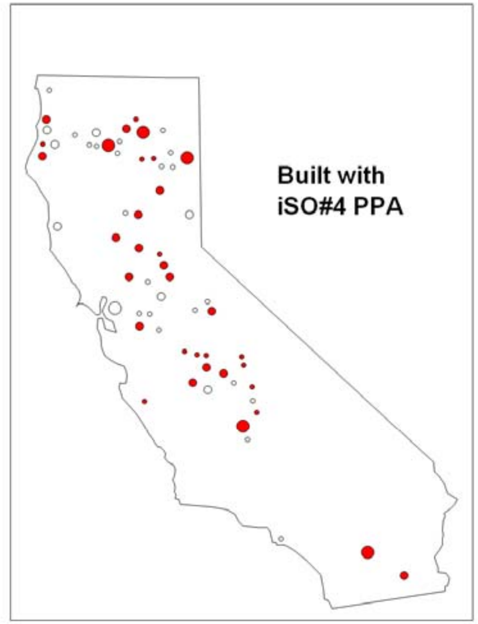
After the Bust

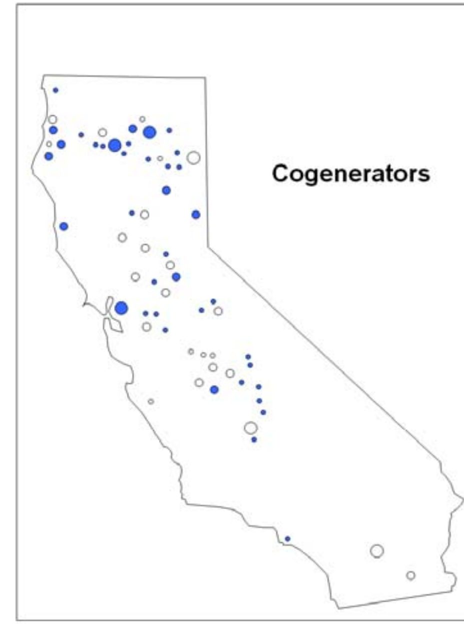
- Utilities provide cash incentives to buy back SO 4 contracts.
- Some plants went down, some curtailed operations.
- Plants that were smaller, less efficient or had poor access to fuel were closed.
- Plants that transitioned into year 11 sought out cheaper fuel sources.
- Attempt at electrical utility deregulation implemented.

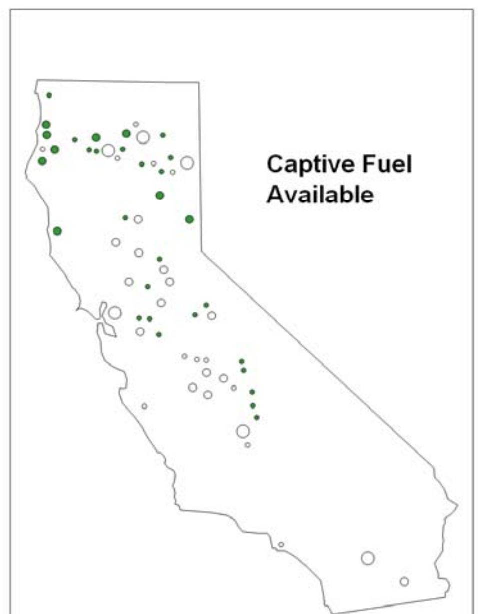
California Experience – Current Situation

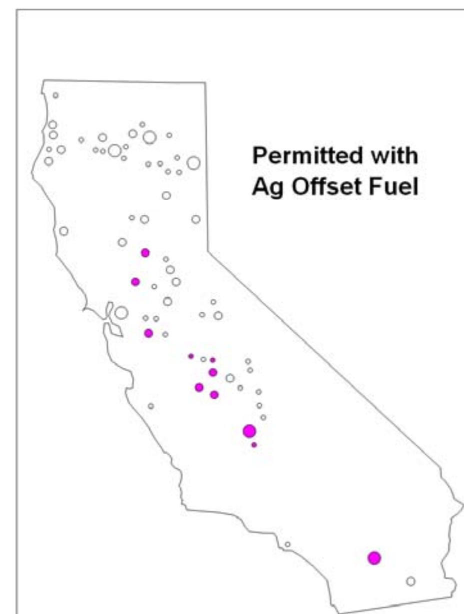
- Approximately 28 plants operational.
- Produce almost 650 MW (enough power for about 500,000 homes).
- Consume around 10,000,000 GT/year:
  - forest biomass
  - agricultural biomass
  - urban biomass
- Generate revenue based upon a variety of power purchase agreements – non-PURPA rates – most on a fixed rate of around $.0645/kWh. Current pricing schedule terms out in June, 2011.


California Biomass Power plants 2004
MW net
0-15
15-30
30-60
operating
idle
dismantled

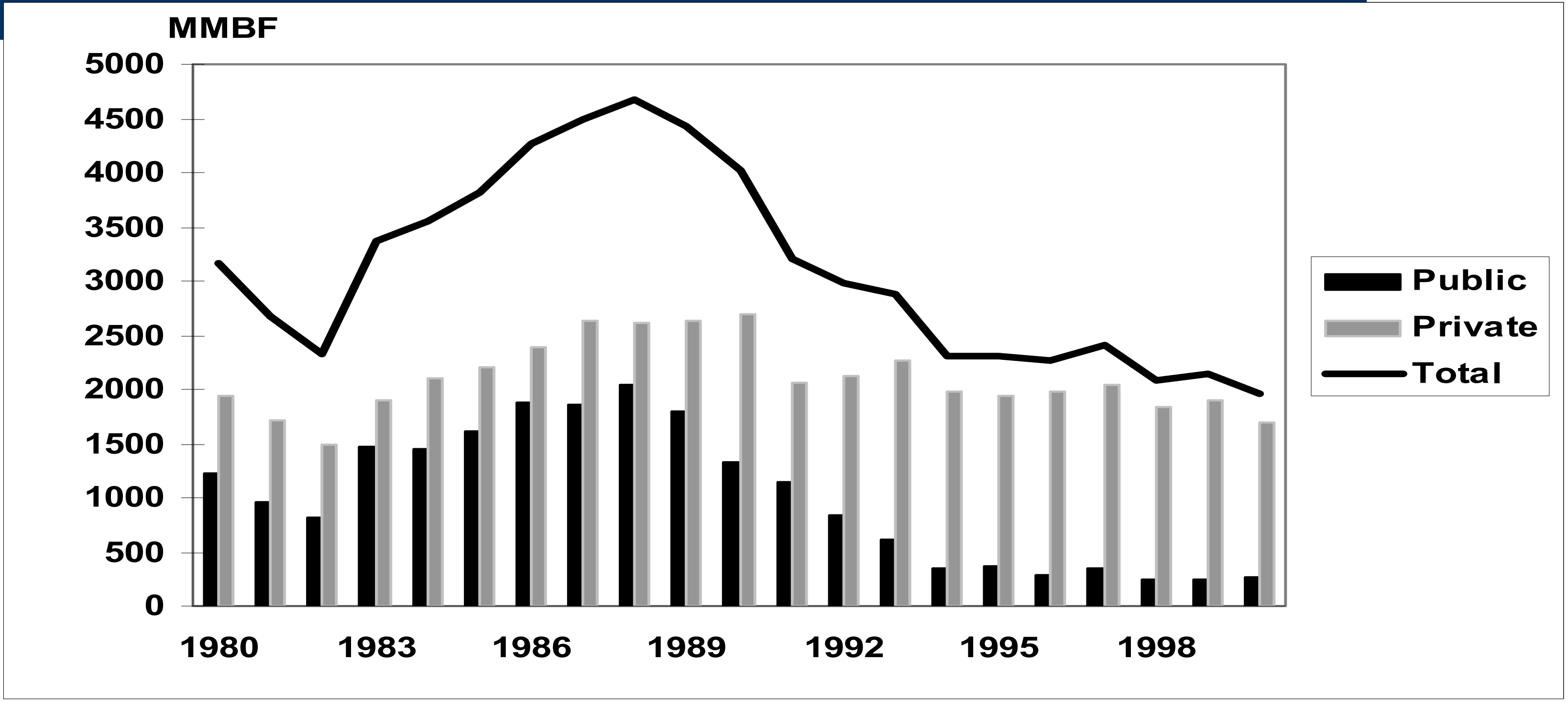

Built with
iSO#4 PPA


Cogenerators

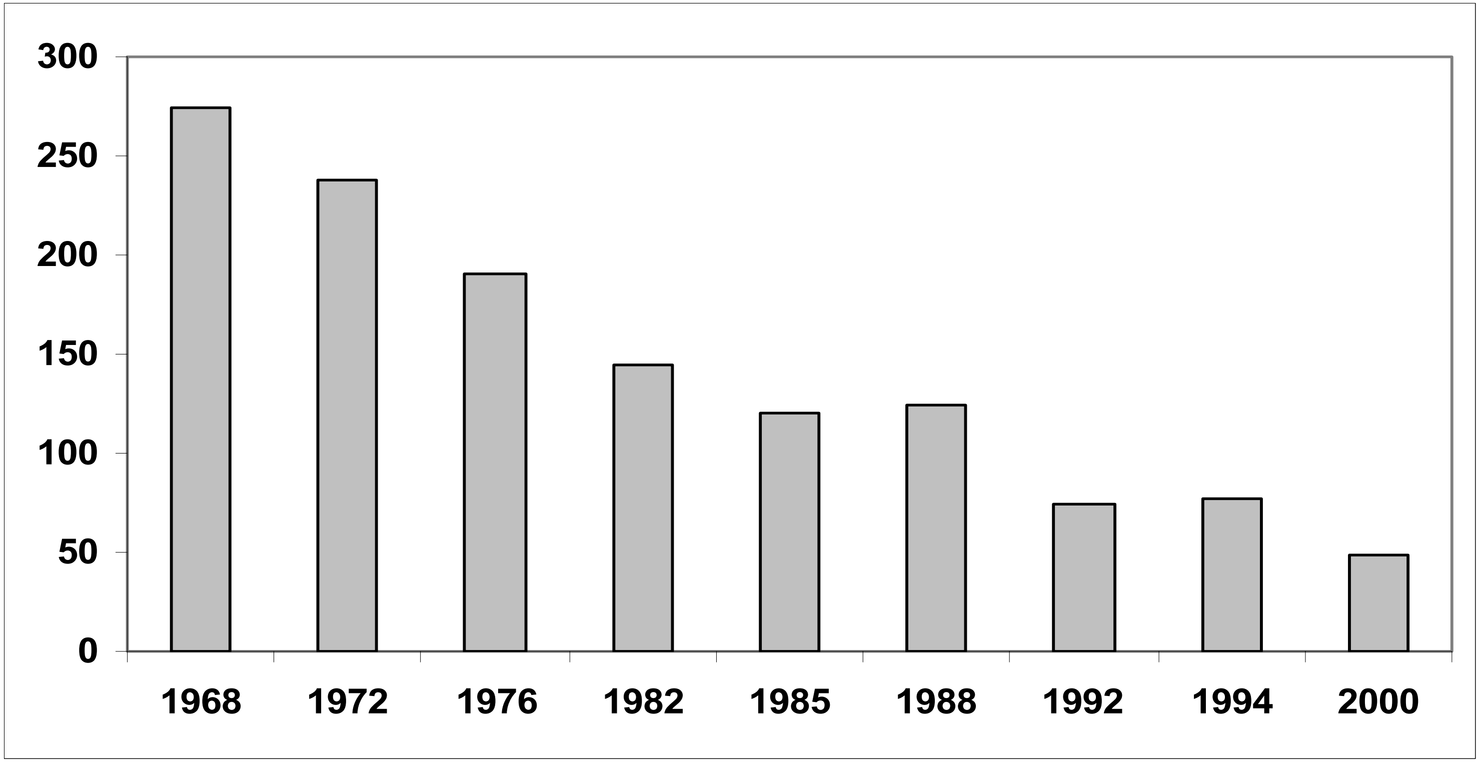

Captive Fuel
Available


Permitted with
Ag Offset Fuel

CA Timber Harvest



Number of sawmills in CA



California Biomass Availability

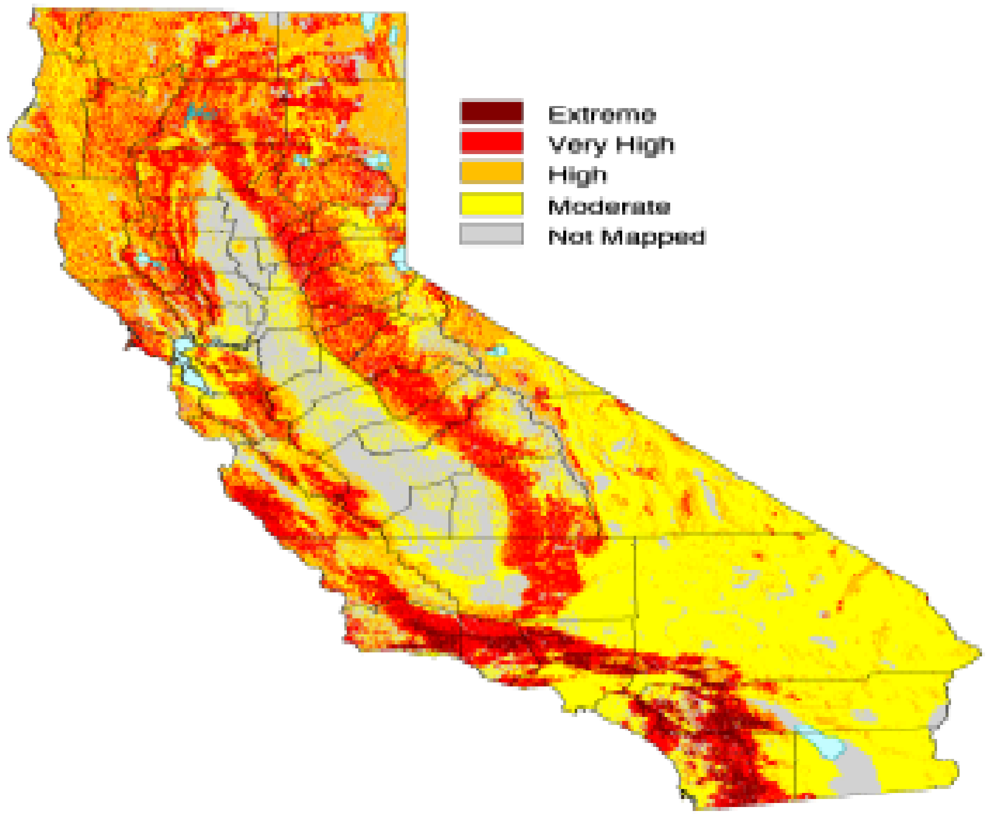
1991 = 60+ million BDT/Year
2004 = 72+ million BDT/Year

2004 Analysis Results:

- 51% Urban
- 29% Agricultural
- 9% Chaparral
- 7% Forest
- 3% Forest products residuals

Source: California Biomass Collaborative

Statewide fire threat



Source: FRAP, 2003


Cone Fire
Unthinned
Thinned
1 1:44PM

Biomass 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.

Biomass Facility Example

- 20 MW plant produces enough power for about 20,000 homes
- New plant construction cost = $40 to 45 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

  ~ $0.06 - $0.09/kWh

Siting/Infrastructure- Part I

- 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 - Part II

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

Biomass Project Development – Fatal Flaw Issues to Consider

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

Woody Biomass Supply Sources

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

Fuel 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)

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

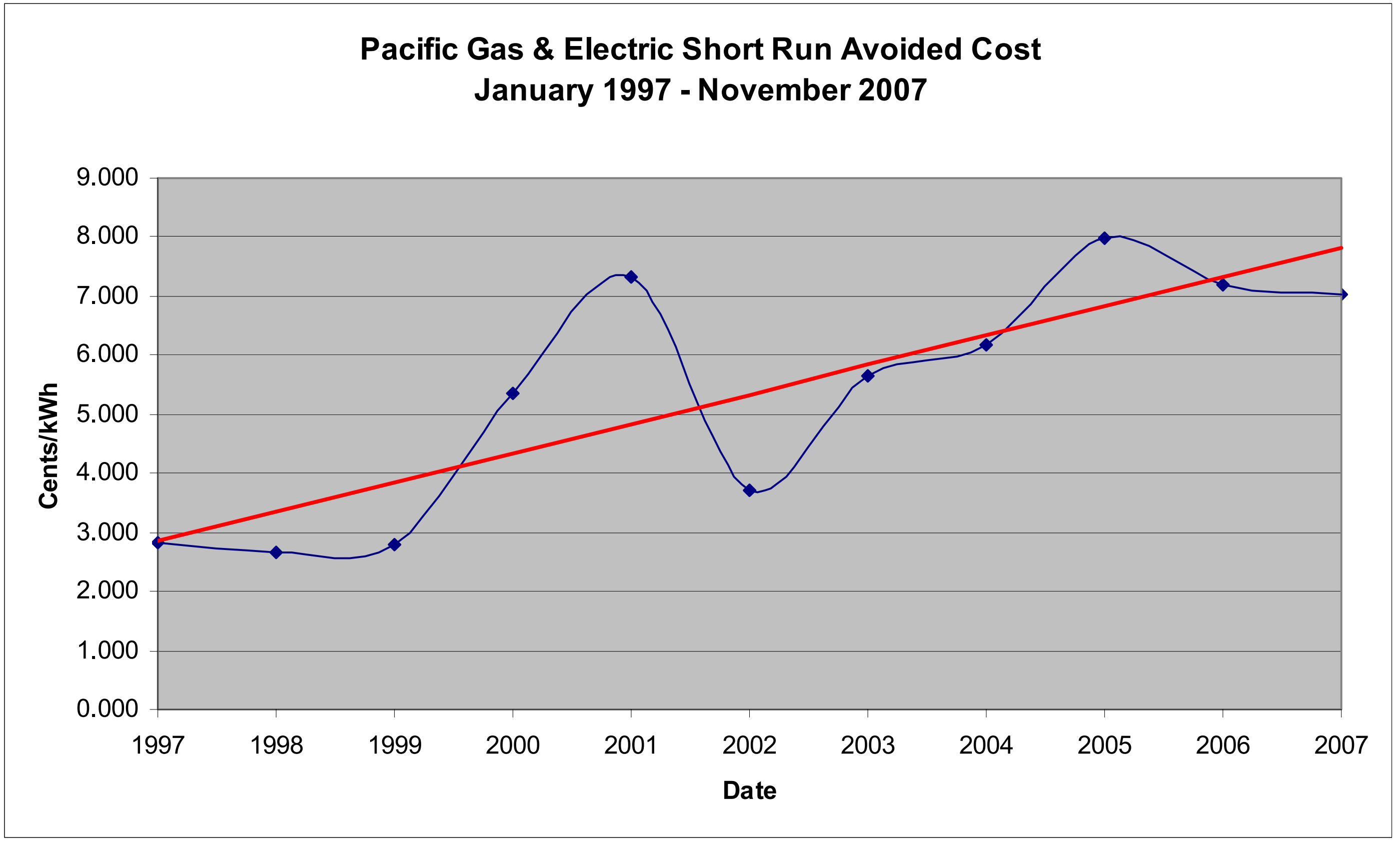
Project Economics

- Sustainable and economical fuel supply
  - Fuel supply typically represents the highest variable cost for a biomass facility
- Existing incentives
  - Production Tax Credits
  - Business Energy Tax Credits
  - Local incentives – enterprise zone
- Markets for heat and power
  - Market support justifies capital investment
- Return on investment
  - Minimum ROI of 20%+

Potential Power/Heat Purchasers

- Regulated utility:
  - Pacific Gas + Electric
  - Southern California Edison
  - San Diego Gas + Electric
- Municipal Utility District:
  - Sacramento Municipal Utility District
- Forest products manufacturing facility
- Agricultural processing facility
- Community buildings
- Others

Electricity Prices



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

Project Development Steps Part I

- 1 - Conduct preliminary feasibility study (Fatal Flaw Analysis)
- 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 Part II

- 7 - Complete power purchase/thermal delivery agreement
- 8 - Enlist equity partners
- 9 - Secure financing
- 10 - Select EPC firm
- 11 - Engineer/construct project
- 12 - Generate renewable energy

Questions? Comments? Heckling Remarks?

Tad Mason

Managing Partner

TSS Consultants

916.638.8811 ext 112

tmason@tssconsultants.com

www.tssconsultants.com