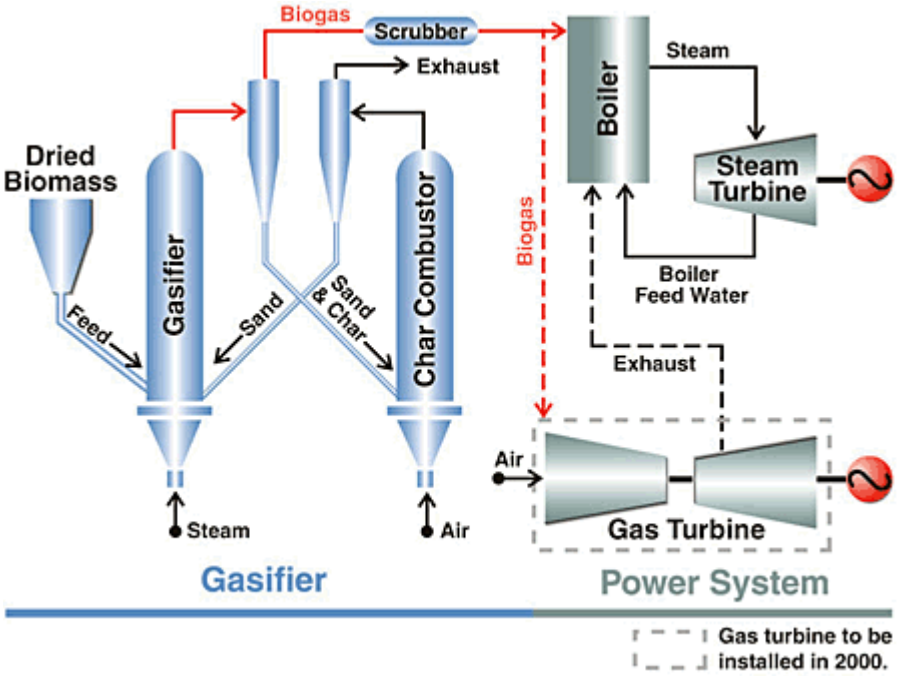
Energy From Biomass Burning: Feasible or Not?



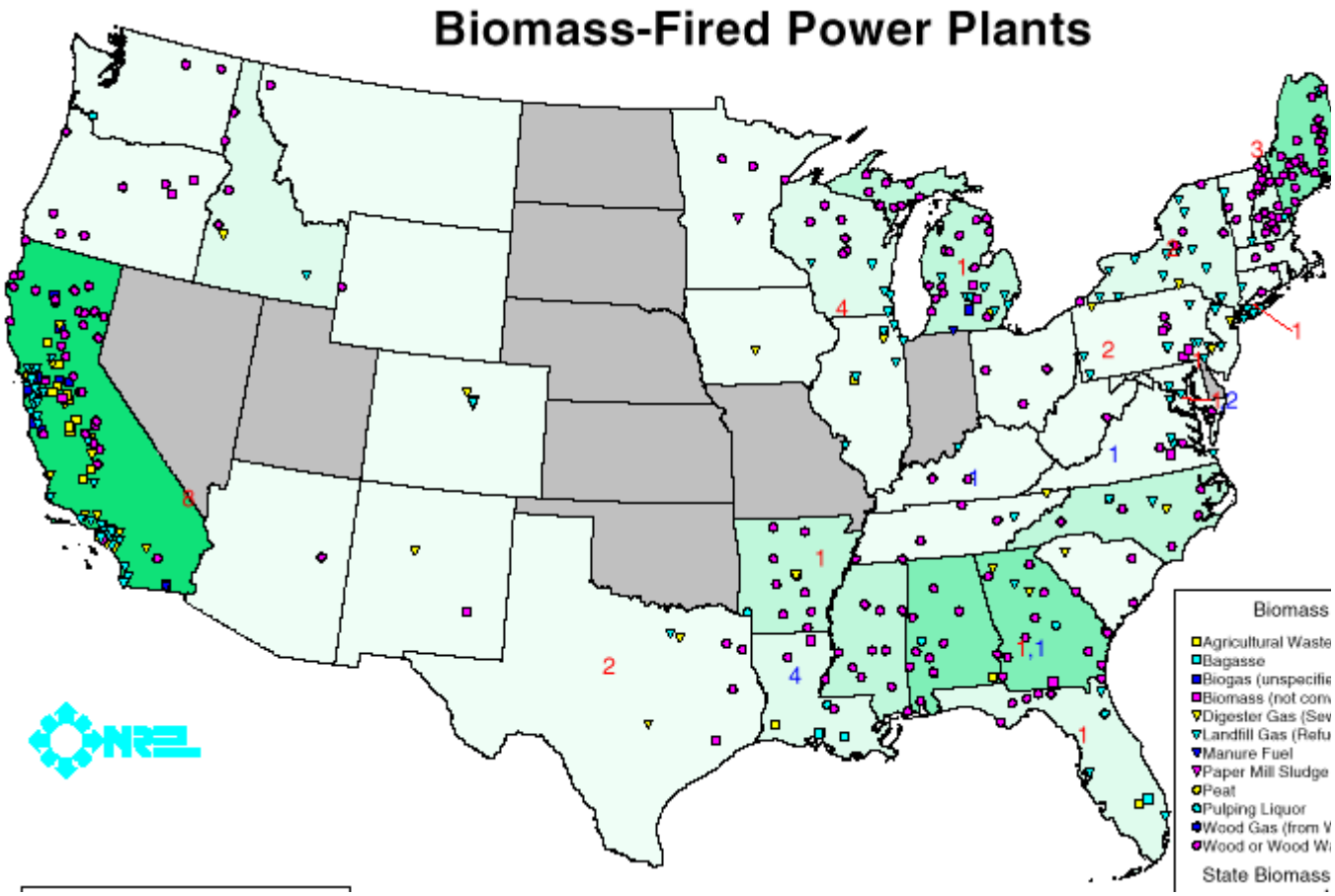
One Example:

The McNeil Generating Station in Burlington, Vermont, generates 50 MW of electric power for the city's residents using wood from nearby forestry operations-forest thinnings and discarded wood pallets. The gasifier is capable of converting 200 tons of wood chips per day into a gaseous fuel that is currently fed directly into the McNeil Station boiler, enough to generate 8 MW.

Biomass ☞ converting organic matter into energy. The energy source is stored solar energy. Heating via woodburning is an example of using biomass as an energy source.

In general, biomass burning is perceived as being a sensible form of energy generation.

Biomass power (biomass-to-electricity power generation) is a proven electricity generating option in the United States.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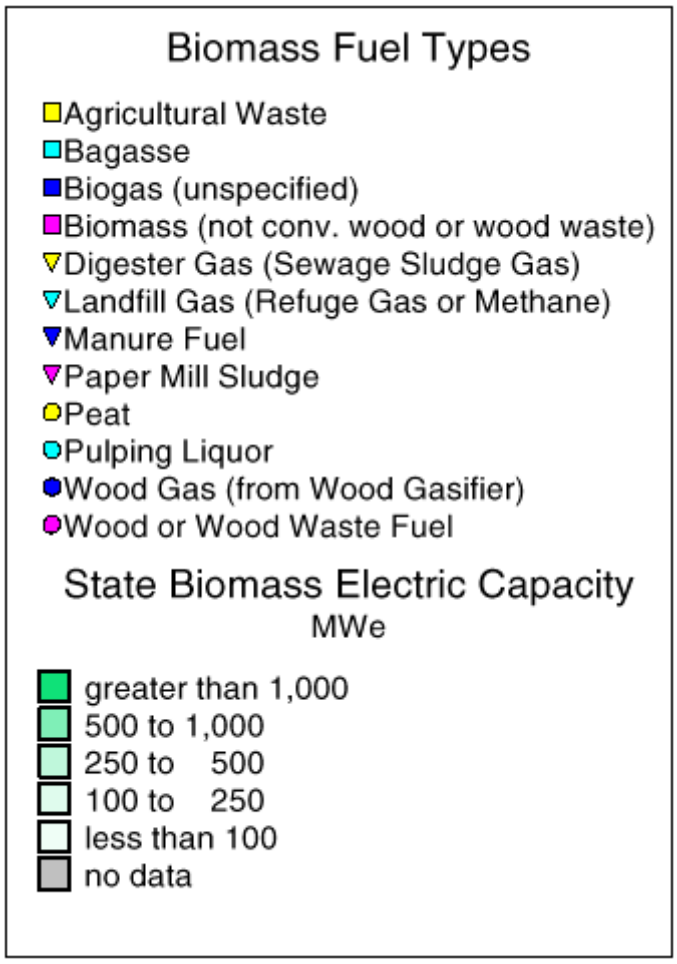


- **Approximately 10 GW of installed capacity ☞ single largest source of non-hydro renewable electricity, distributed in 500 individual power plants.**
- **7 GW are generated using forest product and agricultural industry residues ☞ 0.5% of US electrical consumption**
- **2.5 GW using municipal solid waste-based fuel**

All of today's biomass power capacity is based on mature, direct combustion boiler/steam turbine technology. The average size of existing biomass power plants is 20 MW (the largest approaches 75 MW), and the industry average biomass-to-electricity efficiency is 20 percent.

Advanced technologies:

Gasification technology can convert biomass into a liquid or gas

that can be burned in a combustion turbine. Gasification technology has not been fully developed and has not yet been demonstrated in commercial power plants. However, it has some great potential advantages including a low capital cost, high efficiency even in small plant sizes, and low pollution emissions.

A Case Study in BioMass Cogeneartion

Okay, let's look at this with a critical eye:

Some common forms of biomass from which energy can be extracted:

- **trees and timber waste**
- **wood chips**
- **corn**
- **sugar cane**
- **grass clippings and leaves**
- **manure and municipal solid waste**

Most biomass is made of Carbon and Hydrogen (e.g. Methane = CH_4)

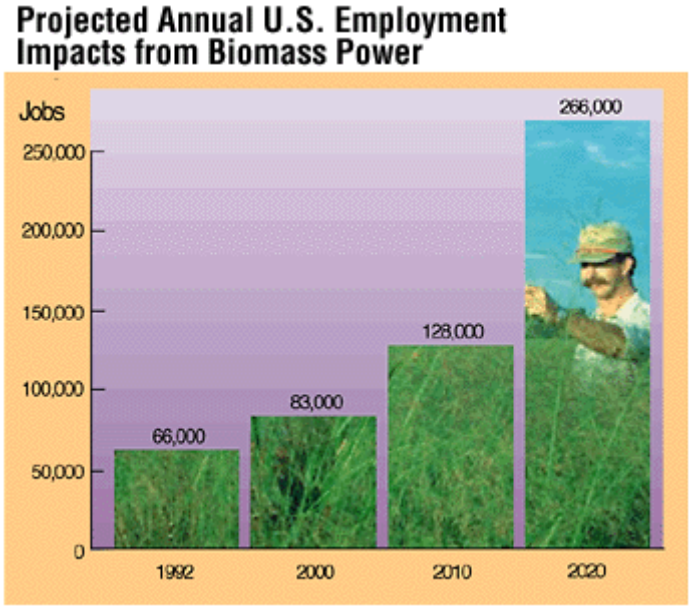
Half of the World cooks with wood. In developing countries, biomass accounts for about 70% of the energy generated

In the US, there are now wood waste power plants that have a capacity of 80--100 Megawatts; approximately 10% of the capacity of a coal fired steam plant.

Production Line Strategies for increasing the power yield:

- **Grow specialized crops**
- **short rotation forestry ☞ currently a booming business.**
- **improve boiler efficiency (currently 10--30%) ☞ efficiency translates directly into biomass tonnage**

- **have 20% of the US energy budget come from biomass by the year 2010. The potential is there and if realized would result in a significant increase in jobs:**



Example Calculation:

- **One pound of dry plant material ☞ 7500 BTUs**
- **Equivalent to 4300 calories per gram**
- **Annual Corn yield in the US is about 3300 grams per square meter or 15 tons per acre**
- **Total US harvested land is 350 million acres**

- **Available Energy is then:**

  15 tons/acre yr * 350 x 10^6 acres * 7500 BTU/lb * 2000 lb/ton =79 x10^{15} BTU

  In 1990, the total energy used in the US was 81 x10^{15} BTU

  So the potential is there for a substantial fraction of our energy budget to come from biomass burning.

Only 5% of a plant's total biomass is suitable for food. There are

two alternatives for the remaining 95%:

- **burn it**
- **turn it into fuel**

Conversion of biomass into fuel is somewhat inefficient and costly. At present, its best to just burn the biomass in electrical power plants.

Conversion of corn into fuel:

- **stalk and cobs ground up and mixed in water**
- **cook it to convert starches into sugars**
- **ferment the sugar into ethanol**
- **distill to remove ethanol from the rest of the crud**
- **blend ethanol with another fuel**

At the moment the production of ethanol and methanol is subsidized

- **Sizeable surplus of corn in the US**
- **Many states (Midwest mostly) provide fuel tax exemptions to encourage the conversion of this surplus into fuel**
- **So is gasohol economically viable in a free market?**
- **Is there a net gain? ☞lots of fossil fuels are used in agriculture to grow the corn in the first place**

In other countries, the econmics of biomass conversion are more viable:

- **Brazil has limited oil reserves ☞therefore use ethanol as a major transportation fuel**
- **1/3 of their 10 million cars run on hydrated ethanol (192 proof)**
- **Pertoleum imports would end if 2% of brazilian land area were devoted to growing sugarcane for ethanol**

Converting biomass to Methane:

- anaerobic fermentation of municipal waste
- one ton of sludge converts to about 10 million BTUs (32% coal equivalent)
- conversion process is costly but is quite efficient (50--70%)
- economics are favorable if the organic matter used is waste
- currently, it is not competitive to use waste to produce methane instead of relying on existing natural gas supplies

But, BE WARNED, current agriculturual processes have a heavy reliance on fossil fuels and this reliance is often hidden

- 1900 one farmer feed 5 people
- 1974 one farmer feed 50 people
- Factor of 10 increase in yield due to increased use of:
  - machinery (runs on fuel)
  - irrigation
  - pesticides
  - fertilizers
  - better seeds
- All of the above are quite energy intensive and the infrastructure needed to develop all of these products involves a lot of people

- Hence, it is not clear if there is any net energy gain associated with the conversion of agriculturual crops into gaseous and liquid fuels

Current Air Pollution from BioMass Burning:

- CO = 15% that of gasoline powered motor vehicles
- Particulates = 30% of Coal burning facilities
- Sulfur-Oxides = none
- Hyrdocarbons = 10% of gasoline powered motor vehicles
- Nitrous-Oxides = 5% of gasoline powered motor vehicles

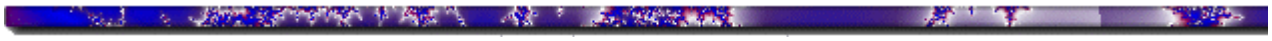
- **Forest Fires: Dominate particulate emission in biomass burning but have slightly lower releases of CO and slightly higher releases of Hydrocarbobns**

☞ **Other Problems:**

- **High moisture content prohibits efficient transport ☞ need to burn on site**
- **Nutrient loss in the soil due to high crop rotation**

Read More about it:

- **Overview of US Program**
- **BioFuels**
- **Bio Energy mailings list archive**
- **Technical Report on Waste Products for Biomass**



 **Previous Lecture**  **Next Lecture**  **Course Page**