



Introduction

Biomass is any material of recent biological origin. There is a huge variety of biomass resources, conversion technologies, and end products as shown below. Two technologies that show significant potential for Kauai are "Direct Fired Biomass" and mass burn of municipal solid waste.

Biomass Sources

- Forests
 - Natural regrowth
 - Energy forests
 - Forest residue
 - Processing residues
- Agriculture
 - Crop residues
 - Processing residues
 - Energy crops
- Wastes
 - Municipal
 - Industrial

Processing

- Drying
- Extrusion
- Compression
- Chipping
- Carbonization
- Anaerobic digestion
- Fermentation
- Gasification
- Pyrolysis
- Fischer tropsch

Fuel Products

- Solid Fuels
 - Charcoal
 - Wood chips
 - Pellets/briquettes
- Gaseous Fuels
 - Methane
 - Pyrolysis gas
 - Producer gas
- Liquid Fuels
 - Plant esters/oils
 - Ethanol
 - Methanol
 - Pyrolysis liquids
 - Biodiesel

End Markets

- Electricity
- Heat
- Solid fuels
- Transport

Direct biomass combustion power plants burn the biomass in boilers to produce steam, which is expanded through a turbine to produce electricity. Prior to combustion in the boiler, the biomass fuel may require some processing (drying, chipping, etc) to improve the physical and chemical characteristics. Wood is the most common biomass fuel. Other biomass fuels include agricultural residues such as bagasse, dried manure and sewage sludge, black liquor, and dedicated fuel crops such as fast growing grasses and eucalyptus. The capacity of biomass plants is usually less than 50 MW because of the expense of transporting a dispersed fuel to a central location.

Municipal solid waste (MSW) may also be burned to generate electricity. The three most common types of MSW plants are 1) mass burn, 2) refuse derived fuels, and 3) plasma arc. In a mass burn plant, the MSW is burned similar to the direct biomass combustion described above. In a refuse derived fuel facility, the trash is pre-processed to remove the recyclable materials and convert it to fluff or pellets for ease of handling. A plasma arc facility burns the trash using a high temperature electric arc. For Kauai, the mass burning of MSW is most promising primarily due to cost.

Potential for Kauai and KIUC

Kauai has very good potential for power production from biomass. Until recently, the island generated a significant portion of its power from bagasse, the fibrous residue from sugarcane. However, the amounts of electricity that can be generated by bagasse available from the one remaining sugar plantation is limited to about 8.6 MW. Other agricultural wastes such as wood, corn, and coffee residuals are available but in much smaller

qualities. Fuel crops such as banagrass could be utilized but at much higher cost. A recent study estimated that over 600 GWh/yr could be generated from a 90 MW plant if only 20 percent of Kauai's agricultural lands were converted to banagrass.

The potential for power production from MSW on Kauai is good but limited. The Kekaha landfill currently accepts over 200 tons of waste per day. This quantity is sufficient to generate about 44 GWh/yr of electricity from a 7 MW plant. Our recent renewable energy study also explored the option of a combined biomass/MSW plant with a capacity of 32 MW.

Capital costs for a 20 MW direct burn biomass plant would be approximately \$4,600/kW. This would result in a levelized cost of electricity of between 18.0 to 20.5 ¢/kW. The relatively high cost for electricity is due to the small plant size and a lack of low cost agricultural waste fuel.

Capital costs for 7.3 MW mass burn MSW plant would be approximately \$11,350/kW. This would result in a levelized cost of between 2.0 to 10.9 ¢/kW assuming a tipping fee of between \$50 to 90/ton. Tipping fees are what the trash haulers pay a landfill or MSW plant to accept their trash.

Advantages and Disadvantages

Direct Burn of Biomass

Advantages

- mature, proven technologies
- utilizes existing agricultural infrastructure and expertise
- creates/retains agricultural jobs
- good potential on Kauai
- carbon neutral

Disadvantages

- more expensive than conventional generation

Mass Burn of MSW

Advantages

- mature, proven technologies
- minimizes trash going into landfill
- less expensive than conventional generation

Disadvantages

- limited potential on Kauai
- emission of pollutants such as dioxins
- odor and noise