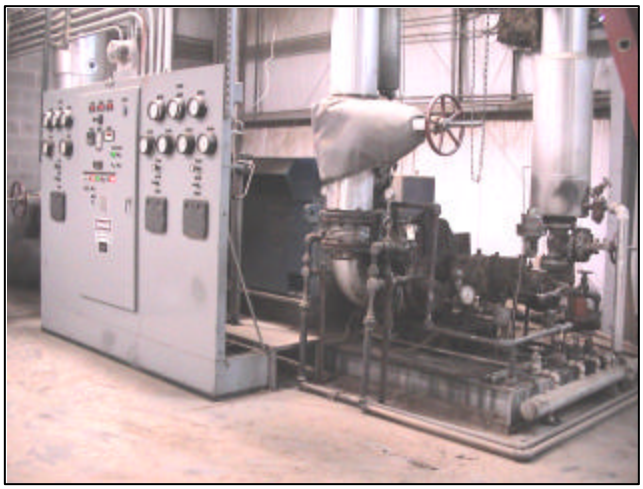
BIOPOWER

In cooperation with the US Department of Energy

Biomass energy used to generate electricity is sometimes called ***biopower***. The method for generating electricity partially depends on the type of biomass material available and the scale of power generation. For example, wastewater from a municipal sewer system would probably be best converted into a biogas in an anaerobic digester and then used to fuel an engine or turbine to generate electricity. Solid forms of biomass such as forestry processing residues may be better suited for burning in a boiler to generate steam.

Fortunately, there are several ways to generate electricity from biomass. The most commonly used method is to burn the biomass in a **boiler** to generate steam, which is then passed through a steam turbine that turns a generator. This method is frequently used in large boilers in pulp and paper mills, independent power plants, and other industries which require boilers.



Boilers can burn solid, liquid, or gaseous fuels, which makes them ideal candidates for co-firing. **"Co-firing"** describes the method of burning biomass fuels with coal or another fossil fuel. The ability to co-fire allows utilities and others with existing solid fuel boilers to use biomass fuels at relatively low cost. The Tennessee Valley Authority, Southern Company Services, and Allegheny Power are all utilities in the Southeast that have extensive experience with cofiring.

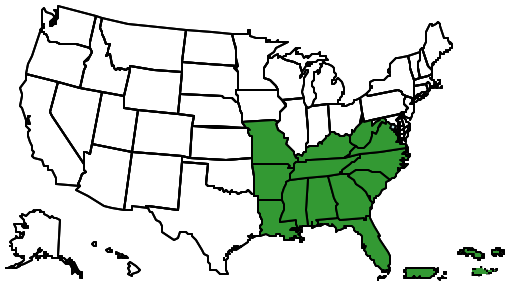
As a rule of thumb, it takes about one dry ton of biomass per hour to generate one megawatt (MW) of electricity. In this case a dry ton refers to biomass that has no moisture content. In reality, the biomass will contain some moisture. For example, trees that are harvested in the summer while they are actively growing will have about half of their weight in water (50% moisture content). For biomass materials with 50% moisture content, it takes about 2 tons per hour to generate one megawatt of electricity. One megawatt will provide electricity for roughly 1000 homes.

A large utility power plant may have the capacity to generate several hundred megawatts. Thus co-firing even small amounts of wood or other forms of biomass in these boilers can generate a market for large quantities of biomass. The increased economic growth associated with growing and transporting biomass to power plants creates additional markets for electricity. And since biomass contains virtually no sulfur in comparison to coal, the power plants also benefit from reduced acid rain emissions.

As discussed in other fact sheets in this series, biomass can be converted into liquid or gaseous fuels, which opens up other avenues to generate electricity, including **combustion turbines**, which can burn either liquid or gaseous fuels. Traditional combustion turbines range from one to 20-MW and are used by

utilities to provide power during periods of high electricity demand. In the last few years, very small turbines, called **micro-turbines**, have become commercially available in size ranges from 25 to 75 kW[1].

Liquid or gaseous fuels can also be used in **piston engines** (also called **reciprocating engines**) that are commonly used with diesel or gasoline fuels. Biodiesel and ethanol blends can be used to fuel engines to generate electricity. Solid forms of biomass can be converted into a gas by heating it in the absence of air, causing it to decompose into combustible gases and vapors, which can be used to fuel engines. Biogas from landfills, wastewater treatment plants, or anaerobic digesters used to treat animal manures can also be used to fuel combustion turbines and piston engines. The use of biogas from landfills to generate electricity is common in a many states. Likewise the generation of electricity from biogas from anaerobically digesting animal manures is rapidly becoming commonplace.



Southeast Biomass State and Regional Partnership

Fuel cells are emerging as another technology that can use fuels rich in hydrogen, such as ethanol and biogas, to generate electricity. One may think of fuel cells as similar to electrical storage batteries, except the chemicals in the "batteries" are constantly being replenished by the flow of the fuel through the fuel cell. Fuel cells have recently been installed at a landfill gas location, wastewater treatment plant, and an on-farm anaerobic digester where they use biogas to generate electricity. Fuel cells are limited in size to a few megawatts but are completely quiet and emit only water and carbon dioxide. These features allow them to be readily used in highly populated areas.

The generation of electricity typically results in the production of waste heat. Recovering and using this heat for beneficial purposes can provide additional revenue from power generation and reduce the cost of electricity. **Combined heat and power (CHP)** systems, also known as **co-generation** systems, are systems designed to do this. Obviously, for CHP systems to be practical they must be installed next to the user of the heat and the need for the heat must closely match the amount of heat generated. Sawmills are good candidates for CHP systems because they have wood residues available and, if they have kilns for drying lumber, require a fairly constant source of heat virtually all the time.

Net metering is a term used to describe situations where any surplus power generated by a customer is purchased by the utility at the same rate the customer pays for electricity. Usually this is accomplished by installing two meters, one to measure the amount of electricity flowing into the facility and one measuring the amount of electricity flowing out. Several states have adopted laws requiring utilities to provide net metering options.

This series of fact sheets was prepared by the Southeast Biomass State and Regional Partnership (formerly the Southeastern Regional Biomass Energy Program). The Partnership is one of five regional administrations of the U.S. Department of Energy's (DOE) National Biomass State and Regional Partnership. The Partnership was established in 2003, and is managed for DOE by the Southern States Energy Board. The goal of this Partnership is to work cooperatively with the DOE Office of Biomass Programs (OBP) to facilitate the increased use of bioenergy and biobased products through coordinated federal, regional, and state outreach, education and technical assistance programs.

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[1] 1 megawatt (MW) = 1,000 kilowatts (kW)