

Biopower Program

TECHNOLOGY OVERVIEW

Biomass – a general term for all of the Earth's plant and animal matter – has special meaning in the renewable energy industry. There, it usually refers to: (1) agricultural residues and byproducts, such as straw, sugarcane fiber, and rice hulls, (2) residues from forestry, construction, and other wood processing industries, and (3) energy crops grown specifically to be used as fuel, such as fast-growing trees.

Because plants use sunlight to grow, biomass energy is actually a form of stored solar energy. Biomass energy can be converted to electricity in two ways:

Direct combustion involves burning the biomass in a boiler to heat water, then running the resulting steam through a turbine – the same process used in conventional coal-fired plants. Virtually all biomass electric plants today use conventional boilers and steam turbines.

Gasification involves converting the solid biomass to a gas that can then be burned in

a combustion turbine, used in a fuel cell, or converted to a variety of products – all potentially much more efficient, but still in the demonstration stage of development.

Biomass can also be cofired with coal, displacing up to 15% of the coal feedstock. For power companies with existing coal-fired capacity, cofiring biomass with coal represents a relatively low-cost option for renewable generation.

U.S. DEPARTMENT OF ENERGY PROGRAM

The U.S. Department of Energy (DOE) works with industry and other partners through the Biopower Program to develop and validate renewable, biomass-based electrical generation systems. Current program priorities include demonstrating new technologies for biomass gasification; cofiring biomass with fossil fuels; and small, modular biopower systems.

Biomass gasifiers can potentially double the average efficiency of the current biopower industry, typically about 20%. Biomass cofiring may represent an opportunity for both consumers and power companies; some customers have indicated a willingness to support green pricing and renewable energy programs, and power generators are attracted to biomass because it represents an often economical supply of locally available renewable energy. Small systems could reach many of the two billion people in the world who have no electricity, because biomass is generally plentiful in developing countries.

All of these systems are capable of providing substantial economic and environmental benefits to the nation. Collaborative partnerships between DOE and the private sector will facilitate the commercialization of a range of small- to large-scale biomass-powered systems.

In concert with this mission, the program is working to enhance economic development

opportunities by providing an array of coproducts – electricity, fuels, and chemicals – through the integration of biomass power with high-yielding agricultural systems while encouraging the highest standards of stewardship of air, water, and soil resources.

The Biopower Program envisions biomass becoming a major cost-competitive contributor to power supplies in both domestic and international markets through the integration of efficient biomass power production with dedicated feedstocks from sustainable farms and forests.

Specific program goals for the next decade include:

- Facilitating the commercialization and widespread availability of economic and environmentally acceptable biomass fuels for power plants.
- Facilitating the commercialization of advanced and high-efficiency biomass power generation technologies.

Warren Gretz, NREL/PIX00308



Most agricultural wastes can be used to generate electricity, including the mountains of fibrous material left over from processing sugarcane crops such as this one in Hawaii.

BIOPOWER PROGRAM

Gasification: Wave of the Future

The biomass gasification process developed by Batelle Columbus Laboratories – being commercialized by Future Energy Research Corp.

(FERCO) – received an R&D 100 Award in 1998, honoring it as one of the 100 most significant technological achievements of the year. The technology is being demonstrated at a new biomass gasification plant in Burlington, Vermont. Located at the McNeil Generating Station, the plant runs on residues from sawmill operations and forestry improvements. It mixes wood with sand heated to 1800°F, which causes the carbon, hydrogen, and oxygen in the biomass to form combustible gases. FERCO plans to market the technology worldwide.



Warren Grez, NREL/PIX04736

Gasifiers can use almost any type of biomass material, including wood chips, sawdust, agricultural residues, and a variety of crops grown specifically to produce energy. The McNeil gasifier, pictured here, can convert up to 200 tons of biomass per day into a clean-burning fuel for power generation. At capacity, the gasifier produces 12 MW of electricity.

MARKET POTENTIAL

Biomass is the fourth largest contributor to the world energy economy, after coal, oil, and natural gas. Virtually every part of the globe has a biomass resource that can be tapped to create electricity. Unfortunately, most biomass is currently used very inefficiently.

Biomass has always been used to generate power and heat in the forest products industry, but its widespread use for supplying electricity to the U.S. power grid is a relatively recent phenomenon. Today, independent biomass power generators supply 11 billion kilowatt-hours per year (kWh/yr) to the national electricity grid and, in the process, provide an environmentally superior disposal service for 22 million tons/yr of solid residue.

Small, modular biopower systems – those with rated capacities of five megawatts or less – could provide village power to many parts of the developing world. Small biomass systems also have great potential in industrialized regions of the world in distributed power applications. These applications consist of generating systems located on the transmission and distribution grid close to where the consumer uses electricity. Distributed applications have large potential markets both inside the United States and abroad. Compared to the small, fossil-fuel-powered systems that dominate today's markets, biomass can provide a more environmentally acceptable alternative. Furthermore, successful commercialization of small biopower systems completes the development of a biopower industry covering all ranges of expected power applications.

For More Information:

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