Bioenergy

FACT SHEET 5.5

INTRODUCTION

Renewable energy is any energy generated from the sun, wind, water, hydrogen, Earth's natural heat (geothermal), or biomass. In 2003, biomass was the leading source of renewable energy in the United States for the fourth year in a row, providing roughly 850 million MWh (megawatt hour) of the roughly 20.5 billion MWh of energy produced. Biological feedstocks accounted for nearly half of the renewable energy, making up about 4 percent of the total energy produced in the United States[1].

What is a BTU?

A British Thermal Unit (BTU) is the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit.

Bioenergy is any energy created from a renewable biological resource. Woody biomass, in particular mill residue, is the most common resource used for generating bioenergy in the form of electricity as well as industrial process heat and steam. Wood can also be used to produce bioenergy in the form of liquid transportation fuels. However, currently agricultural residues are the preferred feedstock.

Technological conversion advances, along with adequate supply, make woody biomass feedstocks for transportation fuels and electricity more appealing. With new emissions standards, carbon credits on the horizon, tax incentives, and consumer demand for "green energy," more and more producers are looking to use biomass-powered systems.

TYPES OF WOOD-BASED BIOENERGY

Woody biomass can be used to create space heat and process heat, electricity, and a combination of both heat and power through a process called cogeneration. Space heat is typically generated from split fuel wood, pellet, or chip combustion. Electricity and the mix of electricity and heat produced from cogeneration are generated through processes such as gasification. A methane rich gas or "biogas" is also created when biomass is "digested" in oxygen excluding containers.

Interest in and use of biobased liquid transportation fuels such as ethanol, methanol, and biodiesel, are increasing rapidly as oil prices increase. Currently, most of the ethanol and biodiesel generated in the United States comes from food-based feedstocks (i.e. corn, soybean, etc.). However, neither ethanol nor biodiesel could replace petroleum without impacting food supplies[2]. Woody biomass can be put through a process called liquefaction (Please see Fact Sheet 5.4 Technological Processes: Thermochemical for more information) to create bio-oil and through biological fermentation processes to create liquid fuels such as ethanol, methanol, and bio-diesel. Ethanol and biodiesel can be used directly or blended with gasoline and diesel to fuel motor vehicles. Cellulose-based ethanol can also be used as a fuel additive to oxygenate gasoline in summer months. For more information on ethanol and biodiesel, please refer to Fact Sheet 5.7 covering ethanol and Fact Sheet 5.8 covering biodiesel.

Ashton, S.; P. Cassidy. 2007. Bioenergy. Pages 179–182.
In: Hubbard, W.; L. Biles; C. Mayfield; S. Ashton (Eds.). 2007. Sustainable Forestry for Bioenergy and Bio-based Products: Trainers Curriculum Notebook. Athens, GA: Southern Forest Research Partnership, Inc.

WHO USES BIOENERGY?

Energy production from biomass is a promising option with the largest potential impact occurring in developing countries, where the current level of energy services and availability are low or non-existent. Biomass currently accounts for about one-third of all energy consumed in developing countries as a whole and nearly 90 percent in some of the least developed countries. More than two billion persons depend on biomass energy for cooking and heating[3].

Currently, consumption of biomass-generated energy is dominated by industry. The pulp and paper industries, solely using black liquor, produce and consume about 320 million MWh of biomass-generated energy. Schools, prisons, and hospitals have recently started using wood to produce energy at the local level. The residential sector consumed 973,000 MWh of energy in 2004. Other sectors are using bioenergy on a variety of scales from 1 MWh up to 15 MWh per hour[4].

What is a MWh?

One MegaWatt Hour will power approximately 850 homes for one hour.

Residential. In the U.S., individual households are the largest consumers of wood fuel. For the most part, wood is burned in fireplaces for aesthetics rather than necessity. Some households have wood or wood pellet furnaces for heat. Additionally, some furnaces burn chips or sawdust.

Energy Talk: What do they mean when they say micro, small, medium, or large-scale production of bioenergy?

- **Micro** — less than 1 MWh (3.4 million Btu/h)
  Micro scale use of bioenergy consists of single residences, small institutions, and sometimes whole villages in developing countries.
- **Small** — 1 to 5 MWh (3.41 to 17.1 million Btu/h)
  Small scale use of bioenergy is in place at small institutions and small forest products manufacturing plants.
- **Medium** — 5 to 15 MWh (17.1 to 51.2 million Btu/h)
  Medium scale use of bioenergy is in place at a few small to medium sized institutions and forest products manufacturing plants.
- **Large** — Greater than 15 MWh (51.2 million Btu/h)
  Large scale use of energy from woody biomass is in place at large forest products manufacturing plants, large institutions, and biomass fueled power plants.

Commercial. In the U.S., public institutions such as schools, hospitals, prisons, etc. use wood for central heating. Modern wood heating systems cool as well through an evaporative process that absorbs heat.

Industrial. Although not as common in the U.S. as in other countries, wood fuel is used to heat brick and lime kilns. In addition, forest products manufacturing facilities and some power plants use woody biomass for energy production.

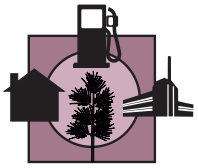
ADVANTAGES OF USING BIOENERGY

Environmental. There are several environmental benefits to using woody biomass as opposed to using petroleum-based fuels for energy. The first benefit is that wood is a renewable resource and it is sustainable if managed correctly. The second is low carbon emissions. Woody biomass, during combustion, produces very little carbon dioxide, a major greenhouse gas. Third, fuel derived from woody biomass contains very little heavy metals, particularly sulfur. Sulfur dioxide is a major source of soil and water acidification. It also poses a threat to human health. Finally, combustion of woody biomass results in very little particulates, including ash. Wood ash is typically less than 1 percent of the weight of the wood and can be used for fertilizer.

Economic. Given the right conditions, wood-burning systems are less expensive than fossil fuel burning systems. The major variables include proximity of fuel source to the processing plant, type of fuel used, and other site and region specific factors such as condition and contour of roads. Because woody biomass has a low energy density compared to other fuels, transportation costs need to be minimized. Wood is least expensive when there is a surplus at forest products manufacturing plants and municipal solid-waste handling facilities. Wood is most expensive when a dependable or consistent supply is not available.

Social and Security. Woody biomass energy delivers unique and valuable social benefits as well. For example, producing and using wood-based fuels will reduce the nation's demand for imported fossil fuels. Moreover, since woody biomass can be grown and processed locally, the use of this renewable, sustainable resource is much more likely to be socially acceptable than the use of non-renewable resources.

Bioenergy from woody biomass is a viable alternative to energy currently generated from petroleum-based feedstocks. Companies that have ready access to biomass resources, at relatively low costs, often choose to mix traditional fossil fuels with biomass through a process known as co-firing to enhance their competitiveness in the marketplace. It makes sense, not only environmentally and economically, but also socially. At this time, woody biomass is used to generate bioenergy in the form of heat and steam, and electricity, as well as liquid transportation fuels on a relatively small-scale. Technological and political advancements will support the large-scale production, utilization, and consumption bioenergy from woody biomass.



SUMMARY AND CONCLUSIONS

Woody biomass is an important supplier of the world's bioenergy. Currently, mill residue, a byproduct of woody biomass, is the most common biological resource used for generating bioenergy in the form of electricity as well as industrial process heat and steam. Fuelwood or firewood is the most common biological resource used in developing countries to generate bioenergy for in-home heating and cooking. In addition, technological conversion advances, along with adequate supply, make the utilization of woody biomass feedstocks for transportation fuels increasingly attractive. With new emissions standards, carbon credits on the horizon, tax incentives, and consumer demand for "green energy," more and more biomass-powered systems are gaining popularity.

For more information, please refer to the Encyclopedia of Southern Bioenergy at http://www.forestencyclopedia.com/Encyclopedia/bioenergy.

ENDNOTES

1 DOE Energy Information Administration. 2005. Annual Review 2004. Washington D.C., 397 p.

2 Hill, J.; Nelson, E.; Tilman, D.; Polasky, S.; Tiffany, D. 2006. Environmental, economic, and energetic costs and benefits of biodiesel and ethanol biofuels. Proceedings of the National Academy of Sciences of the United States of America. 103(3): 11206–11210.

3 Kartha, S.; Larson, E.D. 2000. Bioenergy primer: Modernised biomass energy for sustainable development. Arhus, Denmark: Phonix Trykkereit.

4 Zerbe, J.I. 2006. Thermal energy, electricity and transportation fuels from wood. Forest Products Journal. 56(1).