

Biomass Fact Sheet

Harvard Green Campus Initiative

What is Biomass?

Biomass is the burning of biological products, such as wood and plants to produce heat, electricity, and hot water.

Biomass energy can also be derived from:

- Wastes (agriculture waste, logging residues, paper industry wastes, building wastes, or trash);
- Standing forests (pre-commercial thinnings, imperfect commercial trees, and dead or dying trees); and
- Energy crops (biofuels and fast growing trees and grasses such as miscanthus, switchgrass, hemp, corn, poplar, willow, and sugarcane).

Biomass, in the form of firewood, has been used throughout human history, but its prevalence as a heat source declined when fossil fuel prices dropped. Recently, biomass has been considered anew due to improvements in biomass burning technology and the problems associated with fossil fuel use. Biomass currently produces 1-2% of the U.S.'s electricity.

Most biomass technology involves direct burning of the biomass to produce energy. Other technologies include:

- Cofiring: biomass is added to traditional fuel sources, such as coal and burned jointly;
- Burning of landfill gases (methane and carbon dioxide) or gas from wastewater treatment plants;
- Biomass gasification: biomass is heated in the absence of oxygen to produce synthetic gas, which is burned;
- Liquid pyrolysis: biomass is liquefied in the absence of oxygen and burned; or
- Cogeneration: biomass is burned to produce heat and electricity.

Sustainability

Renewable Source of Energy

Plants utilize solar energy to absorb carbon dioxide and create sugars via photosynthesis. Burning the resultant biomass returns the CO₂ that was absorbed as the plants grew back into the atmosphere and releases the stored energy. **Because of this fact, biomass is commonly said to be carbon neutral (having no net release of CO₂), if the cycle of growth and harvest is sustained.** This is not always true, as it takes some energy and therefore a discharge of CO₂ to grow, harvest, and transport the biomass for use as a fuel source, but the net release of CO₂ is much less than for traditional fossil fuels.

Forest Stewardship Council (FSC)

An ideal situation would be to use FSC-certified forests as a source for biomass fuel to ensure that sustainable forestry methods are used. All Massachusetts state-owned forests have been FSC certified, and the forest waste from these lands is abundant (up to 4 million tons annually).



Emissions

Emissions from biomass burning are less than or equal to coal for all pollutants and less than #6 oil for NO_x, SO₂, and CO₂ when sequestration is taken into consideration. Biomass releases less CO₂ than natural gas, but has higher emissions for other pollutants. Biomass gasification has lower emissions than direct biomass combustion.

Other Environmental Issues

Creating energy crop farms for biomass is beneficial in that many fast growing trees help stabilize the soil and prevent erosion. One downside is that biodiversity is lost if monoculture farms are created. Thinning forests for fuel is beneficial in preventing forest fires. Unlike coal ash which is toxic, biomass ash is benign and can be used as a soil amendment. Consideration of these and other factors should be taken when choosing a biomass fuel source.

Other Benefits

Biomass is locally available, is in continuous supply, and does not contribute to national security issues. Using biomass supports local industries and the local economy. Biomass provides reliable energy output, as opposed to solar and wind energy, which are intermittently productive.

Storage and Supply

Forests

New England's biomass supply generally comes from chipped wood leftovers from sawmills, excess harvested wood, waste from manufacturing, or wood pellets. MA state forests are FSC certified and currently underutilized, making them a good source of biomass fuel. In general, 1.5 tons of wood/hour are needed for each megawatt hour of power generated. Storage for wood chips or pellets would require about 12' by 12' for every 100,000 sq. ft. that is heated.



Pellets

Wood pellets are an ideal energy source for buildings that do not have much storage area. Wood pellets are:

- Made from low grade waste wood (sawdust shavings)
- Consistent size, shape, and weight
- Energy dense (most moisture is removed)
- Efficient: 98.5% combustion
- 1 ton pellets = 1.5 cords of wood
- Low ash
- Manufactured and may not be carbon neutral unless the processing plant uses biomass for energy.



Photo Credit: Wood Pellets Institute

Wood Pellets

For more information, read the [Wood Pellet Heating Guidebook](#) by the Massachusetts Division of Energy Resources.

Funding and Costs

Biomass is a cheaper fuel source than other energy options; in the Northeast, oil and gas cost 2 - 2.5 times as much as wood chips and wood is 8 - 10 times cheaper than electric heat. Biomass costs have been stable over the past 20 years, in part because they are not linked to global instability or corporate monopolies. Future energy taxes are less likely to impact biomass than other fuels.

The Wood Fueled Boiler Financial Feasibility Analysis is a [downloadable Excel spreadsheet](#) that compares the costs of wood to other fuels to determine whether biomass is a cost-effective option for a particular project.

MA Sustainable Forest Bioenergy Initiative



The state of Massachusetts is working to promote biomass as a renewable energy resource in Massachusetts due to the state's 3 million acres of underutilized forestland and other large sources of wood. The [MA Sustainable Forest Bioenergy Initiative](#) was set up to facilitate the development of biomass energy projects and fuel supply infrastructure in the state.

Early studies have found that as much as 4 million tons of woody biomass could be produced annually in Massachusetts, mostly from forests and forest products industries. Using half of that would create about 200 MW of renewable energy!

Case Studies

Middlebury College

Middlebury College is constructing an on-site biomass plant that will reduce their greenhouse gas emissions by 12,500 metric tons annually. The wood chip-fired biomass plant will replace one million gallons of #6 fuel oil per year, Middlebury's previous fuel source. The plant will cost \$11 million and is funded by loans and state grants. Construction was slated to begin in spring 2007 and should be completed in fall 2008. Middlebury estimates that the plant will consume 20,000-21,000 tons of wood chips each year. The gasification system is made by Chiptech, Inc. Middlebury is also planting a 10 acre test plot of willow shrubs to trial as a fuel source.

Mount Wachusett Community College

In 2002, Mount Wachusett Community College in Gardner, MA converted a 3.3 MW electric resistance heating system to a 2.4 MW biomass hydronic system that utilizes wood chip fuel from sawmill residue. The system cut annual heating costs from nearly half a million dollars for electric heat to just \$31,000 for the woodchips. The system heats 450,000 square feet.

The College anticipates that the \$1.86 million conversion, after grants and rebates (\$4.4 million before grants and rebates), will pay for itself within 10 years. They estimate that the conversion to biomass has saved the average student about \$400 a year in fees that would otherwise have increased to help pay for the rising price of electricity. The conversion has also resulted in a 24% reduction in greenhouse gases in the first 4 years. Chip storage is 85 tons and the college uses 800 to 1,200 tons annually. Mt. Wachusett has also installed a pilot 75 kW combined heat and power unit to produce heat and electricity using biomass as a fuel source.

Interested in Using Biomass?

Contact HGCI for more information or assistance

617-496-4678

