Why use biomass for heating?

BTEC
Biomass Thermal Energy Council

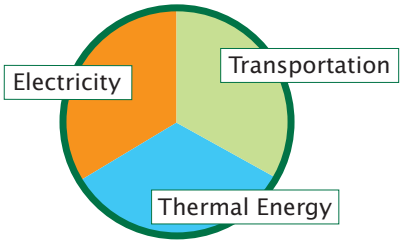
There are numerous benefits to using biomass instead of fossil fuels like oil, coal, and gas for providing heat for homes, commercial users, and industrial processes.

For the majority of human history, biomass was the fuel of choice for producing thermal energy (heat). Whether for space heating, cooking, or manufacturing, we have long used biomass resources to meet energy demands. However, with the Industrial Revolution came the rise of fossil fuels and the corresponding decline of biomass as an energy source. Now, biomass is regaining attention for its role as a reliable source of renewable heat.

In addition to utilizing a locally available renewable energy resource, the use of biomass for thermal energy meets many contemporary environmental and economic goals. Biomass heating and combined heat and power (CHP) can stimulate regional economies, create jobs, offset fossil fuel imports, and promote the sustainable use of our natural resources.

The types of biomass most commonly used for energy include waste wood from the timber and wood products industries, as well as agricultural residues. These fuels can either be directly combusted, or they can undergo a variety of refining processes such as chipping or pelletization for use in a variety of applications. Through combustion, the chemical energy locked in these fuels is efficiently converted to thermal energy (heat) that can be used for space, water, and industrial process heating.

Thermal energy is used daily by homes, businesses, and industrial facilities across the country. These thermal energy demands account for roughly one-third of the total energy consumption in the United States, and are mostly being met with fossil fuels[1]. As a widely available sustainable source of renewable energy, biomass is uniquely poised to meet these heating needs while at the same time displacing fossil fuels.



U.S. Energy Consumption

Biomass: Abundant and Diverse

The Energy Information Administration estimates there are currently 419 million dry tons of biomass available annually for energy use in the United States[1]. The abundance of biomass feedstocks in the United States means that biomass fuels can be harvested and delivered locally in most regions. Currently, biomass for heating accounts for 32% of the renewable energy consumed in the United States, and nearly all of the renewable energy consumed in the residential, commercial, and industrial sectors.

Biomass heating can be achieved with a wide variety of fuels. Woody biomass in the form of chips or pellets is the most common type of fuel. However, agricultural residues, herbaceous crops, municipal waste, and potentially algae can also be utilized.

The applications of biomass thermal energy are just as diverse. Whether to heat homes in the Northeast, commercial buildings in the Pacific Northwest, or factories in the Great Plains, biomass is used to meet thermal needs across the country.

The Advantages of Using Biomass for Heating

Highly Efficient

Using biomass to produce electricity or serve as transportation fuel requires a series of conversion processes, all of which are subject to energy loss. The final result is that the overall efficiency of these end uses is often quite low. The conversion process of distilling 100 BTUs of corn ethanol requires an input of 60 BTUs of energy[2]. Electricity production requires that the thermal energy from combustion be converted first to mechanical energy, and then to electrical energy, with the majority of the potential energy being lost along the way. On the other hand, biomass for heating can be upwards of 85% efficient[3], allowing for the user to utilize the majority of energy stored in the fuel.

Scalable

In addition to being efficient, biomass thermal is a very scaleable technology. Pellet stoves can be used to heat single homes, while biomass boilers can provide space and water heating for commercial buildings, institutions, or even entire communities. Biomass is also well suited to combined heat and power (CHP); a process in which the waste heat created from electricity generation is utilized for thermal applications like industrial process heat. The CHP process can greatly increase the efficiency of the operation.

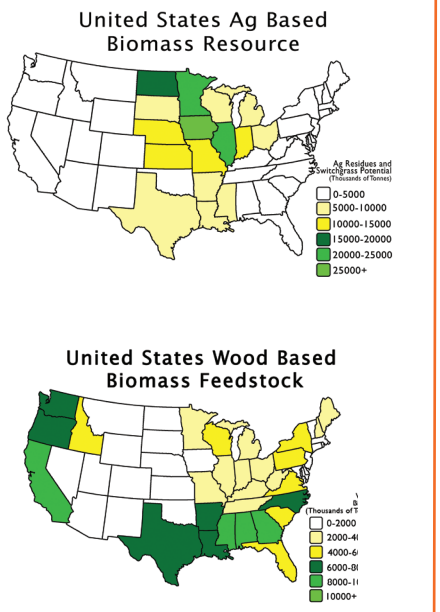


Figure 1. Regional biomass fuel sources with in the United States.
(Source: NREL A Geographic Perspective on the Current Biomass Resource Availability in the United States)

Utilizes Byproducts and Waste Streams

One common characteristic that most biomass fuels share is that they are derived from the waste stream and residuals of other local industries. Materials are often sourced from by-products of lumber mills, furniture producers, or logging sites. Use of these byproducts can create the dual effect of providing revenue to these industries while also securing a renewable source of fuel for thermal energy needs.

A Renewable Baseload

It is important to note that biomass is currently one of the few types of renewable energy that is dispatchable; meaning that it can be stored and used when needed. Solar energy, for instance, is not available when the sun is not shining, often when the demand for heat is higher. Biomass, however, fulfills the heating needs for homes as well as industries at all times.

Creates Local Jobs and Economic Development

The supply chain necessary to produce

[1] EIA Renewable Energy Annual (2008). Renewable Energy Consumption for Nonelectric Use by Energy Use Sector and Energy Source.
[2] USDA, (2002). The Energy Balance of Corn Ethanol: An Update.
[3] US DOE, (2010). Energy Efficiency and Renewable Energy: Wood and Pellet Heating.

biomass fuel involves: transporters, loggers, farmers, pellet mill operators, vendors, and others. All of these participants are typically located within a radius of less than 200 miles[4]. The consumer's purchase of biomass fuel supports the entire biomass supply chain, with fuel dollars circulating locally. Furthermore, the use of biomass fuel creates an additional market for forest products, giving an incentive to maintain forestlands. This leads to forestry jobs, prevents sprawl, and increases land values of timberland.

Reduces Fuel Costs

In the future, a number of factors will likely contribute to price shocks and increased cost of conventional heating fuels such as carbon legislation, further reaching renewable portfolio standards, and inherent supply/demand relationships of these finite resources. However, biomass is more resiliant against these problems and will retain a more stable fuel price in the future. Paying $200 for a ton of wood pellets is equivalent to paying $1.67 per gallon of heating oil[5]. With the 2010 residential heating oil cost of $2.97 per gallon and a projected 2012 cost of $3.55[6], the savings can be substantial. The Northeastern United States—an area which is heavily reliant upon high cost heating oil—is especially well suited to find deep savings in converting to biomass heating.

Wind, solar, and biomass are experiencing strong market growth, but of these renewable energy sources, only biomass can be used to efficiently produce both heat and power.

– EPA CHP Partnership

Case Study: Lower Cost Heating for Schools

While the initial capital investment in biomass heating systems is often greater than fossil-fuel based alternatives, the lower cost of fuel can hasten the payback period. In recent years schools across the country, from the Northeast (where 30% of schools in Vermont are heated by wood[7]) to the Mountain West, are experiencing firsthand the benefits and savings that switching to locally sourced biomass can create.

Case Study: Reducing Heating Oil Consumption in the Northeastern U.S.

Currently, 6.4 million residents in the Northeast rely on fuel oil to heat their homes[8]. This oil is derived from petroleum, which means that it is vulnerable to the same types of price fluctuations that are experienced at the gas pump. The local sourcing of biomass fuel will prevent the flow of capital out of local economies; 78 cents of every dollar spent on heating oil leaves the regional economy[9].

Under these circumstances, switching to regionally sourced biomass for heating would have a substantial impact in terms of job growth and economic development.

Reducing Heating Oil Consumption in the Northeastern U.S.

- $4.5 billion new dollars per year injected into the regional economy
- 140,000 permanent jobs created
- $1.6 billion dollars retained annually within the economy

Source: *Heating the Northeast with Renewable Biomass: A Bold Vision for 2025*. Scenario: Steady increase in the use of renewable energy for heating until 25% is reached, 75% of which is achieved with biomass.

One study found that shifting roughly 18.5% of Northeastern thermal energy demand to biomass by 2025 would inject $4.5 billion annually into the regional economy, retain $1.6 billion dollars, and create 140,000 permanent jobs[9].

Conclusion

Biomass heating and combined heat and power can stimulate economies, create jobs, offset imported fossil fuels, and promote the sustainable use of natural resources. Thermal energy is the most efficient energy pathway for biomass compared to electricity generation or transportation fuel. With the fossil fuel dominated thermal energy sector comprising about 1/3 of the energy use in the United States, biomass can meet the challenge of moving to a sustainable energy future by directly displacing the use these fuels.

Many European nations are already realizing the full potential of biomass heating with the support of a robust framework of incentives, regulations, and education. The abundant and diverse sources of biomass in the United States ensure that all regions of this country can utilize this sustainable resource for our thermal energy needs as well.

Lower Cost Heating for Schools

School	Switch	Savings
Council, Idaho Public Schools	Electric heating system and diesel boiler to a wood chip heating system	$50,000 annually
Leavitt Area High School, Maine	Fuel oil boiler to a woodchip system with a backup oil boiler	$53,000 for the 2006-07 school year
Darby, Montana Public Schools	Three individual oil boilers for a woodchip system	$200,000 for the 2008-2009 school year
Townsend, Montana Public Schools	Two oil boilers for a wood pellet system	Projected $25,000 annually, $12,400 payment collection for carbon offsetting

Source: Biomass Energy at Work: Case Studies of Community-Scale Systems in the US, Canada &Europe. BERC

WERC
Wood Education and Resource Center

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This fact sheet is available online at www.biomassthermal.org.

[4] University of Wisconsin, (2006). Heating Fuels Lifecycle Assessment.
[5] Biomass Energy Resource Center, (2007). Wood Pellet Heating.
[6] EIA, (2011). Short-Term Energy Outlook
[7] Frederick, P. (2007). Woody Fuel Survey Results for the 2006-2007 Heating Season. *Vermont Department of Forests, Parks, and Recreation.*
[8] Census.gov, (2010). American Community Survey.
[9] BTEC, (2010).Heating the Northeast with Renewable Biomass: A Bold Vision for 2025