PERC Case Studies

# Vermont Schools The Nation

## In Woody Biomass Heating

*By Steven Bick*

*Edited by Laura Huggins*

Discussions of renewable energy typically focus on technologies such as solar panels, wind power, and geothermal. In one state, however, a different conversation is taking shape—one that is focusing on refining an age-old source of renewable energy: wood.

The use of wood as an energy source was largely displaced by fossil fuels in the late 19th century and is missing from most discussions of renewable energy; that is, unless you are in Vermont. With its abundance of forests and sawmills, Vermont has long been the nation's leading user of wood—or, more precisely, woody biomass—for heating. Other parts of the country are beginning to follow suit.

## WOOD FOR ENERGY

Woody biomass is the residual material created during forest management and the subsequent supply chain. This includes whole trees removed to improve forest stands, portions of trees that are not suitable for higher-value products, and the sawdust and chips created in the production process. Up to half of the wood that enters a sawmill will become a residual that can be put to use as woody biomass.

Fuel for wood heating is a renewable resource and, under the right circumstances, can be local and sustainable. Moreover, as Vermont demonstrates, wood heat is not limited to home fireplaces. Recent advancements in this ancient technology are making wood a viable energy source for larger facilities.

## THE VERMONT STORY

In Vermont, wood is competitive with other energy sources. As the second least populous state, the vast majority of Vermont's land area is forest (Wharton et al. 2003). Most of this forest is also privately owned and sustains a vibrant timber industry.

With plentiful wood comes an abundance of sawmills and, in turn, loads of residual woody biomass. Just as enterprising sawmill operators have utilized residual wood to heat their mills, Vermont has encouraged the use of the state's woody biomass as a heat source in schools and other public facilities. Indeed, the state is currently home to nearly half of the facilities in the United States using woody biomass for heat.

In 1985, a few schools in Vermont began heating with wood chips. At the time, state aid to local schools covered 30 percent of capital project costs and the Vermont Department of Public Service provided technical assistance in weighing the costs and benefits of wood energy. The

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state believed the subsidies were necessary as the initial costs of biomass heating are significantly higher than those of oil and gas heating systems, but it could see that in the long run the annual cost-savings would provide substantial savings to taxpayers. Veteran Vermont energy analyst Jeff Forward found this to be true even if the schools had to pay the entire capital costs themselves.

A second round of biomass heating conversions occurred over the past decade, driven by the rising cost of heating oil. Even some private companies are now heating with woody biomass. National Life Group insurance company in Montpelier has the largest commercial building in the state. It switched to woody biomass heating in 2010, hoping to meet 90 percent of its heating needs with wood. Today, National Life Group is exceeding this goal—at times meeting 98 percent of their heating needs. In its first season, the company reportedly saved $400,000 in fuel costs.

## FUEL & CONVERSION COSTS

In order to be a viable alternative to conventional fuels, woody

**"A century ago, and for about 400,000 years before that, most people burned wood to stay warm.** Then the arrival of oil- and gas-fired central boilers and furnaces liberated them from the toil, mess and smoke…. Wood heating isn't what it used to be. It's now clean, efficient and, in the right stove, high-tech."

—Logan Ward, *Popular Mechanics*

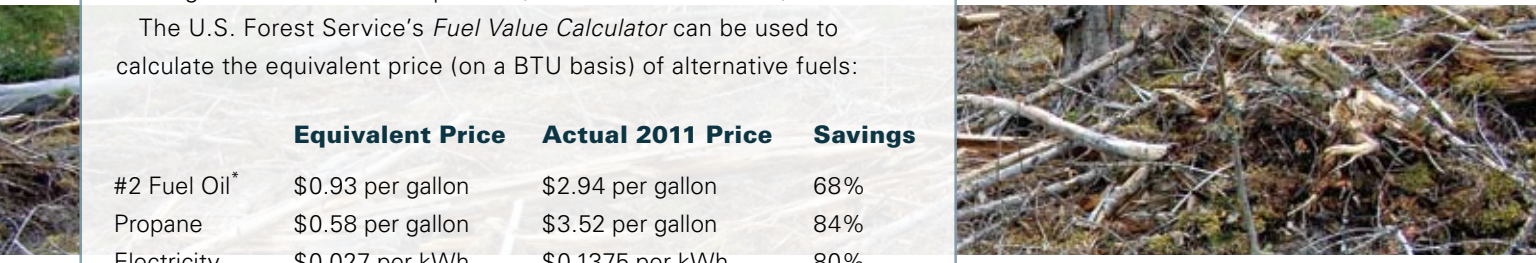
## FUEL COMPARISON

Average price paid for wood chips by Vermont schools in the 2011 heating season was $56.42 per ton (40% moisture content).

The U.S. Forest Service's *Fuel Value Calculator* can be used to calculate the equivalent price (on a BTU basis) of alternative fuels:

| | Equivalent Price | Actual 2011 Price | Savings |
|---|---|---|---|
| #2 Fuel Oil* | $0.93 per gallon | $2.94 per gallon | 68% |
| Propane | $0.58 per gallon | $3.52 per gallon | 84% |
| Electricity | $0.027 per kWh | $0.1375 per kWh | 80% |
| Natural Gas | $0.67 per therm | $1.17 per therm | 43% |

*Fossil fuel prices referenced from U.S. Energy Information Administration website



In order to be a viable alternative to conventional fuels, woody biomass must be cost competitive.

biomass must be cost competitive. Vermont schools paid an average price of $56.42 per ton for wood chips in 2011. Comparing this price on a BTU basis to the going rates in 2011 for fuel oil, electricity, and propane reveals that wood chips cost 62, 76, and 80 percent less, respectively. Natural gas is more competitive, costing only 31 percent more than wood, but there is limited availability of natural gas in Vermont and in rural areas around the country.

Although wood is less expensive than conventional fuels, there are costs involved. Wood chip boiler systems, for example, are more expensive to install than comparable oil or gas systems. Wood systems are often built as stand-alone buildings and require significant storage and unloading space. Wood is not energy dense, so it takes large amounts to supply the necessary heat. Finally, the infrastructure necessary for the delivery of wood-heating fuels is less developed than for other heating fuels (Berry 2009). These hurdles, however, have provided an entrepreneurial opportunity for some forest products companies who seek to capitalize on the state's supply of woody biomass.

## MARKETS FOR FOREST ENTREPRENEURS

The abundance of wood sparked the idea of using it in large-scale heating systems, but it is the people who harvest and deliver it who make it cost effective. Wood suppliers have become better customer service providers by addressing chip quality, delivery schedules, and storage issues. Heating markets need a

better quality chip (less bark, dirt, and stick content) than electrical facilities, and with limited storage space and varying demands, deliveries must be dependable.

Lathrop Forest Products in Middlebury, Vermont, is one of the companies meeting the supply challenge. Formerly a sawmill, their log supply was severely curtailed as less harvesting was done on the Green Mountain National Forest. Jim Lathrop developed a chipping and screening factory that produces high-quality fuel chips. Lathrop stockpiles roundwood in advance of the winter heating season and chips it as needed. He supplies ten schools, in addition to other facilities, with woody biomass. With his customers' storage space limited, he stores the woody biomass on his site.

Bennington College added a new wood boiler system in 2008, with the goal of meeting 85 percent of its heating needs for 60 buildings. Their original supplier could not provide the chip quality or quantity the college needed. Sam Hull and Mike Fahey were brought in as suppliers and quickly solved the problem by purchasing a warehouse nearby. A large supply of wood chips is now available at the college's disposal. This guaranteed supply allows the college to produce even more wood heat than they anticipated and has shortened the payback period on the heating system.

## REPLICATING VERMONT

Regions of the country similar to Vermont—with cold climates, high heating costs, and abundant wood supplies—are experiencing similar success with woody biomass. During a tour of biomass heating facilities in Vermont, school officials from Montana recognized the potential benefits of adopting a comparable strategy for their schools. In 2003, Darby became the first Montana town to heat its schools with woody biomass.

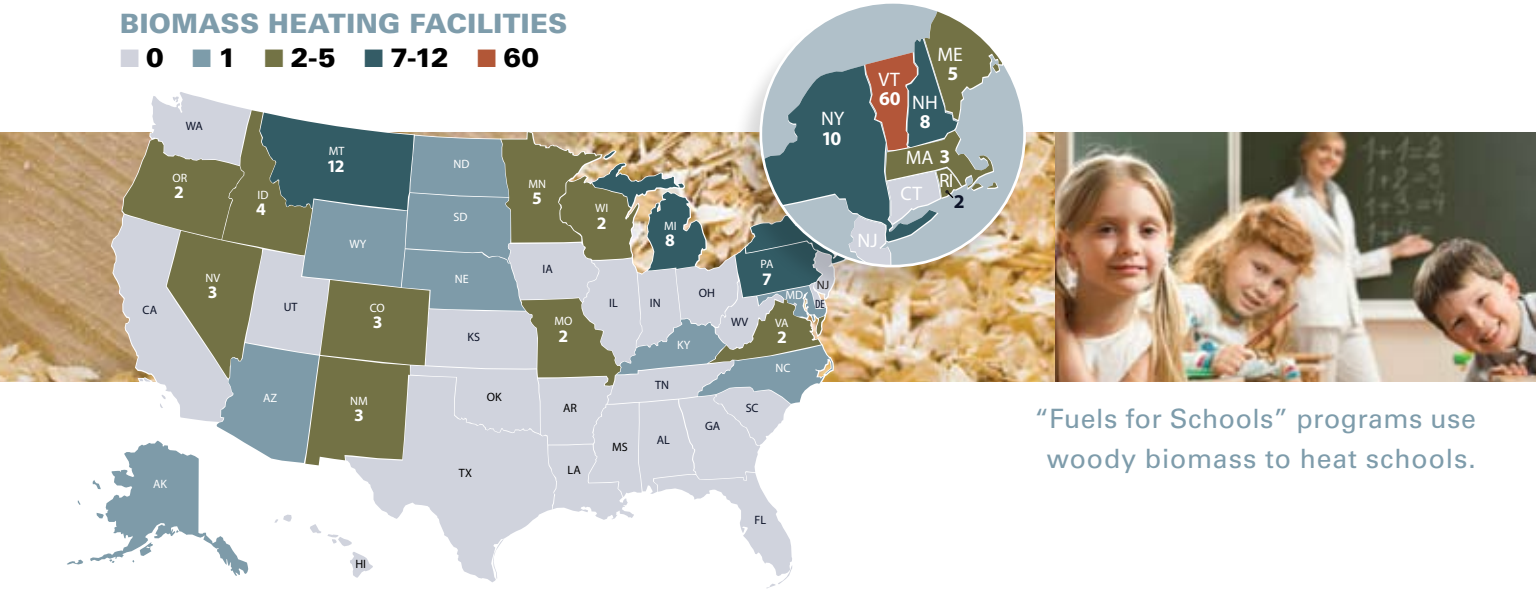
### BIOMASS RESOURCES

BERC – Biomass Energy Resource Center, Montpelier, VT

BERC is an independent, national nonprofit organization that assists communities, colleges and universities, state and local governments, businesses, utilities, schools, and others in making the most of their local biomass energy resources.

BTEC - Biomass Thermal Energy Council, Washington, DC

BTEC is an association of biomass fuel producers, appliance manufacturers and distributors, supply chain companies, and nonprofit organizations that view biomass thermal energy as a renewable, responsible, clean, and energy-efficient pathway to meeting America's energy needs. BTEC engages in research, education, and public advocacy for the fast growing biomass thermal energy industry.






"Fuels for Schools" programs use woody biomass to heat schools.

Since then, states including Montana, Nevada, North Dakota, and Wyoming have developed "Fuels for Schools" programs. These programs take fuels for wildfire out of the woods and use the biomass to heat schools (McElroy 2007).

In addition to public schools and colleges, a wide range of other facilities across the nation are beginning to use woody biomass for heat. Lockheed Martin Corporation converted its 1.6 million square foot facility in Owego, New York, to woody biomass heating in 2008. Using wood residue from the nearby Wagner Lumber Company, along with supplemental hydropower from a local stream, its heating and cooling bills have been reduced by half. The $5.5 million project is expected to pay for itself in four years.

## EMISSION ISSUES

Despite a revival of using woody biomass for heat, there are still some considerable obstacles. Some critics claim that using wood for energy is a bad option due to emissions, but they fail to recognize that over time burning biomass for energy can lead to lower atmospheric greenhouse gas levels. Heating fuels that come from deep in the earth, such as oil and natural gas, produce a one-way flow of carbon to the atmosphere. Carbon is removed from under the earth's surface and emitted into the atmosphere. In contrast, heating with woody biomass is at least carbon neutral because trees absorb carbon from the atmosphere while growing and then release a por-

tion back during decay or biomass burning (Fretwell 2011). This two way flow of carbon gives wood an advantage over fossil fuel because the amount of carbon emitted from burning is balanced by the amount sequestered during growth.

Managing forests through planting, thinning, and removal of woody debris can enhance forest growth and increase carbon sequestration. In most cases, heating with woody biomass is done as a replacement for fossil fuels. This substitution effect means that wood coming from a sustainably managed forest can be a carbon negative source of energy (Lippke et al. 2011).

Although wood has a comparative advantage over fossil fuels in terms of carbon budgets, the complex nature of the material does produce other pollutants of concern. According to the Biomass Energy Resource Center (BERC 2008), when compared to natural gas, modern wood systems emit higher levels of sulfur and nitrogen oxides, but still less than when compared with heating oil. Additionally, woody biomass produces higher levels of particulate matter than all conventional fuels. Smokestack height can help mitigate impacts of particulate matter at ground level. And heating systems that are large enough to meet permitting thresholds are required to lower emissions through the use of modern pollution control devices.

## BARRIERS TO BIOMASS

In addition to emission issues, growth of woody biomass for heating will require overcoming certain economic, regulatory, and physical limitations:

- Woody biomass heating opportunities are not widely known or understood—especially among architects and engineers.

- Initial investment costs are higher than other options, even though justified by lower operating costs. Schools have financing options that produce positive cash flows sooner than many private sector financing options.

- A consistent supply of timber is necessary. Private land can accommodate the wood fuel needs in Vermont and other locations in the eastern United States. Most western forests, however, are public lands. Although industry experts contend that an ample wood fuel supply exists in most western locations, it probably will not come from National Forests where timber harvest volumes have declined by 80 percent over the past decade.

- Carbon emission permitting, as proposed under the EPA's Prevention of Significant Deterioration rule in the 2010 Clean Air Act revision, would reduce the cost effectiveness of biomass heating in industry. The rule treats all industry carbon emissions from stationary sources

as equal, conferring a relative disadvantage on wood regardless of its net zero—or even net negative—atmospheric carbon emissions.

## BIOMASS HEATING: A VIABLE OPTION?

Thermal energy from woody biomass is not a panacea to all heating needs, but Vermont and other cold locations have proven it is a viable and renewable option. Increased knowledge about the efficacy of existing facilities and the attractive returns on investment suggest we can expect to see more facilities adopt this technology. BERC, BTEC, and others are reducing information costs through research and education for those interested in adopting biomass heating systems.

With roughly one-third of U.S. energy consumption used for heating, energy and environmental policy makers would be wise to consider wood as a heat source. Although this ancient technology is far from cutting edge, it can provide an economic and environmentally viable solution for high heating costs in many parts of the country.

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**STEVEN BICK** is a forestry consultant and an adjunct professor at SUNY College of Environmental Science and Forestry. Bick has been a regular visitor to PERC since 2006.

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