VERMONT

Fuels For Schools

A Renewable Energy-Use Initiative

AN OVERVIEW

Vermont Fuels For Schools

An initiative of

BIOMASS ENERGY RESOURCE CENTER

in collaboration with

The Vermont Superintendents Association School Energy Management Program (SEMP)

and in cooperation with

Vermont Department of Forests, Parks and Recreation

Vermont Department of Education

Vermont Department of Public Service

with funding from

U.S. Department of Energy

through the support of Senator Patrick Leahy

VERMONT Fuels For Schools

A Renewable Energy-Use Initiative

A statewide initiative to promote and encourage the use of a renewable, local natural resource to provide reliable heat for Vermont schools.

AN OVERVIEW

BIOMASS FOR ENERGY

It makes sense to use forms of sustainably produced biomass to replace conventional fuels for a number of reasons, such as: increased economic development, biomass energy is good for the environment, and biomass cuts fuel bills.

What is biomass?

Biomass is simply any biological material that can be used to produce heating, electricity, or fuels, including:

- Woodchips and pellets
- Other low-grade wood wastes
- Energy crops or agricultural residues
- Farm animal wastes

Why use biomass for energy?

It makes sense to use forms of sustainably produced biomass to replace conventional fuels (oil, gas, and coal) for a number of reasons, such as:

Increased economic development

Biomass comes from local resources and keeps energy dollars close to home. Money spent on oil and gas is a huge drain on local economies. When a community uses biomass it creates forestry and agriculture jobs in the surrounding region.

Biomass energy is good for the environment

Biomass use reduces the atmospheric build up of greenhouse gases that cause climate change. Wood heating can also have a positive impact on acid rain because, unlike fuel oil, wood contains virtually no sulfur. Woodchip heating systems help keep forests strong by providing a productive use for low-grade cull wood.

Biomass cuts fuel bills

Since the first Vermont school converted from electric heat to woodchips in 1986, biomass heat has always been at least 30 percent less expensive than oil and 75 percent less expensive than electricity. Now, heat from oil, propane, and natural gas costs roughly two to-three-times as much as heat from woodchips.

A Smart Energy Future for Vermont Schools

The Vermont Fuels For Schools Initiative is a collaboration among the Biomass Resource Center (BERC), the Vermont Superintendent Association's School Energy Management Program (SEMP), and three state agencies: the Vermont Department of Education, the Department of Public Service, and the Department of Forests, Parks and Recreation. The goal of Vermont Fuels For Schools is to provide schools with the information and support needed to evaluate and successfully implement woodchip and other biomass heating systems that replace expensive fossil fuels with locally produced wood fuels.

Step 1: Request a free site visit from SEMP. Information provided, in addition to the information in this packet, will give an overview that will help school decision-makers take a first look at the biomass heating option and decide whether to move to a more detailed consideration.

Step 2: Schools that decide to move to the next step will be given a second Vermont Fuels For Schools packet. The information in it will assist a school in carrying out a more detailed assessment and in developing a road map toward bond vote approval of the project. The tools in the second "pre-bond" packet help with assessment of the site's suitability for building a woodchip heating plant, the process of working with an architect and engineer to move the project forward, the development of a project budget as the basis for a bond vote, and carrying out a more detailed cost analysis.

Additional Tools: The Vermont Fuels For Schools Initiative also provides tools for the implementation or "post-bond" phase of a woodchip project, after the decision to build has been made. These tools are targeted toward the school's professional team: architects, engineers, and project managers. These tools provide guidance in design issues, specifications that clarify the particular needs of the project, and selection and successful installation of a woodchip system.

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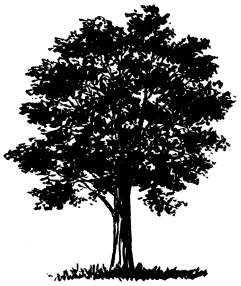


Vermont Leads Nation in Woodchip Heating for Schools

Not only are woodchips by far the least expensive fuel available to schools, their use keeps energy dollars in the local economy and can improve overall forest health.

The Biomass Energy Resource Center (BERC), a national nonprofit based in Montpelier, Vermont, develops the use of sustainable biomass resources for economic and environmental benefit. Biomass is renewable biological matter that can be burned for energy.

Starting in 2001, BERC and its Fuels For Schools partners have played a key role as Vermont has pioneered the use of automated woodchip heating systems in public schools. Today almost 20 percent of Vermont public school students attend a school heated with wood. Thirty schools already operate woodchip systems and more installations are under consideration.

Learning from Vermont's model, the US Forest Service has initiated the Fuels For Schools Initiative across the nation to help communities and is now focused in western states to help reduce forest fire danger from low-grade wood build up in national forests. BERC has helped a number of western states, including Montana, New Mexico, and South Dakota, learn from Vermont's successful model.

In Vermont, woodchips and cordwood are the most common biomass energy fuels. Woodchips historically come from sawmills or timber harvesting operations. Sawmills produce chips from slabs and edges that cannot be made into marketable lumber. Harvest chips come from low-grade trees as well as tops and branches. Historically, both of these byproduct materials have had little economic value and have been sold to paper mills or power plants. Not only are woodchips by far the least expensive fuel available to schools, their use keeps energy dollars in the local economy and can improve overall forest health.

A CLEAN RENEWABLE FUTURE

Using wood to replace fossil fuels is the most powerful action a school can take to address global warming and climate change.

Environmental Answers

Biomass — sustainable fuel for the future

Modern institutional biomass systems burn cleanly and are simple to operate, unlike conventional home wood stoves.

Woodchip boiler systems have virtually no visible emissions or odor. Wood systems installed in Vermont schools emit far less particulate matter (PM) than modern wood or pellet stoves. Over the course of a winter season, the woodchip system of a large (200,000 square foot) Vermont school produces about the same amount of PM as five home wood stoves. All but the very best and largest wood burning boilers, however, have significantly higher PM emissions than do corresponding gas and oil systems.

The combustion of fossil fuels — oil, gas, and coal — adds carbon dioxide to the atmosphere and is a major culprit in global climate change. Burning wood for fuel, on the other hand, adds essentially no new carbon dioxide to the atmosphere. Using wood to replace fossil fuels is the most powerful action a school can take to address global warming and climate change.

Using wood for fuel instead of oil or gas substitutes a renewable fuel for non-renewable fuels and is a positive step toward a smart energy future for Vermont schools. Locally supplied wood is a long-term sustainable answer as long as responsible forest management practices are followed. Using low-grade wood from our forests also helps to keep the forests healthy.

QUESTIONS & ANSWERS

The wood that is used by schools as fuel comes from mill residues, crooked, diseased trees, or low-value boles. The practice of sustainable forestry requires a market for this low-grade wood; using it to heat schools helps keep the forests healthy.

Where does wood fuel come from?

Currently, the primary suppliers to Vermont schools are sawmills, which chip and sell wood that cannot be made into lumber. Increasingly, schools are buying wood fuel from chippers who work directly in the woods.

HARDWOOD SAWMILL WOODCHIPS are high-quality fuel for a reasonable price. If available, hardwood sawmill chips are the preferred choice of schools. Mill chips are very regular in shape and size—about the shape of a matchbook. Schools have to compete for this high-quality fuel with other users, such as wood-fired power plants and paper mills. Because of this competition, schools may have trouble finding mill chips in the future and may have to buy chips out of the woods.

BOLE CHIPS are made by putting the main trunks (boles) of low-value trees through a chipper working in the woods as part of a timber harvesting operation. Tops and branches, where most of the important soil nutrients in trees reside, are left in the forest. While low-grade tree trunks have had very little value in the past, they will become a more important fuel as new demands arise for the limited supply of sawmill chips. Unlike mill chips, the supply of bole chips can grow significantly in the future, providing a new, sustainable form of biomass to new markets. Bole chips are less regular in size and shape than sawmill chips but still make a very good fuel for schools. The quality of bole chips depends on careful operation and maintenance of chipping equipment in the woods.

How does the forest benefit?

Schools use a tiny fraction of the wood grown each year by Vermont's forests. The wood that is used by schools as fuel comes from mill residues, from crooked, diseased trees, or from low-value boles. The practice of sustainable forestry requires a market for low-grade wood; using it to heat schools helps keep the forests healthy.

What are the parts of a woodchip system?

The two major parts of a wood system are the components supplied by the equipment manufacturer and the building that houses the system.

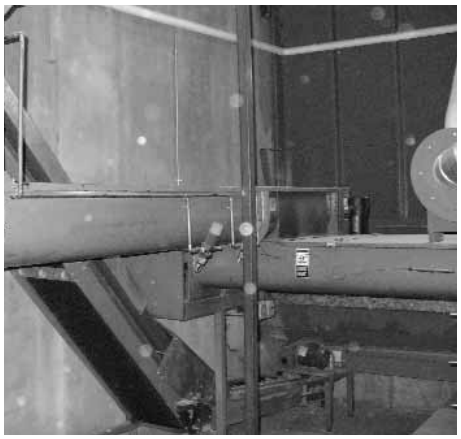
The principal components include:

- A fuel storage area — often a rectangular, below-grade concrete bin (in an automated system) or a flat slab for the chip pile (in a semi-automated system)
- Fuel-handling equipment — conveyors and augers
- A boiler, to burn the wood and create hot water for building heat
- A chimney, to exhaust combustion products (some systems also have flue-gas cleaning equipment)
- The controls that ensure efficient, clean combustion
- A building to house all the equipment and the chip storage area

A more detailed description of system components can be found in the book, *Wood-Chip Heating Systems—A Guide for Institutional and Commercial Biomass Heating* (Chapter Three, pages 18-27).

Is it a lot of work for the maintenance staff?

Modern school woodchip systems are easy to take care of — 30 minutes average per work day for automated systems and up to 60 minutes per day for semi-automated systems. Most of the work involves removing a few shovels full of ash into a trash can each day.



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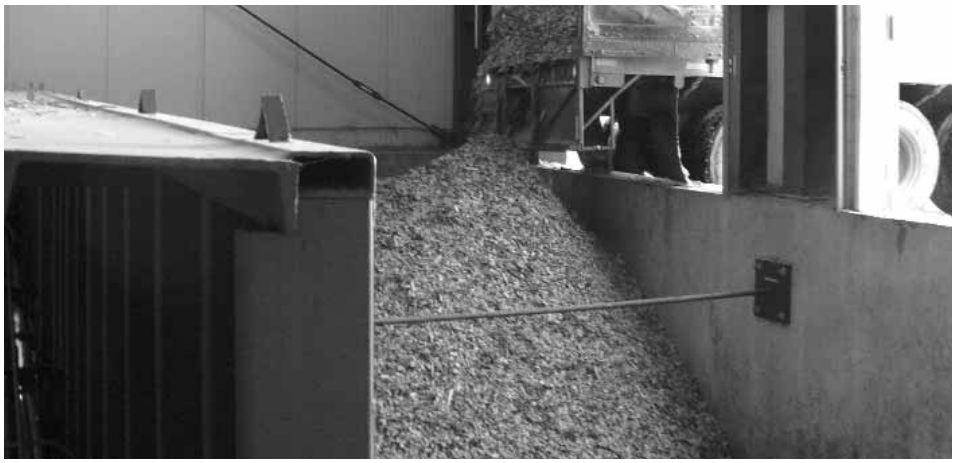
School districts with new wood-energy systems often reduce annual heating expenditures within the first year of use.



How can our school qualify for state aid for a new wood system?

Historically, the State of Vermont, through the action of the Legislature, has provided generous state aid payments to schools that install wood-energy systems. To qualify for this aid, the school must demonstrate cost effectiveness by submitting a detailed cost analysis of the proposed woodchip system. The approved type of analysis is called life-cycle cost (LCC) analysis. LCC analysis is a comprehensive study that looks at fuel costs and savings over time, as well as other operating costs, and balances the net savings against the cost of installing the wood system. If the net present value of the wood option is positive, compared to the oil (or gas) option, the system is deemed to be a good investment for the state and the aid will be granted. If the net present value is negative, state aid will not be provided.

Vermont Fuels For Schools has developed a format for LCC analysis that meets the standards of the Vermont Department of Education. This analysis can be carried out by one of the Fuels For Schools partners or by the school's architect or engineer.

Preliminary LCC analysis is usually done when a school is first considering the wood-heat option, to get an idea of whether it is worth developing a project. A final LCC analysis, using actual bid construction costs, must be carried out and submitted to the Department of Education for final state aid approval.

Are wood systems cost effective?

Woodchips have been much less expensive than fuel oil and propane, and in recent years offer significant cost savings compared to natural gas. For example, if the price of oil was $2.00 per gallon and the price of wood was $50 per ton, substituting wood for oil would then reduce heating costs by 61 percent.

Even though the fuel cost savings from using wood are dramatic, the capital cost of installing a wood system is high. The school will have to borrow money to purchase the system (usually by bonding) and the fuel-cost savings are used to make the payments for the bond during its repayment term.

The experience of wood-heated schools in Vermont is that bond payments are less than fuel savings, so that the schools can budget less for fuel and bond payments than they were budgeting for conventional fuel, and save money for the taxpayers—often starting in the first year. Over time, the savings increase each year. In the last 20 years, wood prices have increased at about the rate of general inflation while oil prices have increased twice as fast. After the bond is paid off, the savings from using wood instead of oil (or gas) are very dramatic.

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What if the wood system is too expensive to be cost effective?

As building construction costs increase in Vermont, more schools interested in biomass heating may need to consider less expensive semi-automated systems or those that use other biomass fuels like wood pellets, corn, or grass pellets.

A smaller school with a relatively modest oil or gas heating bill may find that a fully automated wood system is too expensive. In this case the fuel savings will not be sufficient to cover the bond payments. The LCC analysis will show that the net present value of the wood project is negative, meaning that from the state perspective the project is not worth doing and will not get state aid.

BERC developed the semi-automated wood system to address the needs of small schools with low oil or gas heating bills. The semi-automated system uses significantly less expensive equipment and is housed in a significantly less expensive building.

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High-Price and Low-Price Wood Systems (for Larger and Smaller Schools)

Fully automated wood systems use a large-volume, below-grade concrete bin for fuel storage, and sophisticated combustion controls. The fuel is automatically conveyed from the bin to the combustion chamber, requiring no operator attention. This high level of operator convenience requires costly equipment and a costly building.

Semi-automated wood systems use less expensive slab-on-grade fuel storage: the woodchips sit in a big pile on the slab. Once or twice a day the operator uses a small tractor or skidsteer to move the chips to a small day bin that in turn feeds the boiler automatically. Operator time to fill the day bin is as much as one hour daily. Semi-automated systems are simpler and have fewer advanced features than fully automated systems. To control construction costs, the buildings tend to be of straightforward design with few architectural features.

EXPERIENCE COUNTS

Here is what the people who know have to say about Fuels For Schools

"We were the first full-sized high school installation in Vermont [1992]. It has been a very successful experience. We were replacing an electric system and we had to retrofit the heat source, buy a boiler, and run a mile of copper pipe throughout our building, which is an 85,000 square foot, four-level facility. The installation turned cash-flow positive in three years. Nobody likes uncertainty in their budget process, and fossil fuel costs are a big variable. We bought woodchips for $29/ton for more than a decade, although our price has recently gone up to about $35/ton."

Frank Rucker, Business Manager
Leland & Gray School District

"We installed our system in 1997. We were heating with electricity. The prior year our electric bill was $280,000. Now we heat 150,000 square feet and our hot water with woodchips for $30,000 a year, and our electric bill is about $80,000. The system is very efficient, relatively simple, and easy for a lay person to operate."

Doug Masson, Maintenance Supervisor
Mount Mansfield Union High School

"The Department of Education and the State Board of Education encourage school districts to invest in cost-effective, energy-efficient facility improvements. Woodchip heating systems have proven to be both; they are a tremendous success story in Vermont schools. The School Construction Program helps districts through the process of obtaining state funding, which makes these systems an even better deal for communities."

Cathy Hilgendorf, Coordinator
School Construction Program
Vermont Department of Education

"Vermont is 78 percent forested. We are only cutting one half of the annual growth. For hardwoods specifically, the rate of harvest is lower. The expanded use of wood for energy has increased the opportunity to utilize low-quality trees. Think of it as grooming the forest."

Paul Frederick, Wood Utilization Specialist
Vermont Department of Forests, Parks and Recreation

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EXPERIENCE COUNTS

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"The boiler is so efficient that for every 20 tons of chips we burn, we clean out one 20-gallon trash can of ashes. The controls and diagnostics are computerized. From wherever you have Internet access, you can monitor and adjust the system."

Norm Tourville, Maintenance/Groundskeeping
Champlain Valley Union High School

"We're situated in a valley with many residences, stores, and a hospital close by. There was a lot of concern, some of it my own, that the air might hang and cause odor and smog. None of that has come to pass."

Robert Clark, Facility Manager
Brattleboro Union High School

"Mount Anthony Union High School District 14 installed a woodchip heating system in its new middle school in 2004, and has enjoyed substantial cost savings and virtually no mechanical issues. The school district is currently in the process of bidding, building, and firing up another woodchip unit at the high school facility. As we approach the prospect of 2,500 tons of chip consumption annually (we are using 725 at the middle school and project 1,775 at the high school), my one concern is available chip supply. We draw from two local lumber mills, and have a third at some greater distance that advised they could meet our demand. The supply issue notwithstanding, I believe that this technology offers great opportunities for fuel savings."

Jim Marsden, Director of Buildings and Grounds
Mount Anthony Union High School

"The Department of Public Service is very supportive of the Vermont Fuels For Schools Initiative, which strives to help local schools reduce their heating costs while supporting renewable energy use and sustainable forestry practices. The DPS is particularly focused on encouraging local tax dollars being used to strengthen and support local, renewable fuel options."

Robert Ide, Director, Energy Efficiency Division
Vermont Department Public Service

VERMONT Fuels For Schools

NEXT STEPS

For a free school site assessment and more information about this cost-effective, local solution to heating your school, please contact:

Vermont Superintendents Association
802-229-5834, www.vtvsa.org

For information on state aid to help pay for a biomass heating system, please contact:

Vermont Department of Education
802-828-5402, www.education.vermont.gov

For information on wood fuel supply for schools, please contact:

Vermont Department of Forests, Parks & Recreation
802-241-3678, www.vtfpr.org

For technical assistance in organizing or implementing a wood-heating project, please contact:

Biomass Energy Resource Center (BERC)
802-223-7770, www.biomasscenter.org

For general information on energy efficiency and renewable energy, please contact:

Vermont Department of Public Service
802-828-2811, www.publicservice.vermont.gov

SUSTAINABLE RESOURCES

An environmentally sound energy choice –

HEALTHY LOCAL ECONOMY

saving money for Vermont Schools

CLEAN RENEWABLE FUTURE

and Vermont taxpayers.

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