  

Wood Heat Solutions

A Community Guide to Biomass Thermal Projects

Wood Heat Solutions:
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A guide for:

- Schools
- Hospitals
- Recreation facilities
- Museums
- Correctional institutions
- Senior centers
- Offices and manufacturing facilities
- And more…

Acknowledgments

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Introduction

This fall students at the Enterprise School in Eastern Oregon will be the first in the state to attend a school heated with wood. Meanwhile, the school district will enjoy an annual savings of approximately $112,000. Across the country communities like those in Wallowa County are searching for solutions to spiking energy costs. Many are looking into woody biomass to heat their schools, hospitals, and other community facilities or to generate heat for manufacturing processes.

Using wood as an economical and sustainable fuel source might seem new and unique, but wood has a proven track record. Finland, for example, produces nearly 20% of its annual primary energy supply from wood.[1] On this side of the Atlantic, in Vermont, one out of every five students attends a school that is heated with wood. In the Intermountain West, 14 schools and other facilities are heated with wood, including an elementary school in Council, Idaho, that has been heating with wood chips since 2005.

This guide is intended for people who need an economical energy source and those in the community interested in supporting local and sustainable energy options. Specifically, this guide is for folks that need a lot of heat on a small budget, such as school administrators, city buildings and maintenance staff, hospital administrators and other building owners/administrators. But this guide is also for community leaders, land management agency staff, local businesses, non-profits and others who are looking for ways to meet economic, social and ecological goals through woody biomass utilization in their community.

This guide provides an introduction to woody biomass as a viable alternative to fossil fuels for generating heat and offers case study examples and sources for further information on developing a biomass heat project. It is specifically geared towards communities in the Pacific Northwest where biomass projects support social and ecological as well as economic goals.

The case studies demonstrate how the ingredients of a successful biomass heat project can come together with a little initiative and some hard work. While describing some of the challenges, these examples also highlight the opportunities and benefits of increased savings, support for local wood products industries, reduced dependence on fossil fuels and more sustainable energy systems.

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1 Logging residues from regeneration fellings for biofuels production–a GIS-based availability analysis in Finland. Ranta, T., 2005. Biomass and Bioenergy. (28) 171-182

What is Woody Biomass?

The raw materials to produce woody biomass fuels can come from a variety of sources, including:

- the byproducts of forest management activities
- waste material from woods products manufacturing and slash from logging operations
- woody debris from fuels reduction projects and forest restoration projects
- mill waste
- slash from logging operations
- sawdust
- urban forestry residue
- municipal waste from construction sites

Forest management practices include thinning operations to reduce wildfire risk, restore natural forest structure and enhance wildlife habitat as well as pre-commercial thinning operations. The type and quantity of woody biomass removed from such practices varies widely. Depending on the size and quality, such material can be used in one of three ways: traditional dimensional wood products, value-added products or energy stock. Typically larger diameter logs (greater than 6–12 inches, depending on species and market conditions) are suitable for the production of traditional wood products such as dimensional lumber.

In practice, the term "woody biomass utilization" refers to economic uses for the remaining small diameter trees, branches and needles. Value-added products include wood flooring, molding, post and poles and other products made from small diameter (generally less than 4") trees. Energy stocks such as wood pellets, wood chips, and liquid biofuels can be produced from the smallest size materials as well as leftover scraps and sawdust from the production of finished woods products.

The technology to efficiently produce liquid biofuels from woody biomass is still being developed. Abundant hydropower in the Pacific Northwest makes it difficult to make a profit from selling power back to the grid. Therefore, heat and combined heat and power (CHP) systems are currently the most economically efficient use for woody biomass energy stocks.

Forest management practices to reduce fire risk or manage habitat can yield suitable feedstock for biomass heat systems. *Photo: Firewise.*

Wood-chip-fired systems require an indoor storage area and handling equipment to move the chips from the bin to the boiler. *Photo: Dan Bihn.*

Woody Biomass Technology

Selecting the right technology for your application and available fuel source in your area is critical to any successful biomass heat project. Since wood pellets and wood chips are more practical and economical for most facilities, the remainder of this guide focuses on those fuel types.

Wood Chips

Wood chips are the most commonly used energy stock and have been used extensively for heating large facilities and for process heat applications such as drying lumber. Chips are produced as a by-product in sawmills and can also be made by chipping scrap wood or whole trees. While relatively inexpensive compared to more processed forms of biomass, chip consistency and quality can vary. The ideal chip is dry, uniform in size and free of dirt and other debris. Each combustion system will have a preferred fuel specification. Some systems can handle variable consistency, lower-quality chips (often called hog fuel), but these systems also require more maintenance; therefore it is very important to match your system to the available fuel source. Over the long run it may be cheaper to buy a more expensive chip than feed your system with poor-quality fuel.

The systems to handle chips are generally more complex and expensive, and take up more space, than systems using wood pellets. Consequently, they can be more time-consuming to design and install. Depending on the scale of your system, these costs may be offset by the lower cost per unit energy over wood pellets.

Pellets

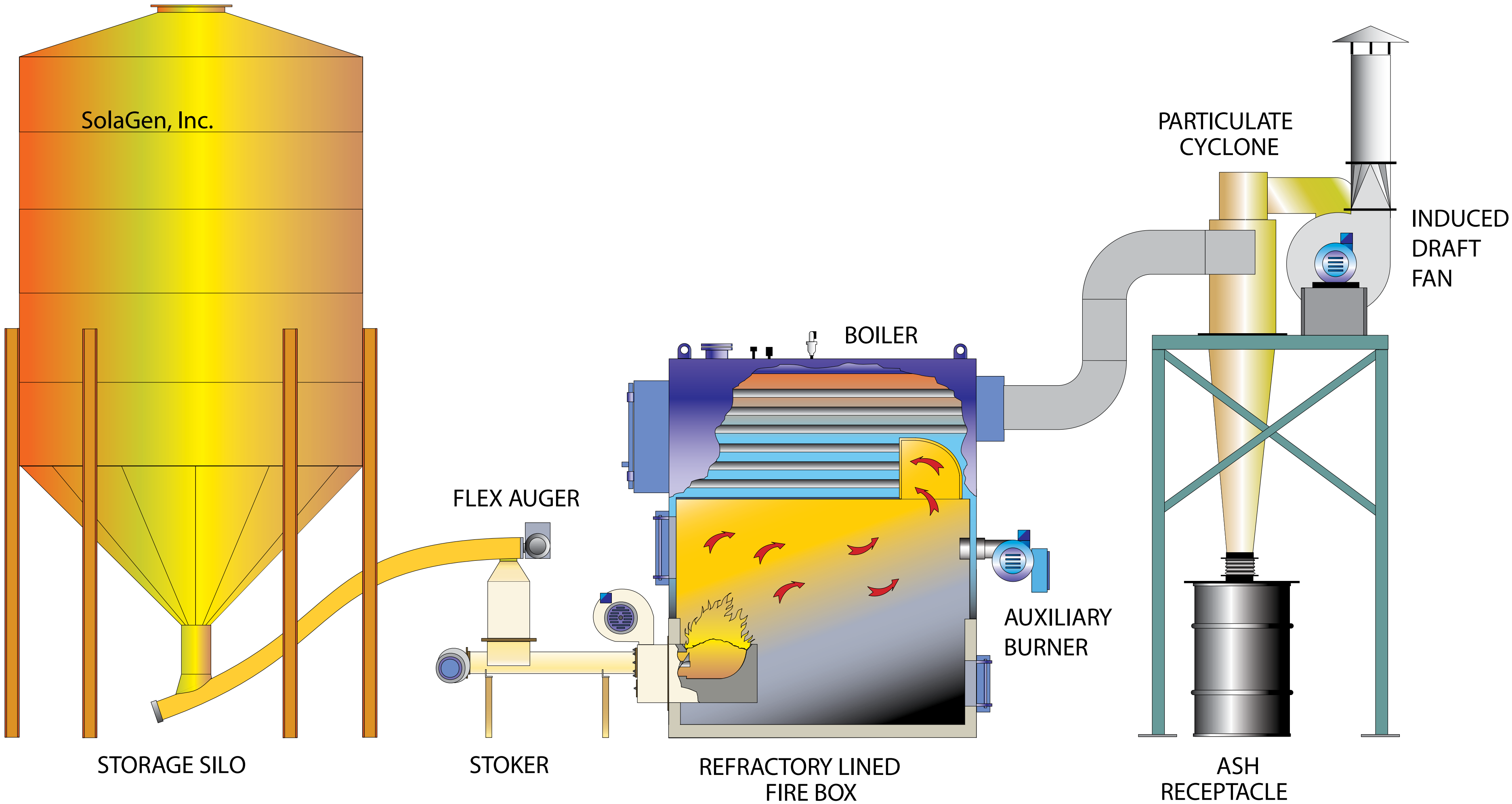
Wood pellets are a wood product that is processed to reduce the water content and increase density, producing a fuel stock that is easier to handle, store and transport compared to cordwood and wood chips. This uniformity allows pellet systems to burn more efficiently. Because the pellets are easier to store and handle, pellet systems tend to be simpler, smaller, less expensive and quicker to install than wood chip systems. The tradeoff is higher cost per unit energy compared to other less-refined fuel stocks--about twice the cost of wood chips for the same energy content. Pellet systems may be more economical for small- and medium-sized applications.

Emerging Technologies

Private and public agencies are developing technologies to refine biomass to make it easier to transport and burn efficiently. Wood gasification and liquefaction are two areas where improved technology may yield other economical systems for producing heat, electricity or for other fuel stocks.

Pellets or chips?

Choosing the right fuel source depends on your heating needs and the availability of fuel stock in your area. Wood pellets are more economical to transport, easier to store and handle, and consequently pellet systems are less expensive, smaller and quicker to install. However, facilities that require a large heat output and have the space for chip storage and handling equipment could save money using wood chips, a less refined and thus less expensive fuel stock.



This schematic diagram of a wood pellet system shows the components of a typical biomass boiler system including a place to store the fuel, equipment to move it to the boiler and equipment to manage the byproducts — ash and combustion gases.

courtesy SolaGen Inc.

Ingredients of a Biomass Heat Project

There's a lot to consider in deciding if a biomass heat project makes dollars and sense. Here are several of the key ingredients to a successful project.

- Scale — Building size, energy demand and existing energy costs will determine if a biomass heat system is right for your facility. Scale will also determine which type of technology is appropriate. According to the Biomass Energy Resource Center (BERC), buildings between 10,000 and 50,000 square feet are generally good candidates for wood pellet boiler systems, whereas larger facilities might realize greater cost savings by going with a wood chip system.
- Technology — Given the variety of systems available, it is important to take the time to select the appropriate system for your facility's needs and the available fuel supply in your area. Some systems are fully automated requiring minimal daily maintenance; less expensive semi-automated systems can be cost effective for smaller facilities.
- Fuel Supply — The long-term economics of your system will depend on a reliable, cost-effective fuel supply. Partnerships with local land management agencies, sawmills and other businesses that produce or transport woody biomass can help to secure adequate, sustainable fuel supplies.
- Community/Political Support — The installation or conversion of an existing facility to use woody biomass can be a significant change in the community. Concerns over air quality, impacts from biomass removal and transport need to be considered along with the economics.
- Internal Support — The support of those who work in the facility to operate and maintain the system is important in a biomass project. Engage these stakeholders early in the process to gather their input and address their concerns.
- A Champion — Making a biomass project work takes a commitment to learning new things. From project development and financing to operation and maintenance, there is always a learning curve. Being dedicated to the long-term economic, social and environmental benefits of biomass utilization is important for success.

Finding a reliable supply of fuel stocks is one of the key ingredients to a biomass heat project. Wood product manufacturers such as this sawmill in Central Oregon are one potential source of wood chips for local biomass projects. Wood pellets are more economical to transport and may be a good source for projects where the supply of local wood chips is limited. *Photo: Resource Innovations.*

Why Woody Biomass?

While every biomass project must be economically feasible, there are many other benefits that can help justify the commitment of time and energy to learning about biomass heat. Because of these additional benefits, there are many agencies and organizations interested in research, development and financing to help people conquer the learning curve and develop the infrastructure to support economical biomass utilization into the future.

While fossil fuel prices are expected to rise with scarcity, price increases in woody biomass fuels may be tempered as the infrastructure as well as the technology to harvest, transport and process biomass matures. The added benefits of woody biomass utilization include:

- Cost Savings — woody biomass heat systems can provide comparable heating at a much lower costs. As the cost of fossil fuel has risen and is expected to continue, the financial attributes of woody biomass heat are very promising.
- Local Economic Benefit — For many rural communities, utilizing biomass helps to support local job creation through forest restoration work and fuels reduction projects that produce woody biomass as a byproduct.
- Air Quality — Burning woody biomass in efficient boiler systems produces less air pollution than burning slash piles, prescribed burning and catastrophic wildfires.
- Forest Restoration — Thinning overstocked forests to meet ecological objectives is expensive. Using the woody biomass byproducts provides opportunities to offset the costs of these operations.
- Wildfire Mitigation — Biomass utilization can also subsidize the costs of forest fuels reduction projects, improving safety for rural communities.
- Carbon Neutral — The trees used to produce woody biomass have absorbed carbon from the atmosphere equal to the amount released when the fuel is burned, therefore biomass is considered a carbon neutral fuel source. In contrast, fossil fuel consumption emits CO_2 that would otherwise remain trapped in underground deposits. When biomass fuels are used instead of fossil fuels, the net effect is lower carbon emissions.

Strategic forest thinning operations can reduce the risk of catastrophic fires and provide economical fuel stocks for biomass systems. *Photo: USDA*

Biomass systems fit to many scales

Small
Tillamook Forest Center, Oregon
Size: 12,100 ft^2
Fuel: Wood pellets
System: 0.42 million Bth/hr

Medium
Enterprise Public Schools, Oregon
Size: 105,000 ft^2
Fuel: Wood chips
System: 2.5 million Bth/hr

Large
Chadron State College, Nebraska
Size: 1.1 million ft^2
Fuel: Wood chips
System: 9 million Bth/hr

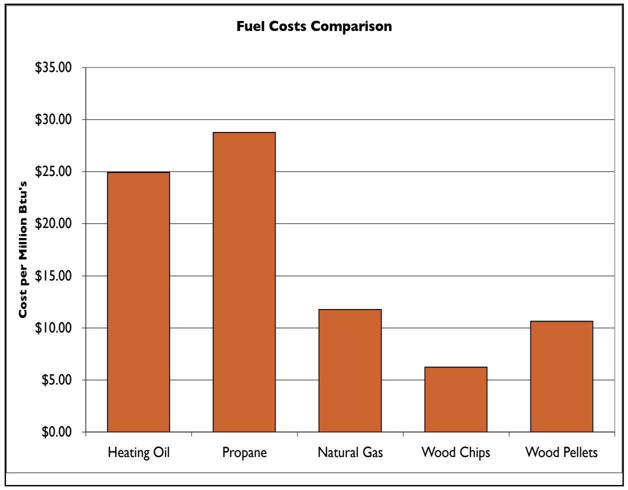
Overview of a Woody Biomass Heat Project

Going from concept to construction happens in a series of smaller steps. There are many potential partners that you can turn to for technical and financial support. Support can come from local, state and federal agencies, non-profits, community organizations, Resource Conservation and Development councils (RC&D's) and private firms. Each of these entities can bring unique experience and expertise to different parts of the process. The following sections give a brief description of each of the major steps to project development and implementation.

Pre-feasibility studies

Done well, a full feasibility study can take a lot of time and money. A quick "back of the envelope" assessment of your situation can determine if biomass might be the right solution. An experienced contractor or consultant can complete an initial pre-feasibility study with some basic information about your facility, utility costs, and heat requirements.

Calculating the *simple-payback period* provides a rough estimate of cost effectiveness — the total project cost is divided by annual energy cost savings to estimate the time required to pay off the investment. A *cash-flow analysis* is a more realistic assessment that factors in the interest on borrowed capital and costs of operations, maintenance and repairs. A *life-cycle cost analysis* is a similar comprehensive assessment that estimates the total costs of the project over its expected lifespan, adjusted to the net present value.



Note: cost calculations assumes bulk delivery to institutional scale applications

source: Biomass Energy Resource Center

Feasibility study or energy audit

Reliable financial estimates require reliable data. A full feasibility study involves a site visit and input from architects and engineers to put together equipment specifications, layout drawings, and detailed budgets that include costs for permits, materials, fuel supply, and operations to name a few. This is also a good time to contact the agencies responsible for air quality and land use permits to assess how the permitting process may impact the project.

Depending on your situation, it may make sense to look at a biomass conversion as a stand alone project, or as part of a comprehensive strategy to increase energy efficiency and long-term savings. A full energy audit will identify areas in your facility where upgrades will have the biggest payoff in energy cost savings.

Often the company that conducts the feasibility study can also identify opportunities to take advantage of tax credits, low interest loans, and grants in order to put together a financial package that makes the project feasible.

Identifying a feedstock supply

Identifying a reliable source of fuel is a critical component of a feasibility study. Wood pellets are relatively easy to transport and widely available so it is simply a matter of negotiating a contract with a producer and a shipper. Wood chips are

Biomass to heat: Space heat and process heat

With current technology, the most efficient energy use for woody biomass is to produce heat or electricity. Heat used to warm buildings where people live and work is referred to as space heat. Heat used in the production of goods such as in greenhouses or to dry lumber is referred to as process heat.

more costly to transport, but can come from a variety of sources. Whereas some communities adjacent to public and private forest lands may find abundant supplies from forest management projects and logging operations, other communities may need to look to more diverse sources or pay more for transportation.

Contact agencies, organizations or businesses in your area that can help you assess the availability, quality, and reliability of wood sources.

Community Involvement

Community members may have concerns about potential impacts to air quality, traffic from delivery trucks, and impacts to the forests as biomass is extracted and transported to the facility. Education and outreach early in the project reduces uncertainty and can help build community support for the project. In addition, it helps to identify concerns and develop solutions sooner rather than later.

Financing

There are a number of incentives and programs designed to support the development of renewable energy such as woody biomass heat. Grants, low interest loans, and loan guarantees are a few of the ways that you can improve the bottom line on a new project or conversion to a biomass facility. Building owners may also choose to use an Energy Savings Performance Contract (ESPC) to use the projected cost savings in energy efficiency to finance the project.

However, as our case study of the Harney County hospital demonstrates, even on a

Wallowa Resources, a non-governmental organization based in Northeastern Oregon, worked closely with several partners to help the Enterprise School District develop and implement their biomass project (case study on page 11). The architectural drawing above depicts the new building that will house the chips, fuel handling equipment and the boiler system that will heat three buildings.

The combustion rate of these wood pellets is controlled for optimum efficiency inside the boiler chamber. *Photo: Dan Bihn.*

Local Fuel Supply

Reduce fuel costs by looking for a local supplier of wood chips or pellets. Buying local also supports jobs in your community. To identify potential local sources call:

- Forest Service or BLM District Office.
- State Department of Forestry.
- Private woodlot owners.
- Local woods products manufacturers.
- Pellet manufacturers.
- Arborists and logging contractors.
- Local community forestry organization.

level playing field without additional subsidies, there are instances where biomass heat can be more competitive than comparable fossil fuel options. Public entities can pursue a bond measure to finance facility improvements, but shouldn't overlook the option to work with private banks and lenders. A feasibility study that demonstrates good economics is an attractive business opportunity.

Permitting

Depending on the type of system and the regulations in your state, you may be required to obtain a permit for the boiler and emissions.

All types of combustion, including biomass, produce emissions including gaseous emissions such as sulfur dioxide (SO_2), nitrous oxides (NOx), carbon monoxide (CO) and carbon dioxide (CO_2). Volatile organic compounds (VOCs) and particulate matter (PM) are also released.

The amounts of these pollutants emitted by the technologically advanced biomass boilers available today are far less than a typical residential wood stove and are in some cases less than their fossil fuel counterparts. Permitting and mitigation requirements vary by state and jurisdiction, but many small and medium size systems do not require a special permit. However, biomass boilers do have higher PM emissions than gas and oil systems. Therefore, a properly designed smoke stack is important to disperse emissions and maintain ground-level air quality.[2]

"You've got to think in terms of total costs; that's what matters over the long run."

—Tim Maker
Biomass Energy Resource Center

Design and Construction

Project management during design and construction operates much the same as any other facility project. While there may be a learning curve, case studies demonstrate that architects, engineers and contractors have risen to the challenge and are gaining experience with an enthusiasm for using woody biomass where it works.

Getting input from maintenance staff during design and construction can help them understand the maintenance requirements involved with the new system. Their involvement can also ensure the facility and system design are optimized for daily operations and routine maintenance.

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2 www.biomasscenter.org/information/emissions.htm (accessed May 20, 2003).

Wallowa County, Oregon — Enterprise School District

Faced with rising fuel oil costs and increasingly tighter budgets, school districts in Wallowa County need to increase efficiency and reduce costs. In the fall of 2008 the Enterprise School District will be the first project in Oregon to convert an existing oil fired boiler to a biomass facility. Their experience highlights the contributions of multiple partnerships, grant funds, a tax credit and an innovative project contract.

The forests of Northeastern Oregon contribute to wildfire risk but also provide an opportunity for a renewable energy investment. Creating markets for woody biomass from forest fuels reduction projects would help fund efforts to reduce wildfire risk in areas identified as high priority in Wallowa County's Community Wildfire Protection Plan.

Wallowa County shows its fall colors. *Photo: Wallowa Resources.*

Pre-feasibility Study

In 2004 Wallowa Resources, a non-profit that promotes ecologically and economically sustainable initiatives, commissioned the Biomass Energy Resource Center (BERC) to help assess biomass utilization opportunities to heat local schools. A USDA grant obtained by Wallowa Resources funded the visit and subsequent pre-feasibility studies. BERC has an extensive history in developing wood heat projects within their home state of Vermont, as well as experience with partnerships to promote biomass heat projects with the U.S. Forest Service through the Fuels for Schools program that also operates in several western states.

During BERC's visit, they assessed three districts, met with school administrators, members of the community and toured two wood products mills. Meeting with different stakeholders allowed BERC to examine the project from many different perspectives. Participants in a public forum on the project were generally positive and appreciative of the social and ecologic benefits that biomass utilization could produce.

Like other areas in the Pacific Northwest, the wood products industry has declined significantly in Wallowa County. However, local businesses still have the potential to supply wood chips for the schools. With additional investment in equipment, Community Smallwood Solutions in Enterprise could use material from its waste stream to produce sufficient quantity and quality wood chips for both the Enterprise and Wallowa School District facilities.

BERC compiled pre-feasibility studies for two of the three school districts indicating positive economic returns over time, but estimated that both the Wallowa and Enterprise districts needed additional funding to cover project costs. Community leaders said that the public was unlikely to support a levy to cover these costs, so the project would need to be financed through other means.

To move the project forward, the Enterprise School District submitted a request for proposals and invited several firms to visit the facility. Of the respondents only McKinstry Co., submitted a proposal indicating that biomass could be a financially viable option. "We bid on the project because of our desire to help rural school districts and have a [positive] impact on the environment," said Cam Hamilton of McKinstry Co.

Financing Through Energy Savings

McKinstry took a comprehensive and integrated approach to the project by conducting an energy

Enterprise School District	
Type of Facility:	Public School
Facility Owner:	Enterprise School District
Size of Facility	Three buildings with a total of 105,000 sq. ft.
Cost of Conversion	$1,519,586
Existing Heating System	Two oil boilers with a steam and hot water distribution system.
Current Annual Heat Expense	51,000 gallons=$147,900 @$2.90/gallon
Biomass Technology	2.5 million Btu/hr Automated Wood Chip Boiler
Fuel Source	90% wood chip, 10% oil
Projected Annual Heat Expense	$18,655 for biomass ($32/ton) $14,627 for oil ($2.90/gallon) [1] Total annual energy cost — $33,282 Annual savings — $112,889.
Expected Payback Time	9.5 Years
Project Status	Anticipated completion — October 2008
Project Partners	Wallowa Resource Center Biomass Energy Resource Center (BERC) McKinstry Co. (Energy Services Company) CTA (Architects and Engineers) Solagen (Boiler Vendor)
Additional Funding Sources	• Wallowa Resources — Pre-Feasibility Study (USDA Grant) • Oregon Department of Forestry contributed funds to cover the portion of the energy audit that addressed the biomass boiler. • Oregon Department of Energy Business Energy Tax Credit (BETC) is estimated to be $448,000 with the final amount determined after the project is complete and final costs are tallied. • (Guaranteed Savings from McKinstry are $76,141)

audit that analyzed all the energy systems in the facility. By entering into an Energy Savings Performance Contract (ESPC) the school district was able to finance the project with guaranteed energy savings identified through the audit. To help support the development of biomass utilization, the Oregon Department of Forestry (ODF) contributed funds to cover the portion of the energy audit specific to the biomass boiler conversion.

According to McKinstry's audit, at current energy consumption and oil prices, the facility was using 51,000 gallons of fuel oil per year at a cost of $147,900 @ $2.90/gallon. The current HVAC (heating venting and air conditioning) infrastructure in the school was steam, so to minimize installation costs, the energy audit recommended using a steam boiler. McKinstry solicited bids from three boiler manufacturers and awarded the contract to Solagen Inc., an Oregon-based company.

Finding the Right Fuel Source

With 105,000 square feet to heat, the boiler would require substantial amounts of fuel, as well as daily maintenance to remove ash and monitor pumps and control devices. Although wood pellets are easier to transport, store and provide more energy for their bulk, the extra processing means they are more expensive than wood chips for the same Btu value. A second reason for choosing a wood chip boiler was the desire to use a local supplier. A pellet-fired boiler would depend on pellet factories outside of the county, but local mills had the potential to supply quality wood chips.

Ensuring a reliable supply of wood chips was one of the biggest challenges to the project. The school district will use an estimated 582 tons of fuel each year, which is approximately 29 truckloads of chips. Since BERC's initial pre-feasibility study, Wallowa Forest Products had closed its mill in Wallowa, leaving Community Smallwood Solutions as the only local source for wood chips. But McKinstry's analysis indicates that once their facility is operating at capacity, they'll be able to meet the fuel needs for the school. Furthermore, as the community learned more about the project, private landowners and the Forest Service have expressed interest in providing woody biomass for the school.

In conclusion, the energy audit anticipates total annual savings from the biomass conversion at $112,889 with a 9.5-year payback period to cover the capital costs. In addition to economic benefits there are many non-market benefits that were appealing to the district and the community. Compared to the previous oil-fired boiler, the wood chip system will reduce CO2 emissions by 508 tons annually. This equates to taking 67.74 cars off the road, or planting 138.57 acres of trees annually.

Local Benefits

The potential to purchase woody biomass from fuels reduction projects means that the district's expenditures to heat the building can stay in the local economy to pay forest workers to reduce hazardous fuels and wildfire risk in the county. The new system is also a source of pride for the small rural community and an opportunity for the science class to learn about new technology and the links between natural resources, economics, energy consumption and environmental quality. Finally, the district is able reduce its exposure to the rapidly rising fuel oil costs.

Many members of the community have been supportive of the project from the beginning, but as with any new technology there is need for clear and accurate information and outreach. Fortunately, Wallowa Resources, through their involvement with Community Smallwoods Solutions and the Enterprise School District, have been able to facilitate communication and educate the community about the project.

During spring and summer 2008, McKinstry has been managing construction at the school to install the new boiler and chip handling system, with it scheduled to be operational for the first day of school in fall 2008. Meanwhile, Community Smallwood Solutions is developing their capacity to produce wood chips, and other communities in the county and the region are watching eager to see how things develop.

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Log peeling at Community Smallwood Solutions. *Photo: Wallowa Resources*

Harney County District Hospital	
Type of Facility	County Hospital
Facility Owner	Harney County District Hospital
Size of Facility	55,000 sq. ft.
Project Costs	$130,000 Boiler $75,000 Building $34,000 Mechanical/Electrical $30,000 Fees/Permits Total: $269,000
Heating System	Wood Pellet Boiler
Current Annual Heat Expense:	Approximately $10,000 for wood pellets
Biomass Technology	500,000 Btu/hr wood pellet boiler, Kob (Austria)
Fuel Source	Wood Pellets
Expected Payback Time	Approximately 3 years
Project Partners	US Forest Service CTA (Architecture and Engineering)
Additional Funding Sources:	No incentives specific to biomass utilization factored into the original feasibility assessment. However, the hospital received the BETC tax credit after the project was completed for an additional $80,000 in savings.

Burns, Oregon — Harney County District Hospital

When the Harney County District Hospital Board sought to construct a new facility, they wanted to save on energy costs, but they also wished to support the woods products industry in the region. The case of the Harney County District Hospital illustrates how local knowledge and a motivated "champion" are important ingredients in implementing a woody biomass heat project. While it's a common assumption that renewable technologies usually rely on tax breaks, low interest loans or other subsidies to stay in the black, this case study shows at least one example of how biomass can compete with other energy sources on a level playing field.

The wood products industry has had a long history in Harney County. Back in 1920, the Hines Lumber Company established a mill that was the major employer in the area for several decades until it closed in the 1980s. When it was time to build a new facility for the Harney District Hospital to replace the aging building constructed in 1950, the hospital's administration and district board saw an opportunity to honor the area's heritage through woody biomass utilization. They also sought to support an industry they thought might one day revive. Concerns about sustainability, climate change and the growing recognition that human-caused carbon emissions are a factor, were also considerations in the decision to investigate woody biomass utilization.

Jim Bishop, the hospital's CEO, had previously worked locally as an engineer in the woods products industry. Other members of the hospital's board had also worked in the industry. Together, their experience was pivotal in turning their idea into a reality. Had they not been familiar with the business, there would have been a much steeper learning curve to understanding the tradeoffs associated with different types of fuel, markets, and supply sources.

Another important factor in this story was the relationship between Jim Bishop and U.S. Forest Service Forest Products Utilization and Marketing Specialist Larry Swan. Jim and Larry had worked together previously, so it was natural for Jim to turn to Larry for information about woody biomass. Larry was a critical resource for information about woody biomass technology, wood pellets, and comparable projects that had been implemented in Europe.

With the information that Larry provided, Jim did his own calculations to figure out if woody biomass might be competitive with other fuel sources to heat the new facility. He calculated that wood pellets could be cheaper in the long run compared to oil, propane and electricity. When he approached the architect and the contractor on the project, they were skeptical. Jim persisted and convinced the architect to do a feasibility study. Those calculations predicted a 15-18-year payback, but didn't include the state energy tax credit and were based on oil prices at the time.

The findings from the feasibility study weren't sufficient to sway the architect. So it was up to the board, which made an executive decision to put a wood pellet boiler in the plans just 45 days prior to ground breaking. Once the decision was made, the architect and contractor followed through and put together a design that everyone was pleased with. Since then, oil prices have increased substantially, reducing the expected payback period to 3 years.

Since a woody biomass heat system was not part of the original design, propane and electricity are used in some parts of the facility that could have been served by heat exchangers off of the main heat system. For example, propane is used for laundry facilities, heated sidewalks and garage space. (In addition, propane heat is available as a backup to the biomass system). Had these systems been integrated, Jim anticipates that there could have been even greater overall energy savings.

The 55,000-square-foot facility has annual total energy expenses at: $30,000 for propane, $77,000 for electricity and $10,000 for wood pellets.

The hospital board considered both wood chips and wood pellets when trying to decide on a fuel source. According to Jim, the benefits of wood pellets outweigh the higher cost of the fuel for all but the largest facilities or large scale uses like power plants.

Compared to wood chips, pellet systems don't require as much space for storage and for the equipment to deliver the fuel to the boiler. The board was also concerned about finding a reliable chip source that could provide consistent, quality chips. Poor quality chips and inconsistent chips can result in higher maintenance costs than anticipated. Third, the board wanted to ensure that the facility would be able to obtain fuel stocks from multiple sources and not rely on the capacity of any one supplier.

> *"Out here in Harney County, folks are just happy that we're using wood and saving money."*
>
> —Jim Bishop
> Harney County District Hospital

The hospital uses at most 100 tons of pellets per year that they obtain from Bear Mountain Forest Products, which has pellet plants in Cascade Locks and Brownsville, Oregon. Truck deliveries occur about once every six months to refill a storage silo that measures just 12 feet in diameter by 15 feet high.

The system is highly automated, requiring very little maintenance. Each day, a staff person takes a few minutes to check on the system to make sure it is running smoothly. The system generates about 30 gallons of ash every 2–3 weeks that is typically given to people in the community to use as a soil supplement.

The new hospital was financed through a combination of Medicare reimbursements, a USDA loan, and financing from local banks. But no special financial incentives tied to the use of renewable energy were factored into the feasibility analysis; proof positive that woody biomass can be a sound economic decision even without state or federal subsidies. However, the hospital finally did apply for and receive a tax waiver from the state amounting to an additional $80,000 of additional savings.

The simple fact that woody biomass was the sensible economic choice was the key to community support. Jim speculates that there might have been community resistance if the hospital was incurring additional expense only to meet environmental concerns.

"Out here in Harney County, folks are just happy that we're using wood and saving money," Jim said.

The entire system, including storage silo, occupies a total of four parking spaces. *Photo: Harney District Hospital.*

Contacts

Jim Bishop, Harney County District Hospital CEO
(541) 573-8329

Larry Swan, Fremont-Winema National Forest, Forester/Forest Products Utilization and Marketing
(541) 883-6708
lswan01@fs.fed.us

Tillamook Forest Center	
Type of Facility	Public Forest Education and Interpretive Center
Building Owner	Oregon Department of Forestry
Size of Facility	12,100 sq. ft.
Boiler System Costs	Approximately $45,000 (in 2005)
Biomass Technology	Three 140,000 Btu/hr wood pellet fire boilers
Fuel Source:	Wood pellets, locally produced from Douglas fir mill waste. West Oregon Wood Products, Columbia City, Oregon.
Annual Heat Expense:	Pellet cost delivered is about $265.00 per ton x about 24 tons / year = $6,360.00. (not including cost for electricity to operate the motors powering the heated water circulation pumps, the air system, etc.)
Expected Payback Time:	10 years compared to a propane system.
Project Status	Completed
Project Partners	Miller Hull Partnership Architects, PAE Engineers and the owner, the Oregon Department of Forestry.
Additional Funding Sources	Primarily funded by donations with seed money from Oregon Department of Forestry

Tillamook, Oregon — Tillamook Forest Interpretive Center

Every aspect of the Tillamook Forest Interpretive Center was designed with an eye on sustainability. Naturally, in choosing an energy source, woody biomass was a perfect fit. Built in 2005, the center is located in the Tillamook State Forest just west of Portland, Oregon. The interpretive mission of the Center is to teach visitors about natural resource use, conservation, sustainable forestry and the history of the devastating "Tillamook Burn" forest fires of the 1930s. Demonstrating sustainability principles throughout its design and operations compliments the Center's educational goals and activities.

Early in the development of the Center, the Oregon Department of Forestry initiated a collaborative process to identify sustainability goals. They assembled a collaborative team consisting of Miller Hull Partnership Architects, PAE Engineers and the center's owner, the Oregon Department of Forestry.

Because of its remote location, the design team was constrained to few choices for heating energy. Electricity is the only readily available energy source, but the overhead transmission lines are vulnerable to winter storms that can cause breaks in service. There is no natural gas line in the area, eliminating that option.

Paul Schwer and Conrad Brown, PAE mechanical engineers, suggested the use of woody biomass as a possible fuel source, noting that a locally produced, renewable fuel source would fit nicely with the center's mission of sustainability. Liquid propane gas (LPG), with initial costs less than that of the wood pellet boiler system, was another alternative considered, but the design team selected the woody biomass option for sustainability and long-term savings on fuel costs. Compared to the LPG boiler, the wood pellet system has a 10-15-year payback.

According to ODF project manager Frank Evans, "Wood pellets are considered a carbon neutral fuel source and they are manufactured by at least three plants within a 100 mile radius of the site. It also is made from a former waste product of the lumber processing industry. Use of this fuel source not only meets one of our sustainability goals for the TFC but it also meets part of our goal as being a center for teaching/learning about managed Northwest forests."

Once the design team decided to pursue the woody biomass option, they had some homework to do. Frank spent a lot of time on the Internet and found useful information on wood pellets from the Pellet Fuels Institute website and local pellet manufacturers, and from reading about how such systems are in use in Europe. Others on the team went to work as well.

"As experienced engineers, we're used to always having the answers, but this was a learning experience," said mechanical engineer Paul Schwer.

Rather than using wood chips which require a larger and more complicated storage and handling system, the design team agreed that wood pellets would be the better option. Being the first facility of this type in the region to invest in wood pellet technology was daunting. There were a lot of unknowns. Not having experienced owners and operators of similar boilers in the area to ask about design and maintenance has been an issue.

Luckily, the design team found a wealth of information in the late Lloyd Nichols, owner of Tarm USA, the U.S. importer of Baxi brand boilers manufactured in Denmark. Lloyd flew out from the company office in Lyme, New Hampshire, to assist with start-up and tuning of the boilers and was very helpful during the initial year of operation as the staff learned to operate and maintain the system.

Some lessons the design team learned through trial and error, including how to get the pellets from the manufacturer into the storage silo. Premium grade wood pellets are sourced locally, from West Oregon Wood Products in Columbia City, Oregon, and delivered by a local company that serves the many dairy farms in the region with feed stock. The first attempt at fuel delivery into the holding silo involved using a "bark blower" apparatus. Moving the pellets through the blower tube caused some breakage and increased sawdust in the system. Following that trial, Frank met with a feed stock delivery company to see if their truck would work for pick-up and delivery of the pellets. It's a win-win situation since the feed stock company can incorporate the delivery into their usual route. The delivery truck has a mechanical auger to transport the pellets up the delivery tube to the top of their 12-ton storage silo. They found that the pellets stayed dry and clean throughout the process and suffered minimal breakage.

A typical delivery comes 2–3 times per year and is approximately 9 tons at about $265 per ton delivered. From the silo, pellets are fed by power augers into three 140,000 Btu/hr wood pellet-fired hot water boilers that heat the 12,000-square-foot building, which has an average of 300,000 Btu/hr peak heating load.

Typically two boilers are in operation at any time, making the third available for routine cleaning or as needed

Using a grain auger from the delivery truck, the silo is refilled about 2-3 times per year. *Photo: Oregon Dept. of Forestry.*

Contacts

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Paul Schwer, PAE Consulting Engineers, Inc.
(503) 226-2921
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for backup. Combustion gases from each boiler heat water, which is then transferred to the heating coil in the main air handler and in the zone hot water heating coils. There, the heated water warms air that is then delivered throughout the building via a conventional forced air HVAC system.

No special permits were required for the wood pellet boiler system since it produces hot water rather than pressurized steam. Regulations on steam boilers are more stringent and require periodic inspections. Additionally, combustion within the boiler is highly efficient with minimal emissions, below levels that would require a special permit from the Oregon Department of Environmental Quality.

Once again, there was a learning curve to the initial operations and maintenance of the system. Involving the maintenance staff early in the design phase helped minimize the learning curve and ensured that the system was designed with daily routines in mind.

On a typical day it takes just a few minutes to check on the boilers and ensure that the fuel feeding system and air controls are adjusted for optimum operation. Every few days during peak heating season, the hoppers are refilled via manual controls that regulate the delivery from the storage silo. Once every 1–2 weeks the heat exchanger tubes are cleaned to maintain maximum efficiency; this process can be done while the boiler is operating and takes 5–10 minutes for each boiler. After 3–4 weeks of operation each boiler is shut down to remove a few gallons of accumulated ash, which is used as a soil additive around the center's grounds.

Local support for the project has been strong and comes from wood products industries, elected officials and visitors to the center. A guided tour of the mechanical room with a focus on the boilers is a highlight of many visitors' trip to the center.

When asked if other owners are considering woody biomass, Paul says people simply don't know about the technology and are skeptical of investing in something that is unfamiliar. But he added that a number of college campuses have set sustainability goals and may think more seriously about woody biomass because of efforts to reduce carbon emissions.

The storage silo for pellets is accessible, but unobtrusive towards the rear of the building. *Photo: Oregon Dept. of Forestry.*

Potential Project Partners

Non-Governmental Organizations, Private Firms and Agencies

There are many possible partners involved in the development and implementation of a biomass project. Each brings valuable information and expertise to the process. Furthermore, the social, environmental and economic benefits of woody biomass utilization mean that there are many opportunities to collaborate and create win-win scenarios.

For example, in the case study featuring the Enterprise School District, Wallowa Resources, a local NGO, was an important partner in securing funding for a pre-feasibility study, providing information to community leaders and helping to identify sustainable fuel sources.

Private firms not only provide the expertise in architecture, engineering and contracting, they can often provide insights about maintenance requirements, permitting information and financing opportunities.

Third, building owners can turn to local and state agencies to assist in financing and permitting. Public lands managers interested in supporting local jobs in the wood products industry and finding ways to utilize slash from logging operations or fuels reduction work can also help in the process.

Biomass Energy Resource Center (BERC)

Based in Vermont, BERC has over 20 years of experience working with schools, communities, colleges, businesses, utilities, and government agencies to develop economical and efficient solutions to energy systems using biomass. BERC provides a range of services from pre-feasibility studies through project design and management. In addition to experience in finding the right technology for a given project, BERC has experience conducting education and outreach, building interagency partnerships and developing financing options.

Check out their website at www.biomasscenter.org

This new boiler house operates on wood chips serving heat to multiple public school buildings in Darby, MT. Multiple partners contributed to the success of this project including the Darby School District, BERC, U.S. Forest Service, CTA Architects and Engineers, Bitterroot RC & D and the University of Montana. *Photo: Dan Bihn.*

Step	Potential Project Partners
1. Pre-feasibility Study	• Non-governmental organizations • Energy services company (ESCO) • Fuels for Schools Program • Biomass Energy Resource Center • Architects, engineers and contractors • Universities
2. Feasibility Study/Energy Audit	• Non-governmental organizations • Energy services company (ESCO) • Wood chip and pellet equipment manufacturers
3. Identify a Feedstock Supply	• Public land management agencies • Wood pellet manufacturers • Local biomass collaboratives and community forestry organizations • Private woodlot owners and associations • Local wood products manufacturers and logging contractors • Resource conservation and development councils
4. Community Involvement	• Non-governmental organizations • Fuels for Schools Program • Local biomass collaboratives and community forestry organizations
5. Financing	• Energy services company (ESCO) • State Departments of Energy • USDA • Private financial firms • Energy Saving Performance Contract
6. Permitting	• County or municipal planning agency • State Departments of Environmental Quality
7. Design and Construction	• Energy services companies (ESCO) • Architects, engineers and contractors

for information about different biomass fuels, technologies, project design and implementation.

Fuels for Schools Program

The Fuels for Schools Program provides information, technical assistance and funding for pre-feasibility studies for schools interested in biomass system conversions. The program started in Vermont in the 1980s, and has since expanded to the Northern and Intermountain regions with support from USDA Forest Service.

In regions where the Fuels for Schools Program has been established, state coordinators serve as a liaison between building owners and a host of resources including information on technology, financing options and education and outreach materials.

CTA, a national architecture and engineering firm, works in partnership with the Fuels for Schools Program to do site visits and conduct pre-feasibility studies. In some cases CTA will go on to be the primary on an Energy Savings Performance Contract (ESPC) or they may be able to recommend other firms in your area.

Currently the Fuels for Schools Program has not been established in the Pacific Northwest Region, however, pending the outcome of federal budgetary processes, there may be opportunities for schools to receive funding for pre-feasibility studies in the near future. Until then, the Fuels for Schools Program website provides links to useful information, contacts and example projects. www.fuelsforschools.info

Project feasibility depends on many variables

- Heat needs and costs
- Biomass technology
- Potential fuel supply
- Environmental impacts/permitting
- Financing
- Construction and site characteristics

This fully automated inclined chip conveyer moves chips from the storage bin to the combustion chamber. *Photo: BERC.*

Non-Governmental Organizations And Programs		
Biomass Energy Resource Center (BERC)	Tim Maker Senior Program Director (802)-223-7770 tmaker@biomasscenter.org	www.biomasscenter.org/
Central Oregon Intergovernmental Council	Phil Chang Program Administrator 541-548-9534 pchang@coic.org	www.coic.org
Flexible Energy Communities Initiative	Carla Harper Program Manager (970) 565-6061	www.fleci.org
Fuels For Schools Program Intermountain Region	Angela Farr Montana DNRC Biomass Utilization Specialist 406) 542-4239 afarr@mt.gov	www.fuelsforschools.info
Mount Adams Resource Stewards Glenwood, WA	Jay McLaughlin Executive Director jay-mars@gorge.net (509) 364-4110	www.mtadamsstewards.org
Resource Innovations Eugene, OR	Marcus Kauffman Program Manager (541) 346-0661 marcusk@uoregon.edu	http://ri.uoregon.edu/
Sustainable Northwest Portland, OR	Chad Davis Program Associate (503) 221-6911 x110 cdavis@sustainablenorthwest.org	www.sustainablenorthwest.org
Wallowa Resources Enterprise, OR	Nils Christoffersen Executive Director (541) 426-8053 x25 nils@wallowaresources.org	www.wallowaresources.org
Watershed Research and Training Center Hayfork, CA	Nick Goulette Deputy Director (530) 628-4206 nickg@hayfork.net	www.thewatershedcenter.com

Financial Incentives

With interest in renewable energy and enegy efficiency on the rise, there are a number of incentives to help private and public entities finance their biomass projects. Grants, low interst loans and tax credits are a few means to improve the bottom line. Available options vary from state to state; this section provides a quick overview followed by a list of contacts to find more information pertinent to your situation and locale.

USDA Renewable Energy and Energy Efficiency Programs

The U.S. Department of Agriculture offers several programs that provide assistance with the capital costs of projects that use renewable energy or generate renewable energy.

Through one of several Community Facilities Programs, public entities, non-profits, faith-based organizations and tribes as well as project partners including banks, utility cooperatives, and economic development groups may be eligible for low interest direct loans, loan guarantees or grants for joint public/private renewable and energy efficiency projects.

For private firms, the "Section 9006" program provides grants and loan guarantees to rural, small businesses and agricultural producers to support renewable energy generating facilities as well as energy efficiency measures. There are also incentives to implement value-added ventures to produce fuel stocks and promote research and development.

State Programs

Each state in the Pacific Northwest offers different types of financial incentives to promote renewable energy development and energy efficiency. One such tool, the *Energy Savings Performance Contract* (ESPC) is used in Washington, Idaho, Oregon and California. These contracts are used to finance project costs by borrowing against future energy cost savings. The next section goes into greater detail on ESPC's and

The wood products industry has a long history in the Pacific Northwest, yet the infrastructure to harvest, process and transport woody biomass continues to develop. Numerous state and financial incentives are available to catalyze investment in renewable energy projects that support local economies and national energy independence.

Photo: Resources Innovations.

provides contacts for more information.

Of all the states in the Pacific Northwest, only the State of **Oregon** promotes renewable energy through a state tax credit known as the "BETC" for *Business Energy Tax Credit*. Although they don't pay taxes to the state, public and non-profit entities can also benefit from the BETC program through the pass-through option. The program offers a tax credit of up to 50% of eligible costs depending on the type of project. The tax credit is taken over a 5-year period with 10% deducted during the first two years followed by three years at 5%. The pass-through option allows public entities and non-profits to partner with a private firm such that the private firm receives the tax benefit and passes on a portion of the savings as a payment to the non-profit or public agency.

Public and private entities, non-profits and tribal organizations can also take advantage of **Oregon's** *State Energy Loan Program* (SELP). Managed by the **Oregon** Department of Energy, Conservation Division, the program offers low-interest loans for a variety of project types including those that save energy and those that produce renewable energy sources such as wood chips and pellets.

Like Oregon, **California** is pushing renewable energy and efficiency with its *Energy Efficiency Financing Program*. The program offers low interest loans to cities, counties, public school districts and other public entities for feasibility studies and energy efficiency projects. The state of **California** also has two programs to offer technical assistance for feasibility studies, project design and contractor selection with projects to upgrade existing facilities or for new construction. *The Bright Schools Program* specifically serves schools and the *Energy Partnership Program* provides the same services to local governments, hospitals, other public entities, and non-profits.

Private and commercial firms in **California** should get in touch with the *State Assistance Fund for Enterprise,*

State and Federal Resources for Information about Grants, Loans and Tax Incentives		
USDA Rural Development (Washington)	Tuana Jones Business & Cooperative Program Director (360) 704-7707 tuana.jones@wa.usda.gov	www.rurdev.usda.gov/wa/
USDA Rural Development (Idaho)	Daryl G. Moser Business & Cooperative Program Director (208) 378-5623 daryl.moser@id.usda.gov	www.rurdev.usda.gov/id/
USDA Rural Development (Oregon)	Don Hollis State Renewable Energy Coordinator (541) 278 8049 x 129 don.hollis@or.usda.gov	www.rurdev.usda.gov/or/
USDA Rural Development (California)	Chuck Clendenin Business & Cooperative Program Director (530) 792-5825 chuck.clendenin@ca.usda.gov	www.rurdev.usda.gov/ca/
Oregon Department of Energy, Conservation Division	Mark Kendall Manager of Policy and Operations (503) 378-6043 mark.w.kendall@state.or.us	www.oregon.gov/ENERGY/
Idaho Office of Energy Resources	Terry Hoebelheinrich Energy Economist (208) 287-4899 terry.hoebelheinrich@oer.idaho.gov	www.energy.idaho.gov
Washington State Department of Community, Trade & Economic Development	Peter Moulton Washington State Bioenergy Coordinator (360) 725-3116 petermo@cted.wa.gov	www.bioenergy.wa.gov
California Energy Commission	Elizabeth Shirakh Energy Specialist (916)654-4089 eshirakh@energy.state.ca.us	www.energy.ca.gov

A mountain of wood chips is ready to produce heat for the drying kilns at the Prineville Sawmill Company. *Photo: Resource Innovations.*

Other Resources for Information about Financial Incentives		
Database of State Incentives for Renewables and Efficiency (Nationwide)	*A project of the North Carolina Solar Center and the Interstate Renewable Energy Council (IREC)*	www.dsireusa.org
SAFE-BIDCO (California)	Scott Huberts (707) 577-8621 wsh@safe-bidco.com	www.safe-bidco.com

Business, and Industrial Development Corporation (SAFE-BIDCO). SAFE-BIDCO offers low-interest loans and grants for renewable energy related projects in **California.**

In 2006 the State of **Washington** launched the *Energy Freedom Fund Program* with an initial commitment of $23 million in low interest loans and grants to promote bioenergy utilization. The program is open to public entities, private firms, non-profits and tribes to support the capital costs of bioenergy research, technology development, production and utilization. Projects must demonstrate a 50% match and support energy independence and local job creation. The Quillayute Valley School District on the Olympic Peninsula received a grant of $1 million in support of their effort to install a wood chip boiler system to replace their aging fuel oil boiler.

As of 2008, all funds in the program have been committed. The state is not accepting new applications until the legislature approves additional funding or replenishes the program after current loans are repaid to the program.

But there may be other opportunities to promote biomass utilization through state-sponsored economic development initiatives. **Washington** promotes economic development in rural communities through the *Community Economic Revitalization Board* (CERB). CERB provides low-interest loans and grants to local governments to develop infrastructure for industrial growth and job creation. On the private side, manufacturing and processing firms can work with the Washington Economic Financial Development Authority (WEFDA) to apply for the *Tax-Exempt Economic Development Bonds Program*. This program provides capital to private firms for projects that benefit the public.

To promote renewable energy initiatives and energy efficiency, the State of **Idaho** offers a low-interest loan program for up to $100,000 of project costs. Loans are available to individuals, organizations and businesses at 4% over a five-year period.

Energy Savings Performance Contracts

An Energy Savings Performance Contract (ESPC) in an agreement that provides building owners with reliable returns on investments to improve energy efficiency. The contact between a building owner and Energy Service Company (ESCO) allows the building owner to use guaranteed cost savings from energy efficiencies to pay off the loan that financed the facility upgrades. If the cost savings are less than the guaranteed amount, the ESCO pays the building owner. In addition to financing, other services can be bundled into the contract including energy auditing, design, and project management.

Legislation in many states including California, Washington, Idaho and Oregon allows public agencies to enter into such contracts using best-value criteria such as past performance, technical expertise and other factors rather than just the lowest bid. Some states take an active role and work closely with the building owners and ESCOs to ensure the process goes smoothly.

Often the project involves a comprehensive energy audit to identify all the potentially cost-effective upgrades including changes to heating, lighting, HVAC infrastructure, insulation, windows and energy control devices.

ESPCs are also a good option for building owners who don't have project management experience or the time to manage all the aspects of a traditional design-bid-build process. Whereas a traditional process involves separate solicitations for energy efficiency studies, design work and construction, the ESPC combines these into one request for proposals (RFP). Although an ESPC can reduce the up-front costs for the building owner as well as the risk and uncertainty in a project, ESPCs may not be the least-cost-financing option. To find out more about ESCOs, contact a representative at your state's Department of Energy.

An Energy Savings Performance Contract (ESPC) allows a building owner to finance the costs of energy efficiency upgrades with guaranteed energy savings.

Questions about Energy Savings Performance Contracts		
Oregon Department of Energy, Conservation Division	Brandon Adams (503) 378-5054 brandon.adams@state.or.us	www.oregon.gov/ENERGY/
Idaho Office of Energy Resources	John Crockett (208) 287-4894 john.crockett@oer.idaho.gov	www.energy.idaho.gov
Washington State Department of General Administration	Roger Wigfield Energy Program Manager (360) 9027198 rwigfie@ga.wa.gov	www.ga.wa.gov/energy/
California Energy Commission	Elizabeth Shirakh Energy Specialist (916) 654-4089 eshirakh@energy.state.ca.us	www.energy.ca.gov

Air Quality and Permitting

Compared to a typical residential wood stove, modern woody biomass boilers are much more efficient and consequently emit far fewer emissions. However, they do emit pollutants worthy of noting, particularly carbon monoxide (CO), nitrogen oxides (NOx), particulate matter (PM), sulfur dioxide (SO_2), carbon dioxide (CO_2) and volatile organic compounds (VOCs).

Compared to coal fired boilers, biomass boilers emit less PM, NOx, and CO, but they emit more PM and CO than fuel oil, natural gas and propane boilers. While some small and medium size systems don't produce sufficient emissions to require a special air quality permit, larger systems that exceed certain thresholds may require a permit from the state agency that manages air quality such as the Department of Environmental Quality (DEQ). As well, there may be restrictions related to land-use compatibility. While the fees for processing a permit may not be a "deal breaker" if mitigation technologies are required, they can be very expensive.

The specifics vary from state to state, but generally follow this process.

1. Seek approval from the local land-use authority to obtain a land-use compatibility statement.
2. File a notice to construct including designs specifications with the state DEQ.
3. If the design specifications indicate that an air quality permit is required, obtain consent to construct which could include a requirement to install devices to filter or remove pollutants from the emissions.

Consistent size, shape, and low moisture content ensure wood pellets burn efficiently in this wood pellet boiler. *Photo: Dan Bihn*

4. Following construction and inspection, obtain an operating permit from the state DEQ.

To find out more about air quality and permit requirements, contact a representative at your state's DEQ.

Carbon and Climate Change

Biomass utilization benefits the global carbon budget in multiple ways. Biomass energy is considered carbon neutral because the combustion of biomass releases CO_2 that was sequestered from the atmosphere during plant growth. Thus, replacing a fossil fuel system with a biomass system results in a net decrease in carbon emissions. For example, converting an existing gas or oil system to wood can reduce CO2 emissions from 75-90%.[3] Also, recent research on forests that have a natural cycle of low-severity fires shows that large carbon emissions from catastrophic fires can be mitigated by thinning. Thinned forests exhibit higher growth rates sequestering carbon in larger, more fire-resistant trees. [4]

3 Biomass Energy Resource Center. http://www.biomass-center.org/information/climate-change.html (accessed July 22, 2008)

4 Carbon protection and fire risk reduction: towards a full accounting of forest carbon offsets. M.D. Hurteau, G.W. Koch, and B.A. Hungate. Front Ecol Environ 2008; 6, doi:10.1890/070187.

State Departments Of Environmental Quality		
Oregon Department of Environmental Quality	Mark Fisher Senior Permit Writer (503) 229-5696	www.oregon.gov/DEQ/
Idaho Department of Environmental Quality Air Quality Division	Bill Rogers Permit Program Coordinator (208) 373-0437 William.rogers@deq.idaho.gov	www.deq.state.id.us/about/divisions/air.cfm
Washington Department of Ecology	Greg Flibbert (509) 329-3452 gfli461@ecy.wa.gov	www.ecy.wa.gov/programs/air/airhome.html
California Environmental Protection Agency Air Resources Board	Kitty Howard Stationary Source Division Manager (916) 322-3984 khoward@arb.ca.gov	www.arb.ca.gov

Burning slash in the forest produces greater emissions than controlled combustion systems such as biomass boilers. *Photo: Dan Bihn*

Informational Websites

Pellet Fuels Institute
www.pelletheat.org

U.S. Department of Energy – Energy Efficiency and Renewable Energy
www.eere.energy.gov

Climate Trust
Portland, Oregon
www.climatetrust.org

Michigan Wood Energy
Ann Arbor, Michigan
www.michiganwoodenergy.org

Flexible Energy Communities
Cortez, Colorado
www.communitybiomass.com

To Do List

Now that you've got some of the basics on biomass, its time to roll up your sleeves and dig deeper. Read through the following case studies for a few more insights on specific projects in the Pacific Northwest, and then use this checklist to work towards putting biomass to work for you.

- Gather information on utility bills and heat requirements.
- Think about whether your facility might benefit from other energy upgrades (insulation, climate controls, lighting, etc.).
- Contact BERC or Fuels For Schools and Beyond to find out about resources to do a pre-feasibility study.
- Contact representative at your state's Department of Energy to find out about available financial incentives.
- Identify possible fuel sources. Contact public land management agencies in your area and ask about the availability of wood chips from forest management practices. Call producers and vendors of wood pellets in your region.
- Contact a non-profit in your region that has experience in promoting biomass utilization or community forestry.
- Research an architecture and engineering firm in your area to find one with experience installing biomass heat systems.

References

Wood Chip Heating Systems: A Guide for Institutional and Commercial Biomass Installations. By Timothy M. Maker. Biomass Energy Resource Center. 2nd ed. 2005.

Wood Pellet Heating: A Reference on Wood Pellet Fuels & Technology for Small Commercial & Industrial Facilities. By the Biomass Energy Resource Center. Massachusetts Division of Energy Resources. 2007.

Where Wood Works: Strategies for Heating with Woody Biomass. Flexible Energy Communities Initiative. 2007.

Resources and Contacts

Architecture And Engineering		
BBI International Consulting Golden, CO	Brian Duff (303) 526-5655 bduff@bbibiofuels.com	www.bbibiofuels.com
CTA Architects and Engineers Billings, MT	Nick Salmon (406) 728-9522 nicks@ctagroup.com	www.ctagroup.com
PAE Consulting Engineers, Inc. Portland, OR	Paul Schwer (503) 226-2921 pauls@pae-engineers.com	www.pae-engineers.com
McKinstry Co. Portland, OR	Cam Hamilton (503) 331-0234 CameronH@Mckinstry.com	www.mckinstry.com
Boiler Vendors		
Chiptec Williston, VT	(800) 244-4146 BobBender@Chiptec.com	www.chiptec.com
Fink Machine Inc. Enderby, BC Canada	(250) 838-0077 fink@jetstream.net	www.finkmachine.com
Greenwood Technologies Bellevue , WA	(800) 959-9184 inquiry@greenwoodusa.com	www.greenwoodfurnace.com
Messersmith Bark River, MI	(906) 466-9010 sales@burnchips.com	www.burnchips.com
Solagen Deer Island, OR	(506) 366-4210 solagen@solageninc.com	www.solageninc.com
Tarm Oak Creek, CO	(877) 789-9276 info@woodboilers.com	www.woodboilers.com
Wood Pellet Vendors		
Bear Mountain Forest Products Cascade Locks, OR	(541) 374-8844 ahaden@bmfp.com	www.bmfp.com
Blue Mountain Lumber Products LLC Pendleton, OR	541-276-4304 dodge@bluemountainlumber.com	www.bluemtnlumber.com
Lignetics, Inc. Sandpoint, ID	(208) 263-0564 info@lignetics.com	www.lignetics.com
West Oregon Wood Products Columbia City, OR	(503) 397-6707 csharron@wowpellets.com	www.wowpellets.com

Fuel reduction projects can generate large volumes of woody debris that used to be considered waste. Increasingly, communities are finding ways to utilize this material in biomass heat projects that save money and reduce their dependence on fossil fuels. *Photo: USDA NRCS*

Woody Biomass Conversion Factors[1]

Summarized below are some woody biomass conversion factors that are commonly used by natural resource managers in the Pacific Northwest:

Wood-chip Volume Factors

1 green ton (GT) of chips	=	2000 lbs.
1 bone dry ton (BDT) chips	=	2.0 GT
1 bone dry ton (BDT)	=	1000 lbs
1 cord	=	128 cubic feet
1 cord	=	2500 lbs
1 ccf (hundred cubic feet)	=	100 cubic feet
1 ccf of logs	=	1.2 BDT chips

Sawlog Volume Factors

board foot (BF) volume is a measure equivalent to wood volume of 12" x 12" x 1" thick

1 MBF	=	1,000 BF
1 MBF	=	6 GT of logs
1 GT of logs	=	160 BF of lumber

Transportation Factors

1 standard chip van	=	25 green tons
1 standard chip van	=	12.5 BDT (assuming 50% moisture content)
1 standard log truck	=	25 green tons
1 standard log truck	=	10 cords
1 standard log truck	=	12.8 ccf or 1280 cubic feet
1 standard log truck	=	4.5 MBF or 4500 BF

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Electricity Factors

When woody biomass is utilized in a commercial (10+ MW electrical output) scale power generation facility the following energy output rules of thumb apply:

1 BDT woody fuel	=	10,000 lbs. of steam
1 megawatt hour (MWH)	=	10,000 lbs. of steam
1 BDT woody fuel	=	1 MWH
1 MW	=	1,000 horsepower
1 MW	=	power for approximately 750 to 1,000 homes annually.

Thermal Energy Factors

1 lb woody fuel	=	7,870 Btu
1 lb sawdust/shavings	=	3,850 Btu
1 therm	=	100,000 Btu
1 BDT woody fuel	=	78.7 therms
1 BDT sawdust/shavings	=	38.5 therms
1 ton of wood pellets	=	156 therms

1 Rural Voices for Conservation Coalition. 2007. Woody Biomass Briefing Paper.

Glossary

Btu — A British thermal unit is the standard measure of energy content equal to the amount needed to raise the temperature of one pound of water 1 degree Fahrenheit.

Cash Flow Analysis — Compared to a simple payback calculation, a cash flow analysis is a more complex way to estimate if a project is financially viable. Included are the costs of financing the capital, operations and maintenance, repairs and replacement parts and price of inflation.

CHP or Cogen Plant — A facility that produces both heat and electricity. (CHP — Combined Heat and Power)

Cyclone Separator — A device that reduces particulate matter emissions by creating a vortex that separates solid particles from the gases. These devices are most effective at removing the larger particle sizes, but less effective at reducing the smallest particles.

District Heating — A system in which a central boiler plant serves multiple buildings via a hot water or steam distribution system.

Electrostatic Precipitator — A particulate collection device that removes particles from combustion gases using an electrostatic charge.

Energy Savings Performance Contract (ESPC) — A contract between a building owner and an Energy Service Company (ESCO) for energy efficiency upgrades in which the project costs are financed by guaranteed energy cost savings. ESPCs also bundle services such as energy auditing, design, project management and post-project monitoring into one contract.

Energy Service Company (ESCO) — A company that provides a broad array of services (including feasibility analysis, energy efficiency audit, project design and management) to a building owner through an Energy Savings Performance Contract.

Gasifier — Short for a close-coupled gasifier. This system first converts biomass to combustible gases that are then burned in an adjacent chamber to produce heat.

Hog Fuel — Biomass fuel that is made from grinding up different types of wood. It could include mill scrap, bark, slash and sawdust. Generally hog fuel refers to variable low-quality fuel.

Life Cycle Cost Analysis — Similar to a cash flow analysis in that the same variables are included, but normalizes the costs to the net present value. Typically the analysis is done out to 30 years.

Simple Payback — A time period calculated by dividing the incremental project costs increase by the annual savings per year, often used as a rough estimation of cost-effectiveness.

Therm — A unit of heat energy equivalent to 100,000 Btu, which is about the amount obtained from burning 100 cubic feet of natural gas.

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