Developing a Wood Pellet/ Densified Biomass Industry in Washington State: Opportunities and Challenges

A Report to the Washington State Legislature

December 2012

WASHINGTON STATE UNIVERSITY
EXTENSION ENERGY PROGRAM

www.energy.wsu.edu

Densified biomass: Part of Washington's energy solution

The Washington State University (WSU) Energy Program was directed by the Washington State Legislature [3ESHB-2127, section 603 (8)] to conduct a study of densified biomass as a renewable fuel for heating homes, businesses and other facilities in our state. This report to Governor Chris Gregoire and the Legislature presents a summary of the WSU Energy Program's densified biomass study findings.

Washington's pellet mill industry has shrunk by one-third in recent years, primarily due to the facilities' debt loads.

- In 2009, three mills – located in Omak, Shelton and Tacoma – had a combined capacity of 180,000 tons per year. Another mill in Skagit County was in the permitting process, but never opened.
- By 2012, the state had only two operating mills – Olympus Pellets in Shelton and Manke in Tacoma – with a combined capacity of 160,000 tons per year.

This report provides insights to reinvigorate the densified biomass/wood pellet industry in Washington, which will leverage our region's extensive biomass resources and provide renewable energy to homes, businesses and industries. The goal of this effort is to prompt focused discussions about – and support the possible development of – an investment-grade business plan and feasibility study to get Washington's densified biomass/wood pellet industry back on its feet.

What is densified biomass?

Raw biomass materials, such as forest slash and construction waste, are irregular in shape, low in energy density, greatly affected by moisture, and can be difficult to transport.

Biomass densification solves these problems by compressing sawdust and chipped wood to create solid biofuel pellets that provide consistent quality, low moisture content, high energy density and homogenous size and shape.

Densification increases the energy density of biomass by approximately 10 to 15 percent, so more heat is produced per unit of pellets burned than if the same amount of raw wood was burned.

Opportunities

Wood pellets are a clean alternative to fossil fuels

Pellets made from wood shavings and sawdust offer environmental advantages over traditional fuels such as heating oil and natural gas.[1] Wood pellets produce smaller volumes of hydrocarbons – such as methane – and carbon dioxide (CO_2) when burned in an approved pellet stove. CO_2 that is released when wood pellets are burned is considered to be carbon neutral; that is, this fuel does not add to or reduce the amount of carbon in the atmosphere.

When plants are living, they take CO_2 out of the atmosphere; when plants die and are used as fuel, the same amount of CO_2 is released back into the atmosphere. Fossilized fuels, on the other hand, store CO_2 for very long periods of time, so when natural gas or fuel oil is burned, CO_2 that has been out of circulation for thousands of years is released, which is perceived as a net increase in the atmospheric CO_2 concentration.

Biomass harvested from unhealthy forests can help restore forest health

In major portions of the western U.S. and Canada, forests have become unhealthy and overgrown, which significantly increases the risk of catastrophic forest fires. In Washington, legislation has been passed [Revised Code of Washington 76.06] to address forest health issues.

Timber from state lands affected by pine beetles can provide a constant near-term supply of feedstock for the wood pellet industry. In addition to removing this infected biomass from the forest, harvesting dead and dying trees provides an economic benefit that can help pay for programs to restore the forests to good health. For example, selling merchantable logs allowed the U.S. Forest Service to apply treatments to many more acres of ailing forests than they were able to afford without these economic benefits.[2]

The Washington State Department of Natural Resources (DNR) provides leadership in the sustainable use of forest biomass to produce renewable energy. DNR conducted a major review of the state's forest practices rules, including forest biomass,[3] and developed a detailed sustainable forest biomass supply assessment.[4] DNR is proceeding to develop and issue biomass supply contracts for sale of biomass materials.

Using urban sources of biomass keeps waste out of landfills

Urban wood waste includes construction and demolition debris that do not contain lead paint or metals. Recycling these organic materials is consistent with a long-standing policy goal of Washington to reduce the volume of waste that is disposed of in landfills.

According to the latest annual ***Solid Waste Status Report*** prepared by the Washington State Department of Ecology,[5] approximately 22 percent of urban waste is made up of woody materials. While much of this is already being separated from the urban waste stream, a sizable amount of woody material – 100 million tons per year – could be diverted from landfills and used as pellet mill feedstock.

Rural areas present opportunities for pellet mill development

While most of our urban areas have access to pipeline natural gas – which we rely on to fuel our industries and heat our homes – it is not readily available in many rural areas. Liquefied natural gas can be trucked to remote areas, but this is very expensive.

Areas that are not currently served by pipeline natural gas are the best areas in the state to develop the densified biomass pellet mill industry. These include much of the Olympic Peninsula and the Cascades, where woody biomass feedstock is locally available. Mills in these areas will produce a fuel that is less expensive than the petroleum alternatives.

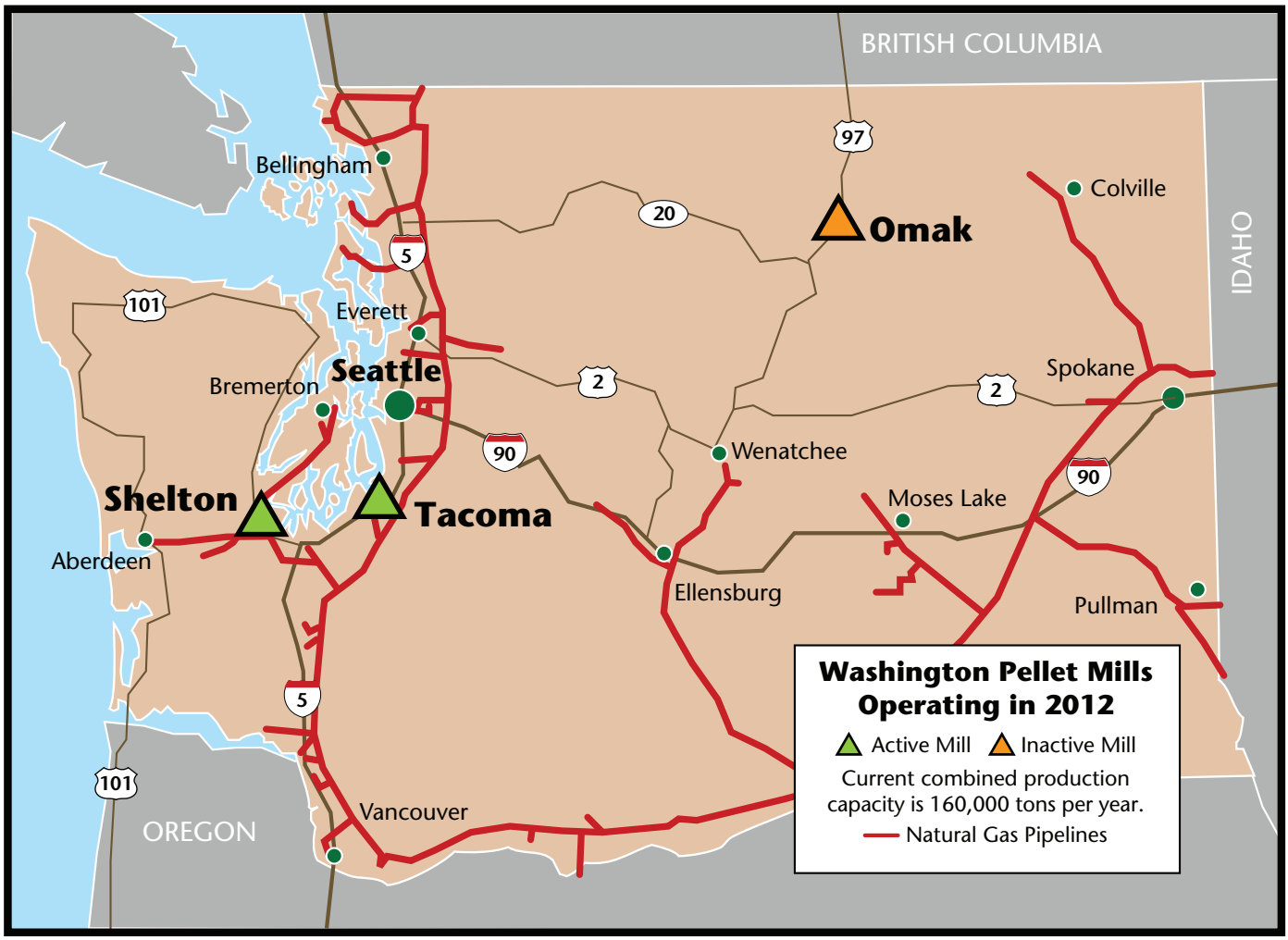
Pellet fuels are a valuable commodity in-state and beyond

Cultivate in-state anchor tenants for fuel use

One strategy that has proven effective is to build demand for pellet fuels by developing large anchor tenants that use large volumes of wood pellets. This demand, in turn, supports the industries that supply pellet fuels.

Commercial, institutional and industrial facilities that currently use diesel, fuel oil and propane could switch to wood pellets and serve as anchor tenants to support the development of pellet mills. These include food processing facilities; correctional facilities; asphalt, concrete and petrochemical companies; and schools.

The wood pellet industry tends to be seasonal, peaking in the winter when heating needs are highest. An ideal anchor tenant would be summer seasonal or year-round to balance winter heating.



Export to foreign markets

Wood pellets could also be exported to Asian or European markets, but this is a more complex market to enter than the in-state market.

Tough competition already exists from the southeastern U.S. and Canada, which are well established in the export market and have lower price structures than Washington. The southeastern U.S., with a faster-growing timber cycle and less rugged terrain, has competitive advantages that have allowed its export market to expand.

International pellet standards (principally defined by established European standards) are significantly more stringent[6] than the voluntary U.S. standards developed by the Pellet Fuels Institute.[7] To enter the international market, U.S. pellet mills will need to meet these international standards.

Wood pellets for a new boiler are unloaded at Sealaska's headquarters in Juneau. *Casey Kelly photo.*

Build demand then build supply: the Sealaska approach

Sealaska, an economic development corporation for Southeast Alaska Native Americans, took an interesting approach to develop a pellet mill industry in Southeast Alaska. First, it focused on building baseload demand in larger facilities. When volume reaches sufficient levels, a pellet mill will be developed to meet that demand.

Early steps have included converting the heating system in Sealaska's four-story headquarters building to wood pellets, eliminating the need for 35,000 gallons per year of heating oil.

This approach is now supported by the Alaska Energy Authority, the U.S. Coast Guard and the U.S. Forest Service. An interagency agreement has been signed between the U.S. Coast Guard and the U.S. Forest Service. A second major facility considering conversion to wood pellets is the U.S. Coast Guard Station in Ketchikan, AK, which will also help to build regional demand for the wood pellet industry.

Applying the Sealaska strategy in Washington

The north Olympic Peninsula has several major commercial, industrial and institutional facilities that could switch from fuel oil to wood pellets, including Clallam Bay Corrections Center, Olympic Corrections Center, Lakeside Industries in Port Angeles and the U.S. Coast Guard Group in Port Angeles.

Taken together, these facilities could build market demand for densified biomass products that, in turn, could allow a forest products/ pulp and paper mill to establish local pellet mill production. Anticipated residential wood pellet sales would build on this foundation.

An additional challenge is commodity purchase expectations (*"We buy what is on the market today"*) versus the need for multi-year contracts between buyer and seller to enable capital investment in pellet mill production facilities.

For these reasons, the export market for wood pellets does not currently look as promising as the domestic market.

Challenges

Forces competing with pellet mill development

The wood pellet industry in rural Washington faces a variety of competitive forces, including:

- Cheap and plentiful oil and natural gas,
- Reduced need for fuels, due to enhanced energy efficiency, and
- Competition for biomass feedstock.

Cheap and plentiful oil and natural gas

Fuel oil prices in the U.S. are dropping compared to the world market price as fracking technology is used to produce large volumes of oil and natural gas. For the first time in decades, U.S. oil prices are below world market prices. The U.S. demand for foreign oil is also dropping, which frees significant global oil resources for Asia and Europe, dampening the potential export market for densified biomass products.

Industrial and institutional facilities – in areas that are not served with natural gas pipelines – could use liquefied natural gas that is brought in by truck instead of wood pellets to meet their demand for thermal energy.

Enhanced energy efficiency

By reducing the need for energy, technologies such as variable refrigerant flow heat pumps become an alternative fuel source – and a significant competitive risk for the wood pellet market.

The table below compares the cost to produce a specific amount of heat using various fuels. At $18.94 per unit of heat delivered, the heat produced from wood pellets is significantly less expensive than heat produced by electric baseboard heaters, fuel oil and propane, and more expensive than heat produced using heat pumps and firewood.

Competition for biomass

Pellet mills need a cheap and reliable source of wood waste materials. Competition and prices for this feedstock fluctuate as emerging uses compete for this resource:

- **Alternative wood products** – Recycle One of Tacoma is producing a composite wood fiber/plastic board for construction uses.

- **Aviation biofuel** – The market demand for aviation biofuel and other advanced biofuel alternatives has triggered a race to complete the research and develop these biofuels from woody biomass.

- **Biochar** – Biochar made from woody biomass – an alternative to activated carbon make from petroleum coke – is used to restore disturbed soils and remediate soil contamination. The Washington State Department of Ecology is supporting research at WSU to develop engineered biochars.[9]

- **Bioproducts and nutraceuticals** – This emerging industry aims to offset petro-chemicals used to produce fragrances, food-stuffs and dietary supplements and promises the most lucrative market competition for woody biomass.

Scrap wood from construction and furniture making is an excellent source of biomass raw materials.

Comparisons of the costs to produce a specific amount of heat using various fuels.

Fuel	Units	MMBTU/ Unit [a]	Fuel Cost per Unit	Efficiency Percentage	Cost/ MMBTU
Heat pump	$/kWh	.003147	$0.11	200% [b]	$13.78
Cord wood	$/Cord	18	$175.00	60%	$16.20
Wood pellets	**$/ton**	**16.5**	**$250.00**	**80%**	**$18.94**
Baseboard electric	$/kWh	.003147	$0.11	100%	$31.14
#2 Fuel oil	$/gal	.1396	$3.50	80%	$31.34
Propane	$/Gal	.0915	$2.50	80%	$34.15

Source: *http://www.wired.com/autopia/2011/11/aviation-biofuel*

[a] MMBtu is the abbreviation for one thousand thousand British thermal units, which is a unit of heat.

[b] Variable refrigerant flow heat pump systems can range from 150 to 400 percent efficiency, with a typical value of 250 percent. However, below 0°F, these heat pumps have reduced ability to keep a building warm. In harsher winter climates, such as northeastern Washington, a backup heating system is needed.

Feedstock harvesting and transportation costs

New techniques and equipment for rapidly pulling logging slash out of the woods promise to improve access to forest biomass. For example, chip trucks with log truck frames and rear-wheel steering provide better access to forest biomass supplies, and new methods of chipping the wood allow for faster loading and higher-quality chips.

To reduce the costs of transporting biomass to pellet mills, it is helpful to look at a remedy that has been successfully employed in British Columbia and Idaho, where higher weight limits on the roads significantly improve efficiencies of hauling feedstock materials. This approach is also supported by proposed federal legislation that would allow trucks with an extra axle to haul heavier loads of agricultural and forest products. However, truck lengths are not increased with this proposal.

Volatility in the wood pellet marketplace

Pellet fuel manufacturers should secure their supply of feedstock years in advance to avoid price fluctuations due to dips in feedstock availability and increases in use, such as during a cold snap. This will also enable pellet mills to stabilize their product supplies so consumers feel confident relying on this fuel source as a viable alternative to electricity, propane or fuel oil.

Supporting the pellet mill industry

Despite the cautions mentioned above, investors in Washington are finding many promising opportunities in the densified biomass/pellet mill industry. The pellet mill industry has an opportunity to increase demand for its products, provide a clean energy alternative to industries and homes especially in rural areas of our state, and convert wood waste into a valuable commodity while reducing landfill impacts. Like other emerging bioenergy industries, it needs on-going technical and programmatic support to achieve these goals.

Alaska Airlines, based in Seattle, is an industry leader in aviation biofuel.

The next step is to guide the pellet mill industry as it works to develop market demand.

Washington tax incentives

Further exploration and follow-up analysis is needed to identify opportunities to use New Markets Tax Credits and Industrial Revenue Bonds with the Washington State Housing Finance Commission. Washington has three tax incentives that support development of the pellet mill industry:

- A reduction of the business and occupation tax rate to 0.138 percent on gross revenues from manufacture of wood biomass fuel [RCW 82.04.260(1)(F)]. No expiration date. This tax rate compares to a manufacturing rate of 0.484 percent [RCW 82.04.240].

- A six-year property and leasehold tax exemption on buildings, equipment and property used to manufacture wood biomass fuel [RCW 84.36.640 and 82.29A.135]. This tax exemption is scheduled for expedited Tax Preference Performance Review in 2013 by the Joint Legislative Audit and Review Committee. The deadline for applications for this tax incentive is December 31, 2015.

- While Washington taxes logging slash coming from the forests as a forest product ("stumpage value"), it also provides a business and occupation tax credit for forest-derived biomass sold or used to produce electricity, steam, heat or biofuel. The credit is $3.00/green ton through June 30, 2013 and $5.00/green ton though June 30, 2015.

Federal tax incentives

There are no residential or commercial federal tax incentives for converting to wood pellet heat from fuel oil, residual oil or propane *(http://www.irs.gov/uac/Energy-Incentives-for-Individuals-in-the-American-Recovery-and-Reinvestment-Act)*. The residential energy credit for this conversion expired in 2011.

The federal business development programs under the U.S. Department of Agriculture Rural Development Agency are a source of federal incentive funding. For developing a new pellet mill, possibilities to explore include:

- **Industrial Revenue Bonds** – These are the equivalent of tax-free municipal bonds that do not loan the full faith and credit of the state. They function under federal tax law and are administered by the Washington Housing Finance Commission. Montana is pursuing this tax pathway for a pellet mill for the export market.

- **New Markets Tax Credit** – *http://www.irs.gov/pub/irs-utl/atgnmtc.pdf*

Carbon credits

Carbon credit markets continue to emerge and develop, presenting opportunities to support the development of the pellet mill industry. Financial incentives based on carbon emission reductions are continuing to develop. An on-going analysis of this opportunity is needed in conjunction with developments in climate change policy.

- **British Columbia** established a carbon tax on a revenue-neutral basis. This system does not need a carbon market.

Wood pellets, packaged for market, are moved at the Olympus Pellet Mill in Shelton, WA.

- **Oregon** established a non-profit organization called ***The Climate Trust***. It directly funds projects around the Northwest that reduce greenhouse gases *(http://www.climatetrust.org/index.html)*. The Climate Trust funded the Fuels for Schools program to shift rural schools off of fuel oil to wood waste boilers or pellet boilers. This program has been discontinued as cap and trade markets have emerged.

- The **California** carbon cap and trade system held its first auction of "tradable carbon allowances" in October 2012. Each allowance – selling for $10.09 – represents the right to emit one ton of carbon. This market is governed by the California Air Resources Board under the Global Warming Solutions Act of 2006 [AB 32]. A key current lawsuit hinges on whether buyers are paying a fee to emit or are being taxed.

- Voluntary carbon markets, such as the **Climate Action Reserve** (*http://www.climateactionreserve.org/*) also bear watching for market incentives. Rigorous ground rules have been developed in recent years to establish greater market discipline.

State policies

While Washington state has not yet clearly focused on developing the densified biomass/pellet mill industry, a number of supportive policies are in place:

- **Beyond Waste** – Development of new landfills is very difficult and expensive. Alternatives such has recycling, composting organics and developing beneficial uses of materials otherwise heading to a landfill have been part of state law since 1971 [RCW 70.93]. Organics materials management in particular focuses on wood recycling. The Beyond Waste policy approach is found at *http://www.ecy.wa.gov/beyondwaste/*.

- **Sustainable forest biomass** – DNR has taken the lead on developing forest biomass policy [RCW 79.150]. This legislation was preceded by forest biomass energy demonstration project legislation in 2009. The statewide sustainable forest biomass supply assessment fits in this policy context.

- **Forest health** – Forest health issues are also a policy driver to encourage the development of economic uses for wood biomass. Oregon is the most aggressive state in dealing with this problem. Governor Kitzhaber's 2013-2015 budget includes $4 million in state funds to support forest health restoration work on state forest lands.

- **State energy policy** – For over three decades, Washington state energy policy has principally, but not exclusively, focused on electricity energy policy. RCW 43.21F.010 (3) states in part "to promote energy self-sufficiency through the use of indigenous and renewable energy sources, consistent with the promotion of reliable energy sources, the general welfare, and the protection of environmental quality."

  In addition, RCW 43.21F.088 sets forth principles to guide development and implementation of the state's energy strategy. Subsection 10 (d) states: "Reduce dependence on fossil fuel energy sources through improved efficiency and development of cleaner energy sources, such as bioenergy, low-carbon energy sources, and natural gas, and leveraging the indigenous resources of the state for the production of clean energy." Within this legislative context, densified biomass and use of wood pellets promotes energy self-sufficiency and reduces dependence on fossil fuels.

- **Climate change** – Greenhouse gases emissions are limited to 1990 levels by 2020, with further reductions in 2035 and 2050 [RCW 70.235.020]. In addition, Chapter 163, laws of 2009, states in Section 1: "Utilizing forest biomass to generate energy can reduce the greenhouse gases emitted by burning forest biomass." The use of wood pellets to offset petroleum products reduces greenhouse gases. Climate change policy options were developed in the ***2012 State Energy Strategy***, Chapter 6 *(http://www.commerce.wa.gov/Documents/EO2012WAEnergyStrategy.pdf)*.

The white marks are the results of the deadly pine beetle. Dead timber from state and federal lands affected by pine beetles are a good source of biomass raw materials.

Several additional state policies and programs would further enhance the development of a densified biomass/pellet mill industry.

Thermal energy policy

Building on the ***2012 State Energy Strategy***, there has been a growing awareness of the need to develop thermal energy policies. The Cascade Power Group developed the ***Clean Energy Roadmap: Washington State*** (*http://www.northwestcleanenergy.org/NwChpDocs/WA%20Clean%20Energy%20Roadmap%202012.pdf)*. This work and the thermal energy baseline[10] developed by the WSU Energy Program provide an analytical basis to further develop thermal energy policy, with the goal of further reducing dependence on petroleum products.

A number of state and local facilities use petroleum products – principally fuel oil – to provide heat and/or steam. Shifting from these sources to wood pellet systems will not only reduce operating budget costs; these facilities will also become anchor tenants for the pellet mill industry. Further support of Fuels for Schools programs (such as Montana's program, *http://www.fuelsforschools.info/*) will help local school districts with high heating bills.

Looking ahead

The densified biomass study by the WSU Energy Program, as summarized here, focuses on a sustainable way to meet rural Washington's energy needs. By differentiating between the state's two energy economies – those with and those without pipeline natural gas – this study also examines how to move the wood pellet industry forward.

Wood pellets can provide heat while saving money, reducing greenhouse emissions and reducing use of fossil fuels.

Considerable work still needs to be done to build on the assessment given here. The WSU Energy Program looks forward to continuing this effort.

The comprehensive densified biomass study will be available on the WSU Energy Program website (*http://www.energy.wsu.edu*) in early 2013.

---

[1] *The Pellet Handbook*, Table 9.7, page 314.

[2] Estimated by the U.S. Forest Service, Region 6.

[3] The Forest Practices Biomass Work Group developed a set of recommendations that were submitted to Forest Practices Board in August 2012: *(http://www.dnr.wa.gov/Research-Science/Topics/OtherConservation Information/Pages/em_forest_practices _workgroup_resources.aspx)*

[4] DNR, *"Washington Forest Biomass Supply Assessment,"* March 2012: *http://www.dnr.wa.gov/Publications/em_finalreport_wash_forest_biomass_supply_assess.pdf*

[5] Available at *http://www.ecy.wa.gov/ programs/swfa/solid wastedata/report.asp*

[6] The European wood pellet standards test for additives, energy content and heavy metals that are not currently specified in the U.S. wood pellet standards.

[7] *http://pelletheat.org/pfi-standards/*

[9] For additional information, see the Pacific Region Biomass Partnership website *(http://pacificbiomass.org/Library.aspx).* "Introduction" *(http://pacificbiomass.org/Library.aspx#Introduction)* and Biochar: Background & Early Steps to Market Development *(http://pacificbiomass.org/documents/Biochar%20Backgound%20and%20Early%20Steps%20to%20PNW%20Market%20Development%2010%202012%201207.pdf)*

[10] The WSU Energy Program compiled a thermal energy baseline of all boilers in the state permitted by the regional clean air agencies and the Department of Ecology Industrial Section.

Wood Pellet Basics

Biomass feedstock

Ideally, biomass used to make wood pellets is sourced from an established biomass waste stream such as sawdust from a mill, pine beetle-infested logs, or clean waste wood from construction or furniture making. In Washington state, wood waste from logging and mill residues make up the majority of feedstocks used for pelletizing.

The type of raw material determines the amount of grinding and drying needed before the conditioning process. If a feedstock is not in a raw state, such as with reclaimed wood, only grinding and minimal drying may be necessary.

Purchasing the biomass feedstock is the most costly aspect of pellet production. Drying the raw materials is the most energy-intensive aspect of pellet production.

Energy balance

The energy balance is the energy inputs and outputs of a process or system. For pellet production, the energy balance can be divided into three sections: harvesting forest byproduct feedstock – which includes transportation to the sawmill; producing the pellets; and transporting the finished product to the point of sale.

The net energy balance for wood pellets is strongly positive, as explained in detail in the complete study that will be available on the WSU Energy Program website in early 2013. The energy embedded in the wood pellets significantly exceeds the energy used to create them.

U.S. pellet standards

To help standardize pellet production across the industry in the U.S. and adhere to the U.S. Environmental Protection Agency's wood-burning emissions requirements, the Pellet Fuels Institute (PFI) developed standards for pellet fuel producers. At this time, adherence to these standards is voluntary.

Due to the variability of feedstocks and proprietary production techniques of individual manufacturers, wood pellets are defined by their feedstock source, density, moisture levels and ash content and are then categorized as Premium, Standard or Utility. This information helps consumers understand what to expect from the pellets they purchase to heat their homes, businesses or schools.

So far, 40 U.S. pellet mills have agreed to adhere to these standards, but none of the pellet mills in Washington have yet agreed to follow them.

European pellet standards

The main differences between the PFI standards and the European standards are in material origins, additives, net energy value and regulated contaminants.

The voluntary European pellet standards (*http://biowatt.ru/files/docs/gost/pellets-standard-en14961-1.pdf*) were created to ensure a reliable biomass commodity and consistent quality standards along the entire supply chain, from raw material to delivery. The primary emphasis was to provide a product with quantified energy content and validated origin source information that consumers could use to help make informed purchasing decisions. These standards also address source and quality concerns that exist around products made from biomass, which had led to earlier market volatility.

Pellet manufacturing

Fuel pellets can be manufactured from various types of biomass feedstocks, from corn stover to hard woods. Raw biomass is densified to increase the energy content of the biomass per unit weight so it can compete with oil, propane and other fuels.

The biomass densification process includes:

- Feeding the feedstock into a dryer;
- Grinding it to the required size;
- Conditioning the mixture, which involves reducing moisture of the feedstock for efficient use with pellet equipment;
- Pelletizing, cooling and screening the pellets; and
- Packaging the product for storage, shipping and sales.

WASHINGTON STATE UNIVERSITY
EXTENSION ENERGY PROGRAM

Our Mission

To advance environmental and economic well-being by providing unmatched energy services, products, education and information based on world-class research.

About Us

Our staff of approximately 100 people (energy engineers, energy specialists, technical experts, software developers, energy research librarians, and more) work out of our Olympia, Spokane and satellite offices. Operating similar to a consulting firm, the WSU Energy Program is a self-supported department within the University.

WSUEEP12-083 • December 2012

905 Plum Street SE
P.O. Box 43165
Olympia, WA 98504-3165

360-956-2000