FOR 207

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Wood to Energy: Use of the Forest Biomass for Wood Pellets[1]

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Introduction

Wood pellets are small "nuggets" of compressed, sawdust-size wood fiber (Figure 1). People all over the world use wood pellets to generate heat and energy from renewable resources. Wood pellets are cylindrical with standard diameters of 6 and 8 (± 0.5) mm and lengths up to four times the diameter (Alakangas 2006). Their compact size and portability, their high energy density, their low moisture content (below 10%), and their minimal net carbon output make wood pellets very appealing as a renewable energy source. Adding to their appeal, wood pellets are easily adaptable to automated combustion systems, and, with carefully controlled combustion, their emissions can be rendered marginal. A variety of wood sources (feedstock) can be used to produce pellets. Utilization standards, transportation and capital costs, and availability can be critical limiting factors in feedstock selection.

Figure 1. Wood pellets made from southern yellow pine.
Credits: M. Marinescu

Current Feedstock Sources for Wood Pellets

Most of the feedstock for pellet production is currently comprised of *pulpwood chips* (Figure 2) from both hardwood and softwood species. Softwood species include pine, fir, and spruce. Hardwood species include oaks, birches, beeches, willows, and poplars. Most producers prefer softwood to hardwood sources because softwood, due to its lower density, is

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easier to chip and mill into pellets than hardwood. However, feedstock supply and pellet prices favorable to hardwood pellets could easily change this preference. For both hardwoods and softwoods, stem wood is preferred over other parts of the tree (bark, roots, tops, and limbs), because wood pellets as a commodity product, require homogeneity and predictability of burning (combustion) characteristics. For example, wood pellets produced from tree branches and tops have high ash and bark content, which could limit their access to pellet markets where strict standards for these characteristics exist (e.g. European pellet markets).

Figure 2. Pulpwood chips, stored in piles, ready to enter the pellet manufacturing process. Credits: M. Marinescu

Sawmilling residues, such as planer shavings and sawdust, are another feedstock for wood pellet production. Because they are a byproduct of the lumber manufacturing process, sawmilling residues require little or no drying before entering pellet production. In regions where sawmilling residues have no competing use (e.g. animal bedding, engineered wood products), their cost to wood pellet manufacturing facilities could be low. Conversely, in regions where the sawmilling residues are used extensively for engineered wood products (medium density fiberboard - MDF), or as fuel to generate heat for lumber driers, the competition for sawmilling residues could lead to higher than average feedstock costs (Bergman and Zerbe 2008).

New Feedstock Sources for Wood Pellets

Harvesting debris or logging residues (Figure 3) such as tops, limbs, and roots, and forest understory (Figure 4) are promising feedstock alternatives for wood pellets.

Figure 3. Harvesting debris is left on the ground in piles. Credits: M. Marinescu

Figure 4. Forest understory comprised of bushes and small diameter trees. Credits: M. Marinescu

Forest understory is comprised of all non-merchantable biomass (unsuitable for high-value wood products, such as pulpwood, saw timber, etc.). Forest understory biomass typically consists of shrubs and small-diameter (approximately five inches or lower diameter at breast height), underdeveloped, and non-merchantable trees. To prevent catastrophic fires, forest understory is usually burned under strict regulations (prescriptions). Instead, forest understory biomass could be used as a renewable resource for conversion to a variety of fuels and energy applications, including wood pellets. These feedstock sources could become more profitable with the introduction of fuel reduction contracts between industry, government, and residents in areas affected by forest fires (Neary and Zieroth 2007). Forest understory as feedstock for wood pellets provides a venue for using invasive species such as kudzu, bamboo, Chinese tallow, and cogon grass (Figure 5). However, forest understory feedstock may contain

significant amounts of bark, leaves, needles, dirt, and rocks that can cause substantial production inefficiencies and substandard pellets. Also, the removal of forest understory biomass could deplete the forest ecosystems of nutrients. Considerably more research and development is necessary to assess the sustainability of these emerging feedstock sources and to improve their combusting characteristics.

Figure 5. Cogon grass in a pine stand. Credits: Rick Williams

Another potential feedstock for wood pellets is comprised of plantations of short rotation trees, also known as energy crops (Bain and Overend, 2002). Targeted for energy crops are fast growing tree species such as eucalyptus, paulownia, willows, poplar, and aspen. Energy crops could be established on marginal lands, although species selection will still have to depend on their requirements for water, soil type, and geo-climatic conditions. The benefits of well-established energy crops are: a reliable and consistent inventory, an easy-to-plan harvesting cycle, and a well-defined supply chain. The drawbacks are initial capital investment in land, equipment, seedlings, and labor, and the operational costs of maintaining and harvesting the crops. Also, there are risks associated with species selection. For example, willows are usually harvested four years after planting; there is little guarantee that bioenergy markets at the time of harvest would be the same as when the willows were planted (Gigler 1999).

Another possible feedstock for wood pellets is the *construction and demolition waste and natural disaster woody debris*. As more houses are built and forest lands are cleared for development or as a result of natural disasters (e.g. hurricanes), vast amounts of woody biomass are trucked for burial in landfills. Unfortunately, the rigors of processing this feedstock into wood pellets, combined with the extraneous material this feedstock contains, make it more suitable to burning in large biomass combustors because of their higher tolerance for foreign material and size variability.

Is It Feasible?

An important question regarding feedstock for wood pellets is whether it is economically feasible. In 2008, average wood prices for pellet plants in the United States followed the reported prices of pulpwood (Bergman and Zerbe, 2008). This has much to do with the fact that, except for pulpwood, a robust commodity market for biomass does not exist. The wood pellet industry has seen notable growth in the past decade because the cost of wood pellets to the home consumer has been less than that of electricity, propane, kerosene, or natural gas (EIA 2008). The vast majority of domestic wood pellet consumption is in the (colder) northern states and, therefore, an increase in pellet production and demand for forest biomass feedstock in those states is expected. The biomass-rich southeastern states, including Florida, are seeing a dramatic growth in the pellet production sector, although the majority of pellets are being shipped to European Union bioenergy markets. The two largest facilities in the world were built in 2007 in the United States South: one in Cottondale, Florida (capacity of 550,000 tons of pellets) and another in Selma, Alabama (capacity of 500,000 tons of wood pellets). All the wood pellets produced by these two facilities will be shipped to Europe by boat to be burned in European biomass power plants. Both of these production facilities are using pulpwood pine trees and pine pulp chips in their operations. The influence of these new plants on pulpwood prices is difficult to predict but expected to be significant in the long run.

Research Needs

Currently, there are more questions than answers about the sustainability of forest biomass as feedstock for wood pellets and other bio-fuels. From an ecological perspective, an important research question is whether the removal of more forest biomass than is traditionally harvested for timber will

deplete the forest ecosystems of soil nutrients, decrease wildlife habitat, or harm the water tables. Although studies are starting to emerge for and against the use of forest biomass, the issue demands considerably more research. From a social perspective, the benefits of biomass use for bioenergy are reflected in more "green," high-paying jobs. However, considerably more research is needed to understand what the trade-offs are with the other sectors impacted by the emerging bioenergy sector. From an economic perspective, there is an acute need for comprehensive research into the feasibility of each feedstock source. In addition, research and Extension projects are needed to study and enhance the access of forest landowners and the bioenergy sector to carbon credit markets.

References

Alakangas, E., J. Valtanen, and J. Levlin. CEN technical specification for solid biofuels – fuel specification and classes. Biomass and Bioenergy 2006; 30: 908-914.

Bain, R. L. and R. P. Overend. 2002. Biomass for heat and power. Forest Products Journal 52 (2): 12-19.

Bergman, R. and J. Zerbe. Primer on wood biomass for energy. USDA Forest Service, State and Private Forestry Technology Marketing Unit, Forest Products Laboratory, Madison, Wisconsin, 2008.

Energy Information Administration. Renewable energy annual: 2006 edition, EIA 2008.

Gigler, J.K, M. Gerrit, and M. T. H. Eligius. Willow supply strategies to energy plants. Biomass and Bioenergy 1999;17:185-198.

Neary, D.G. and E. J. Zieroth. Forest bioenergy system to reduce the hazard of wildfires: White Mountains, Arizona. Biomass and Bioenergy 2007; 31:638-345.