Wood Energy: Understanding the Forest Connection

INTRODUCTION. The renewed interest in using wood as a renewable energy feedstock has been brought about by recent national and international concerns related to energy production, to include energy security concerns, the nonrenewable nature of fossil fuels, and environmental concerns regarding combustion of coal. Woody biomass feedstock is often produced from low-quality trees and tree residues often referred to as unmerchantable trees, slash or forest residues and for the following energy technologies.

● Liquid Biofuels: Liquid or gaseous fuel made from wood chips produced from trees or forest residues that have gone through a thermal or chemical process.

● Electricity: In the U.S., wood chips or a mix of wood chips and coal are burned in boilers or gasifiers to produce electricity. In Europe and other countries, the preferred fuel is wood pellets because of their density and ease of handling related to transporting pellets in bulk.

● Combined heat and power: Multiple forms of energy (heat, process steam, and power) using boilers or gasifiers – often for industries or institutions.

With this renewed interest come many questions about the production of this feedstock from natural and planted forests. This publication addresses many of the concerns about feedstock production and the markets influence on production of the feedstock.

WHO OWNS THE FEEDSTOCK. In the southern U.S. forests dominate the landscape, making it an ideal location to obtain woody biomass feedstock—a basic raw material from which higher value products are derived. There are approximately 215 million acres of forestland in the south with approximately 87 percent in private ownership and 13 percent in public ownership (Figure 1) (Smith, et al. 2009). Natural forests, those from natural origin, make up 80 percent of these forests. The remaining 20

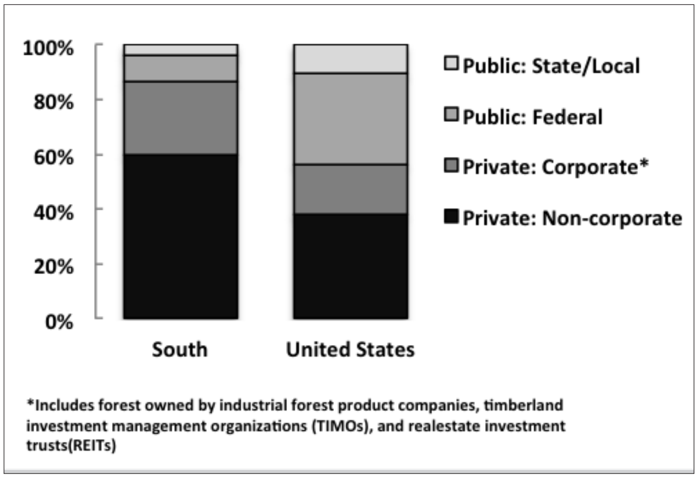

Figure 1. Profile of forest ownership, 2007

percent are plantations. Natural forests are those established from natural origin, that is they regenerated from seed, existing seedlings, root suckers, and stump sprouts. Of the 215 million acres of forestland almost 90 percent is in private ownership.

OBTAINING THE FEEDSTOCK. In the Southeast U.S., woody biomass feedstock for energy production traditionally comes from trees and tree residues that are often left behind following a partial or "complete" harvest. Which trees and tree residues are cut and removed, and which are left behind following a harvest, is significantly influenced in the short-term (week-to-week) by mill inventories and in the long-term with mill openings and closings. Loggers remain in business by exploiting small profit margins, and at times, by necessity. Decisions are made daily on the harvest site based on several factors including:

- Tree Quality: The quality of the standing trees for conventional roundwood markets are highly influenced by past management decisions. For example, a bottomland hardwood stand selectively logged of the top quality trees for decades, often lacks the quantity of trees to produce enough merchantable roundwood stems to haul to traditional markets. Energy markets provide an opportunity to harvest these types of forests and begin meaningful management again.

- Transportation Costs: A large portion, 25-50 percent, of the total delivered costs is associated with the cost of transporting the raw material to the mill (Mayo et.al., 2002). These transportation costs are influenced by hauling distance, fuel prices, vehicle capacity and other factors. For example a logger may be operating near an energy plant but at some distance from a paper or OSB mill such that it makes economic sense to haul some of the material as energy wood thus saving diesel fuel and driver labor.

- Production capacity: Once a facility meets its market quota loggers are often unable to deliver the harvested raw materials to the mills. Because of the market it often does not make economic sense to accumulate low-value pulp or OSB stems at the deck to be hauled to an OSB mill or pulp mill, when the energy plants need material now.

- Wood Supply Chain Concerns: For example, equipment failures at the mill. A roundwood unloader at the mill may be out of service increasing the downtime of log trucks waiting to unload their loads. This reduces the efficiency of logging, causing increased cost in labor and transportation.

Although what is harvested from the forest somewhat differs from locale to locale and over time, some generalizations can be made.

TRADITIONAL FEEDSTOCK? In general terms, harvested trees are sorted into three general product classes; sawtimber, pulpwood, and residuals. The product class into which a tree is placed will be based on the tree's species, size and quality (Figures 2 and 3). Sawtimber and pulpwood trees are often cut into logs that are sorted into 2 or three product classes. Sawtimber from species such as oak, yellow poplar, and loblolly pine that have little to no defects are of high economic value to the landowner and are often sent to mills that produce high-value products such as veneer, poles and pilings, and dimensional lumber that is used in furniture, flooring, and cabinetry. Large diameter stems of

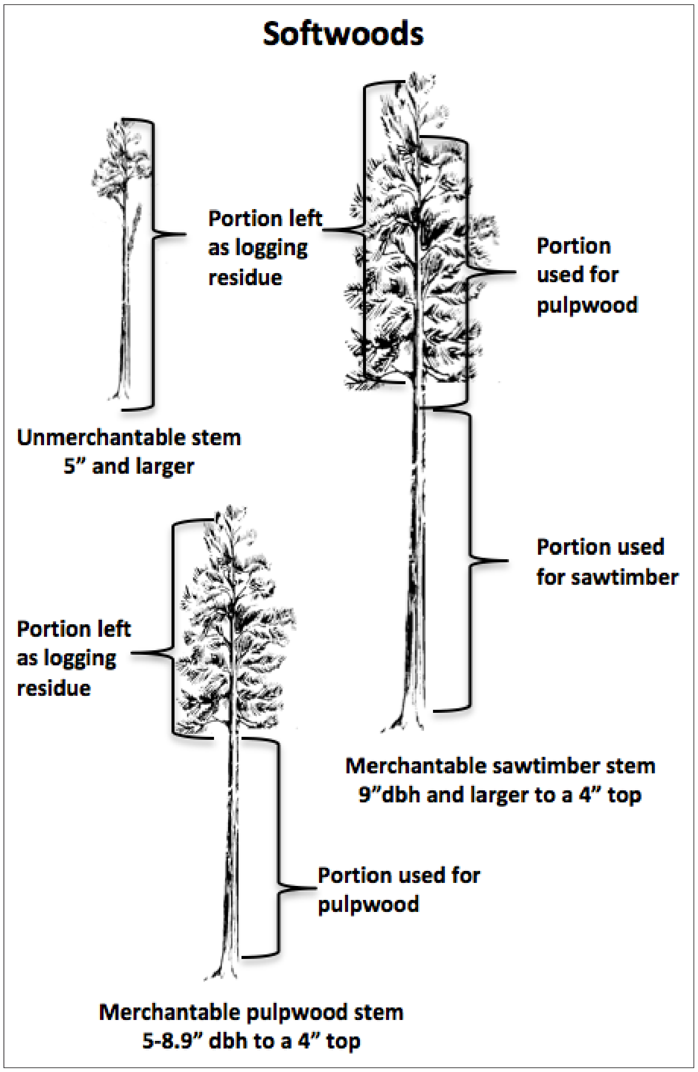

Figure 2. General product classes for softwoods in the southeast U.S.

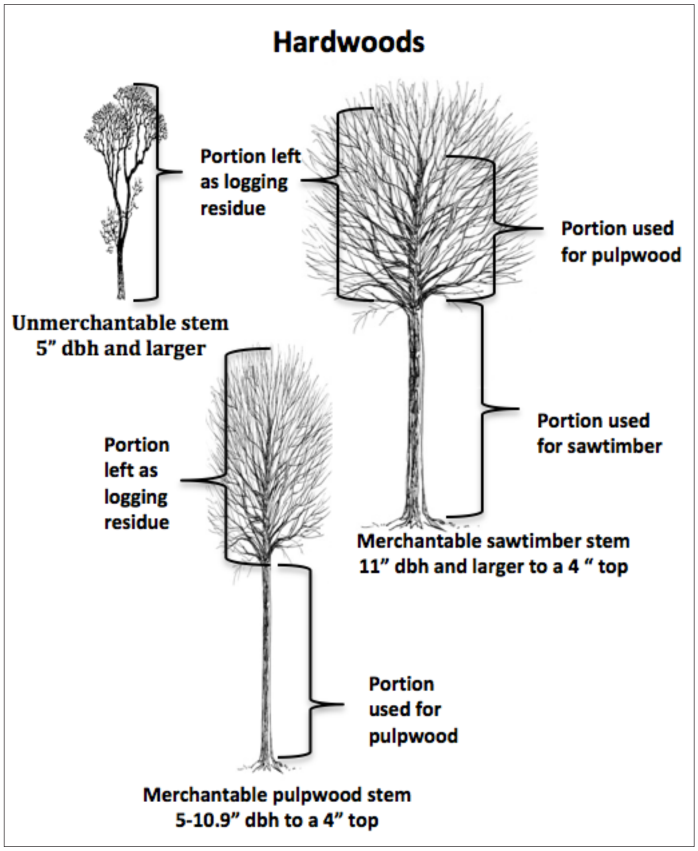

Figure 3. General product classes for hardwoods in the southeast

poor quality or any larger stem from non-lumber species, such as red maple or sweetgum are of medium to low economic value to landowners and are often used in the production of pallets, railroad ties, or pulp depending on local markets. Pulpwood often provides the least economic return to landowners and is used in the production of pulp and products such as oriented strand board (OSB), depending on local markets. All of this material described can be considered "roundwood" and leaves the site on log trailers.

TRADITIONAL RESIDUES? Type and extent of residue varies according to the type of harvest being conducted and the local markets. If it is a precommercial thinning, a thinning where the landowner pays the cost for the thinning operation because low value markets do not exist, non-crop stems are left where cut or knocked to the ground. If it is a commercial thinning or final harvest, unmerchantable trees, trees with no market value because of species, quality or size, are often cut and left on the ground or knocked to the ground by the logging equipment. This unmerchantable material is often considered "logging residues" and can include any pulpwood size or sawtimber size stems or stem portions not marketable because of lack of local markets, however temporary. Also left as logging residues are limbs and tops scattered across the site that were broken off during harvesting. At the log decks where limbs and tops are separated from merchantable roundwood, there often remain large volumes of this additional logging residue. Large unusable tree butts may also be left at the deck.

WHERE ENERGY MARKETS EXIST. With this new market, the logging residues that were traditionally left behind are now economically recoverable and may result in a landowner receiving a few extra dollars for the material removed. The logging residue that is recoverable is processed at the same time as the roundwood for the traditional markets.

ENERGY MARKETS BENEFIT LANDOWNERS THROUGH:

- *Improved aesthetics through cleaner logging*
- *Reduced site prep costs*
- *Reduced planting costs*
- *Reduced fire risk*
- *Reduced insect and disease risks*

For the most part, trees utilized in the traditional markets will be cut, sorted into their various product classes, and sent to the mills as when there is no wood energy market. The small stems and unmerchantable trees that were traditionally left are now harvested at the same time as the merchantable trees in the traditional markets resulting in cleaner harvest sites and increased utilization. The logging residues are bunched by the cutter as biomass and hauled to the deck for chipping as fuel chips. Also, the limbs and tops separated from roundwood at the deck are chipped as fuel chips. These chips will be delivered to energy companies to produce energy. For larger unmerchantable stems, they are skidded to the deck to be topped, delimbed, and loaded on log trucks as roundwood to be delivered to pellet mills or other facilities that use low value feedstock.

NOT ALL LOGGING RESIDUE IS RECOVERABLE. Limbs and tops of trees, which break off during felling and skidding are normally not economically recoverable and remain where they break off. Low-quality and large-diameter roundwood butt trimmings may be too large for the chipper and remain on site unless a tub grinder is used to recovers their biomass. The amount of residue left behind post harvest is considerable, as shown by research conducted by Osborne (2012) (Figure 4). Similar results were also documented by Briedis et.al. (2011).

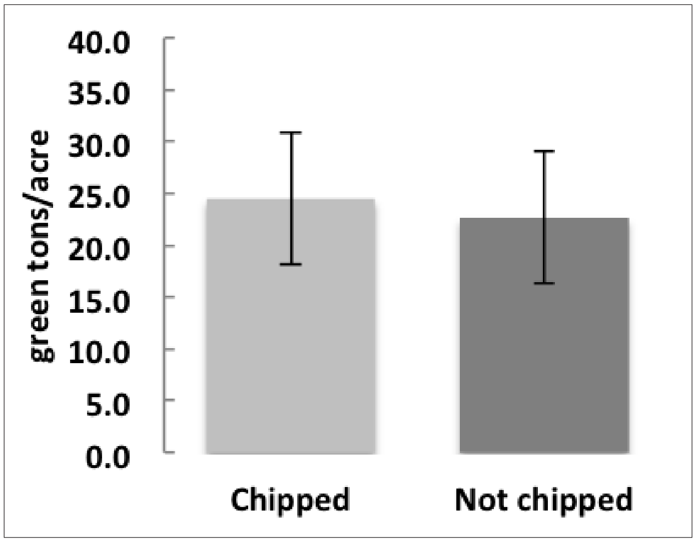

Figure 4. Average volume of downed woody material left on site following a final harvest with and without chipping of biomass feedstock in the piedmont and coastal plain of North Carolina (Osborne, 2012.)

HOW DOES ECONOMICS FACTOR INTO WHAT GOES TO WHAT MILL? Woody biomass feedstock is a low value product in which the price paid often barely covers the cost of harvesting the feedstock. The price paid for delivery of the feedstock must cover logging and transportation costs, profit to the logger and to the extent that there is any money left, stumpage offered to grower (Figure 5). This market often only covers the costs of production and overhead, keeps work force employed or increases harvest efficiency, safety, and reduces average cost of harvesting of the more valued product classes. In most cases, for the logger to cover their costs and maximize their profits, it is in their interest to deliver the timber for its highest and best use.

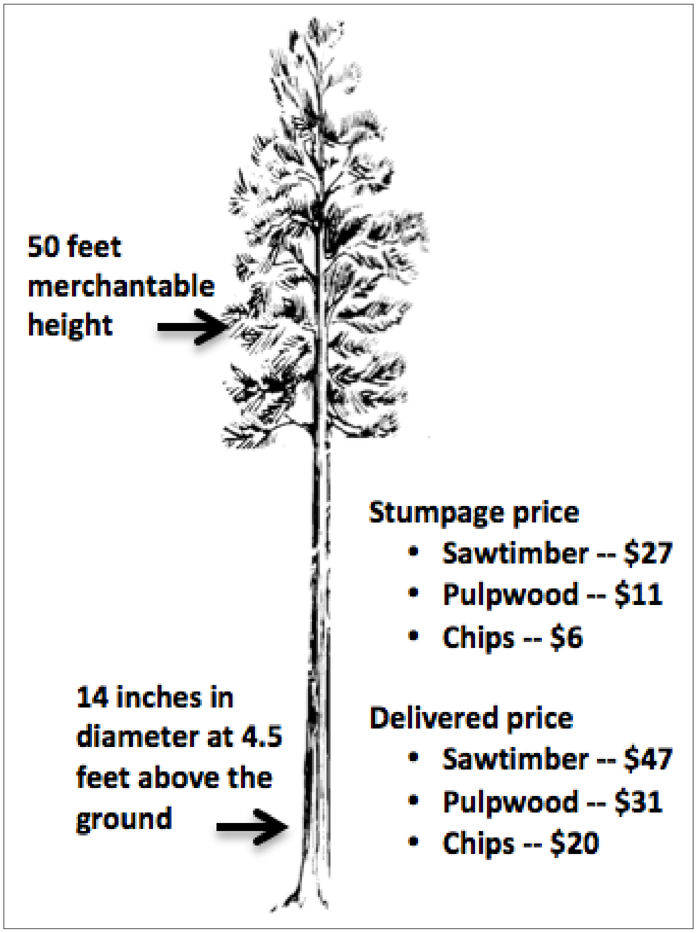

Figure 5. Example of the stumpage and delivered values of a softwood tree in southeast U.S.

SUMMARY Nationally and internationally there has been a renewed interest in using woody biomass feedstocks in the production of energy, with the southeastern US being ideally situated to provide this feedstock. New markets are being created for wood that, until now, has been considered unmerchantable material due to lack of markets or poor quality stems. These new markets can bring better utilization of logging residues, reduce risks for landowners and increase economic returns, while leaving ample logging residue for productivity, water quality and other ecosystem services.

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