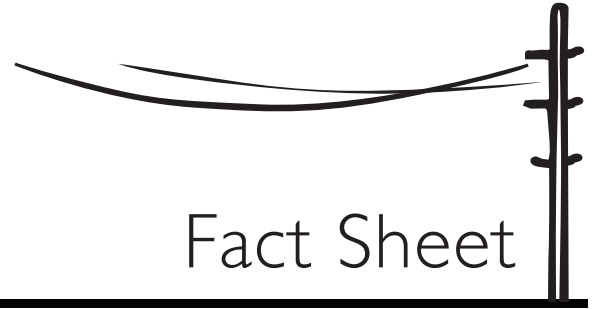




# WOOD to ENERGY



## Fact Sheet

### Sources and Supply

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Energy sources that can be regenerated without depleting the underlying stock are considered “renewable.” Examples of renewable energy sources include biomass, such as wood or other agricultural crops; water; wind; and sunlight. However, in order for the conversion of wood to energy to be economically viable and environmentally responsible, forests must be properly managed to ensure that bioenergy projects do not use more wood than is sustainably available. A key component to sustainable forestry is ensuring that forests are not depleted by overharvesting. This means that wood removal cannot exceed wood growth in the long term.

The sustainable amount of wood that is available depends on the productivity of local forests and land-use practices. Proper management of the forest resource can be split into two categories. First, forest managers must make accurate measurements of how much wood can be removed without harming forests. Second, care must be taken to use fuel wood as efficiently as possible. In many cases, this means using wood that is actually a residue from other activities, such as timber harvesting and land clearing for development. In this fact sheet, we discuss each of these factors in the context of the southern United States.

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#### Available Data on U.S. Forests

The Forest Inventory and Analysis (FIA) program of the USDA Forest Service was mandated by the McSweeney-McNary Forest Research Act of 1928 and the Forest and Rangeland Renewable Resources Planning Act of 1974 to monitor the quantity and quality of timber on the nation’s forestlands. FIA collects data on sample plots annually within each U.S. state. FIA data, including forestland area, timber growth, and harvest volumes, can be accessed at <http://www.ncrs2.fs.fed.us/4801/timber.products/index.htm>.

### Forest Sustainability in the Southern United States

The U.S. produces more than 25 percent of the world’s total industrial timber and is the second largest exporter of timber products after Canada. Most of this timber is produced in the South (Wear and Greis 2002). In spite of these high rates of production, average wood growth in the southern U.S. continues to surpass the amount of wood harvested. Future timber growth is projected to be greater than harvests in response to projected demands for timber (Adams et al. 2003). This means that researchers are predicting that forests will be growing faster than people are using wood. At local levels, sustainable forest management can provide woody biomass for energy along with other wood products.

Nationwide, the volume of timber has increased over the past fifty years from 616 to 856 billion cubic feet, mostly from conversion of agricultural lands to forestlands (Smith et al. 2004). The most recent available Forest Inventory and Analysis (FIA) data indicates net growth<sup>1</sup> of growing stock<sup>2</sup> was greater than harvest for ten of the thirteen southern states (Figure 1). In other words, in ten southern states, wood is being grown faster than it is harvested.

### Sources of Woody Biomass

Waste wood and industry by-products are good candidates for woody biomass sources because they are inexpensive and do not represent added pressure on local forests. Unfortunately, FIA data only include forestry residues and not urban waste or by-products. County-level yields of logging residues across the South vary widely, from zero to 222,000 dry tons per year, reflecting

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<sup>1</sup>“Net growth” means growth before harvests minus mortality.

<sup>2</sup>“A growing-stock tree is a live tree of commercial species that either contains or is capable of producing at least one 12-foot or two 8-foot logs in the saw-log portion” (Bentley and Johnson 2004).

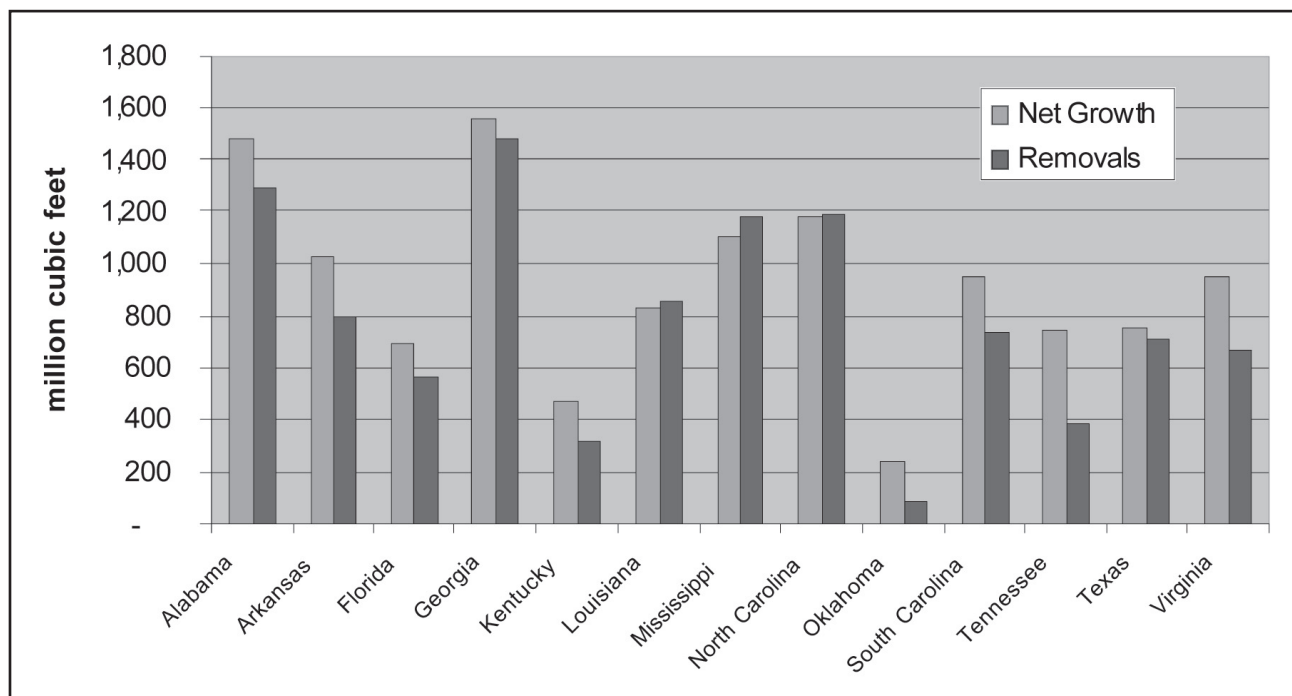


Figure 1. Net growth and removals of growing stock of thirteen southeastern U.S. states. ACCESSED FROM FIA MAPMAKER VERSION 2.1 ON JULY 19, 2006.

variation in county size and forestry practices. For some communities, however, this can be a significant source of fuel. In Alachua County, Florida, for example (a mid-sized county with a modest forestry industry), 60,106 dry tons of forestry residue is sustainably available per year. This is equivalent to about 7 megawatts (MW) of electricity generation. Following is additional information about potential sources of woody biomass.

**Forestry By-products.** Local forests in which trees are grown for sawtimber produce waste wood in two ways. The first is from forest thinning. Trees for sawtimber are often planted at high densities so that they produce straight, knotless wood. However, as the trees grow, they require more room in order to thrive and are thinned accordingly. For example, the trees may originally be planted at a density of 700 trees per acre. After twelve years, these trees may be thinned to a density of 400 trees per acre. Forests may be thinned two to three times during the course of the trees' development. At the first and second thinning, the cut trees may be too small to be sold as lumber but can be made available for power production.

The second source of waste wood from sawtimber operations comes during the harvesting of the timber. Stumps, branches, and tree tops that are too small for lumber production are often left on the harvest site or otherwise disposed of. These residues too can be used for

producing energy. However, stumps are often difficult to remove and may bring along dirt and rock. In addition, leaving stumps in the ground helps reduce soil erosion. Any changes in local timber producing activities can cause changes in the amount of residue wood available for power production. For example a shift from pulp wood production for paper—which can use smaller trees—to sawtimber production would make larger quantities of wood from thinnings available for energy production during the forest's lifetime.

Typically, the wood from harvesting operations is simply piled up on-site and burned or left to rot. Often when people think of using wood for energy, they worry about the carbon within the wood adding to greenhouse gases. It is important to note that whether this wood is burned on-site, left to decay, or burned for energy, the carbon contained in the wood is released into the atmosphere. See the fact sheet, *Climate Change and Carbon*, for more information about this topic. All of our materials can be found at <http://www.interfacesouth.org/woodybiomass>. The potential benefit of burning wood in a controlled environment such as a utility plant is that pollution control devices help reduce air pollution.

Let's use Gainesville, Florida, as an example to get an idea for how much energy could be supplied by using the two types of waste wood we've described. Slash pine operations have been shown to produce about 15 green tons

(or wet tons) of wood waste per acre from harvesting operations (Watson et al. 1986).

There are approximately 1.38 million acres of pine plantations within 50 miles of Gainesville's largest power plant. Each dry ton of wood represents about 16 million British thermal units (Btu) of energy. If we assume half of the logging residues are available for energy, then on each acre harvested about 7 green tons of wood are available, which equals about 3 dry tons of wood. Therefore, 3 dry tons of wood per acre  $\times$  1.38 million acres equals about 4.1 million dry tons. Multiplying the 4.1 million dry tons by their energy content—16 million Btu/ton—yields  $6.6 \times 10^{13}$  Btu. Logging operations in the South often have 25-year cutting cycles, meaning that each acre will be cut once every 25 years. So, we can divide the  $6.6 \times 10^{13}$  Btu by 25 to get about  $2.6 \times 10^{12}$  Btu available annually. Assuming that  $1.0 \times 10^{11}$  Btu per year equals 1 MW per year,  $2.6 \times 10^{12}$  Btu divided by  $1.0 \times 10^{11}$  Btu/MW/year yields 26 MW of energy per year from the wood waste of timber operations.

**Habitat Restoration and Fuelwood Control.** Another source of wood available for energy production is from the management of natural areas. For example, managing a natural area to maintain a specific kind of habitat (e.g., longleaf pine) requires removing certain species of trees that are not naturally found in that habitat. These removed trees can become a source of fuel for a biomass power plant.

Secondly, many forests require fire management. In pristine forests, naturally occurring fires keep the amount of woody biomass—such as dead wood and underbrush—under control. Forest managers can mimic this natural process with controlled burns or by removing some of the woody biomass from the forest using machines. In the latter case, the woody biomass removed from the forest can be available for energy production. Thinning may be particularly preferable for forests in the wildland-urban interface (where human development meets undeveloped natural areas) because the risk of fire must be reduced to protect nearby homes, and prescribed burning can create conflicts.

**Urban Wood Waste.** Wood removed from residential and business properties, such as unwanted trees and trimmed limbs, can also be a significant source of wood for energy production. Research has shown that there are about 0.12 dry tons of urban wood waste (city tree trimmings and storm debris) generated per person per year (Wiltsee 1998). For an average county population size in the southern U.S. of about 75,000, this is equivalent

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A green ton refers not to the color of the ton, but to the moisture content of the wood. When wood is first cut, water constitutes roughly 50 percent of its weight. To account for this weight, foresters distinguish between green tons and dry tons of wood. "Bone dry" wood contains no moisture. The moisture of air-dried wood depends on ambient humidity.

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to 9,000 dry tons of wood, which can provide enough power to supply 400 to 900 homes per year (Bellemar 2003). Many people living in the southern U.S. can attest to the increase in yard waste that results from storms felling trees and limbs. Since people currently pay to have their yard waste removed—either to private landscapers or within their utilities bill—collecting this waste as a source of fuel can become an economically viable operation for an energy facility.

**Phytoremediation.** The term *phytoremediation* describes the process of using trees to clean up sites that have contaminated soil or water. Trees planted in these areas extract the contaminants, such as arsenic and nitrates, from the soil as the trees grow. The trees, along with the contaminants they contain, can then be removed from the site and used for energy production. The contaminants may become denatured by the high temperatures of combustion or captured in ash or air emission control systems. Notably, wood from phytoremediation projects contains lower amounts of these contaminants than what is normally found in coal.

**Commercially Available Wood.** The previous four sections of this fact sheet all involve the use of waste wood from other processes. Another potential source of wood for energy production is small-diameter wood from timber plantations. Since forest landowners have the option of selling their wood to the highest bidder, when the price of wood is low at pulp mills, or when the price for energy is high, an estimated 8 million dry tons of wood currently grown for conventional timber products could be allocated to energy production (Perlack et al. 2005). This is enough energy for about 1,200 MW of electricity or 500,000 to 1,000,000 homes annually.

## Additional Aspects of Sustainable Forestry

In addition to sustained yield, other aspects of sustainable forestry include biodiversity, ecosystem health, social values, and soil quality. Various governmental and

nongovernmental agencies are dedicated to fostering sustainable forest management. Having a biomass source “forest certified” by an independent forest auditor is one option for communities that want to ensure sustainability of the fuel products. See the fact sheets *Sustainable Forest Management* and *Environmental Impacts* for more information on these topics.

## Find Out More

You can find more general information about bioenergy at the Renewable Energy Policy Project Web site (<http://www.repp.org/bioenergy/index.html>). More information about forest thinning for sawtimber production is available in a paper by David South of Auburn University (<http://www.forestry.auburn.edu/sfmc/class/density.htm>). And more information on sustainable forest management and forest certification can be found at the USDA Forest Service (<http://www.na.fs.fed.us/sustainability>), the Forest Stewardship Council ([www.fsc.org](http://www.fsc.org)), and Abundant Forests ([www.abundantforests.org](http://www.abundantforests.org)).

For more information about using wood to produce energy, visit <http://www.interfacesouth.org/woodybiomass> and read other fact sheets, community economic profiles, and case studies from this program, or <http://www.forestbioenergy.net/> to access a number of other resources.

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