



# WOOD<sup>to</sup> ENERGY



## Community Economic Profile

### South Carolina: Oconee County

Matthew Langholtz, Douglas R. Carter, Alan W. Hodges, Annie Oxarart, & Richard Schroeder

In the southern United States, communities with increasing populations and nearby forests may be able to consider using woody biomass to generate energy. A variety of other factors must also be considered, such as the price of existing energy sources, competing markets for wood, community acceptance, and the economic availability of wood resources. Many counties in South Carolina have forests in close proximity to growing populations. To gain a better understanding of the range of possibilities for economic availability and the local economic impacts of using wood for energy, Oconee County was selected for analysis in this community economic profile.

South Carolina's abundant natural areas are diverse, including forested mountains and waterfalls in the western region as well as barrier islands and intercoastal waterways in the east. National and state forests, parks, and wildlife refuges, along with privately owned forests, account for the state's 66 percent forest cover. Eighty-eight percent of the forests are owned by private individuals, corporations, and forest industries. Oak-hickory and hardwood forests dominate half of the state's forested land; the other half is dominated by loblolly-shortleaf pine forests (USDA 2003). The forest products industry is an important economic resource for South Carolina, as it is the third largest employer and provides the third highest payroll of the state's manufacturing industries. In addition, timber is the most valuable agricultural crop in the state (South Carolina Forestry Association 2003). A wealth of forest resources provides South Carolina with many benefits, such as wildlife habitat, recreational opportunities, tourism income, cleaner air and water, timber products, and enhanced quality of life.

Oconee County is located in the scenic northwest region of South Carolina, bordering Georgia and North Carolina. Situated in the foothills of the Appalachian Mountains, this area has many waterfalls, rivers, and lakes. In addition, forests cover 70 percent of the area (USDA 2006). Sumter National Forest, Devils Fork State Park, and the Chattooga River are well-known natural areas that both

residents and tourists frequent. Oconee County has a prospering business community with industrial parks, a commerce center, and manufacturing industries. Successful agriculture and forestry industries contribute to a vibrant local economy. Several cities in Oconee County such as Seneca, Walhalla, and Westminster are noted for their historic buildings, downtown shopping districts, and small-town southern charm. The towns attract many tourists who enjoy the surrounding area's natural beauty.

Oconee County residents take pride in their heritage and environment and strive to optimize effective use of their resources while planning for the future. According to the U.S. Census Bureau (2007), from 2000 to 2006 the population of Oconee County grew 6.6 percent to an estimated 70,567 residents. With this rapid growth and development, the county is experiencing increasing demand for energy. Duke Energy, a major employer for the county, operates Oconee Nuclear Station, which provides 2,358 megawatts (MW) of energy, as well as two hydroelectric plants that distribute energy throughout the region. For communities that want to increase their use of renewable sources of energy and where wood is economically available, using wood to produce energy may be an option. Oconee County's abundant wood resources could be used to generate energy for a utility or a smaller facility, such as a school, a hospital, or industry.

Woody biomass from urban wood waste, logging residues, and forest thinnings, for example, can be used to generate energy. Using wood to generate electricity provides many potential benefits such as reduced greenhouse gas emissions, healthier forests, and local jobs and other economic impacts. For more information on these topics see the *Climate Change and Carbon*, *Sustainable Forest Management*, and *Environmental Impacts* fact sheets. All of our materials are available at <http://www.interfacesouth.org/woodybiomass>.

To estimate the amount of wood that could be available in a community, we include three sources: urban wood

waste, logging residues, and pulpwood. While other woody biomass resources exist and could be added to the resource assessments, we include only these resources, for which cost and supply data are available. Urban wood waste is generated from tree and yard trimmings, the commercial tree care industry, utility line clearings, and greenspace maintenance. Logging residue is composed of the leftovers from forest harvesting, such as tree tops and limbs, and poorly formed trees. Pulpwood refers to small diameter trees (3.6 to 6.5 inches diameter at breast height) that are harvested for manufacturing paper, purified cellulose products (including absorbents, filters, rayon, and acetate), and oleoresin products (including pine oils, fragrances, cosmetics, and thinners). This profile excludes secondary woody waste from sawmills and furniture makers, which is available but may already be used within the industry to produce energy. See the fact sheet, *Sources and Supply*, for more information.

Economic factors, including fuel costs and the creation of local jobs, are major determinants of the feasibility of bioenergy projects. Assessing the economic availability of biomass requires learning about the delivered cost of wood, the quantity of available wood, and its geographic distribution. This information is then used to create biomass resource supply curves, which express price per unit of biomass at a range of potential quantities of consumption. The following summary uses these methods to assess the economic availability of wood resources for Oconee County, South Carolina. More information about the development of this supply curve can be found on the Web site in *Assessing the Economic Availability of Woody Biomass*.

### Cost Calculations

The delivered cost of woody biomass to a facility is the sum of the amount paid to buy the wood from the original owner (procurement), the harvest cost, and the transportation cost. Although rail transportation could be used in some

cases, woody biomass is typically transported by truck. The cost of transportation depends on the time it takes a truck to travel from the harvest site to the facility. Haul times to the central delivery point in the county are calculated using a software program called ArcGIS Network Analyst Extension (Figure 1).

Assuming that haulers drive the speed limit on the quickest route available to them, we calculate total transportation times for the forested areas around the delivery point, and then increase haul times (and thus costs) by 25 percent to account for delays, such as traffic and stops. These haul-time areas delineate potential “woodsheds” or areas that can provide wood for a specific community or biomass user. If demand is established in more than one area in proximity, woodsheds can overlap, causing competing demand for biomass.

The total delivered cost is derived from the sum of the procurement, harvest, and transportation costs for urban wood waste, logging residues, and pulpwood. This is calculated at 15-minute increments up to one hour from the

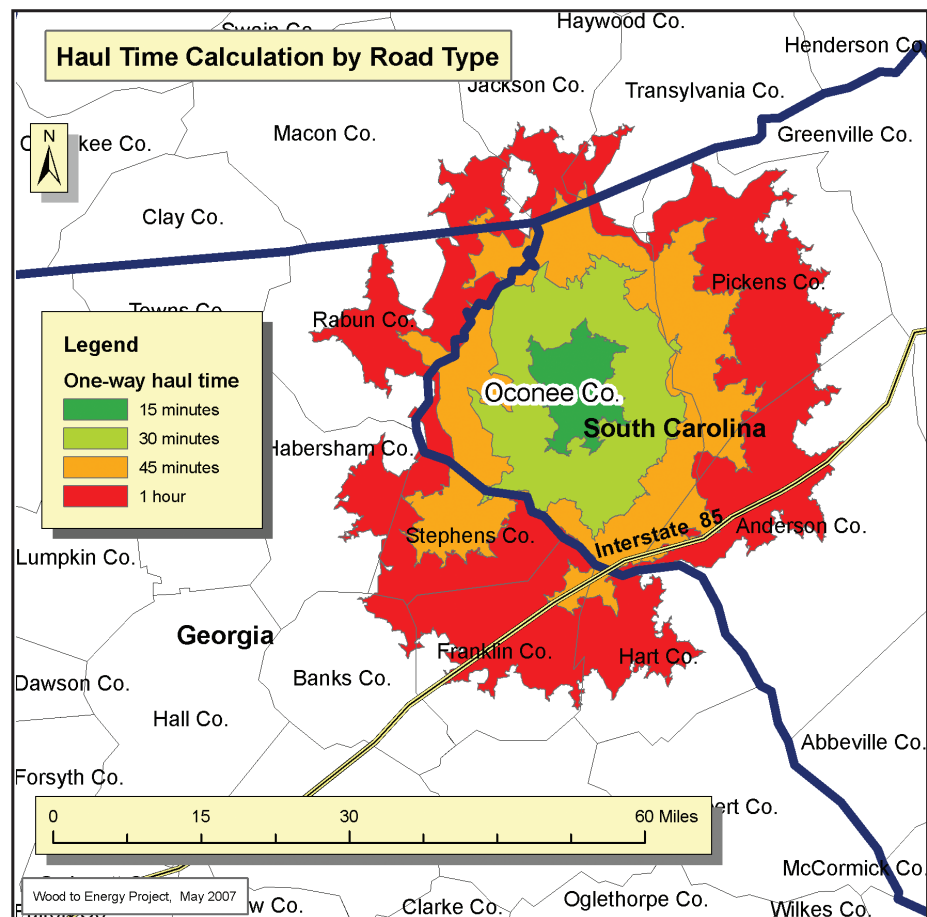


Figure 1. Wood harvested within each colored band can be transported to the center of the county in 15-minute increments.

delivery point. Delivered costs allow us to see the progression of the most- to least-expensive woody biomass resources. For example, if urban waste wood were delivered within the one-hour limit, the total delivered cost would be \$19.46 per dry ton, or \$1.25 per million British thermal units (MMBtu). However, if pulpwood were delivered from the same distance, the delivered cost would increase to \$49.14 per dry ton, or \$3.04 per MMBtu, primarily because pulpwood is more expensive than urban wood waste.

### Physical Availability

In addition to the delivered cost of wood, knowing how much of each type of woody biomass is available is necessary to construct supply curves. Annually harvested pulpwood and annually available urban wood waste and logging residues within Oconee County are shown in Table 1.

For urban wood waste, it is assumed that 0.203 green tons (40 percent moisture content) of urban wood waste is generated per person per year (Wiltsee 1998). This includes municipal solid waste wood from yard waste and tree trimming but excludes industrial wood (e.g., cabinet and pallet production) and construction and demolition debris. This average yield was multiplied by county population estimates and reduced by 40 percent to estimate total annual county yield of urban wood waste. For example, this results in 8,500 green tons of urban wood waste per year in Oconee County.

The amount of logging residue and pulpwood for all counties in the southeast U.S. was obtained from the USDA Forest Service (2003) Timber Product Output Reports. This database provides forest inventory and harvest information, including annual yields of forest residues and pulpwood. We reduced the figure for logging residues by 30 percent to exclude stumps. For example, in Oconee County, there are 35,900 green tons (37 percent moisture) of logging residues available annually from existing forestry operations. There are also 46,100 green tons (50 percent moisture) of pulpwood harvested annually. Because the pulpwood harvest is currently used

**Table 1.** *Three Sources of Available Wood*

| Available urban wood waste | Available logging residues | Harvested pulpwood |
|----------------------------|----------------------------|--------------------|
| 8,500                      | 35,900                     | 46,100             |

Moisture content refers to the amount of moisture remaining in wood and is an important consideration in the quality of biomass resources. Moisture content is 0 percent in oven-dried biomass, about 20 percent for air-dried biomass, and about 50 percent for fresh or “green” biomass. As the moisture content of wood increases, the energy content per unit mass of wood decreases. Thus, wood with low moisture content will combust more efficiently than wood with high moisture content. Moisture content in this document is reported on a green-weight basis.

to produce pulp and paper products, not all of this resource is economically available for bioenergy. However, additional biomass is available from forest thinning, particularly those conducted for ecosystem restoration, which is not included in this assessment (Condon and Putz 2007).

### Supply Curve Construction

Given information regarding cost, quantity, and distribution of all three types of woody biomass, a supply curve can be generated for Oconee County. Figure 2 shows the price of wood at different quantities needed. The y-axis represents price per MMBtu of energy and the x-axis represents the total amount of wood available in 15-minute increments. The width of each bar signifies the quantity of wood available. The height of each bar estimates the price one would pay for delivered wood. The first 0.01 trillion Btu of urban wood waste from 0-15 minutes is too small to appear as a bar in the graph. Several scales are provided to translate the quantity of wood into tons, energy content, and houses electrified. Biomass sources include urban wood waste, logging residues, and pulpwood within a one-hour haul radius of the center of Oconee County.

### Supply Analysis Results

Energy resources and costs for each resource-haul time category for the Oconee County woodshed are shown in Table 2 (resources are ranked from cheapest to most expensive based on delivered cost of energy). These values were used to construct the supply curve shown in Figure 2. The supply curve suggests that 1.2 trillion Btu (or 10 MW) of electricity, which is enough to power 4,200 households in the South (Bellemar 2003), are available for less than

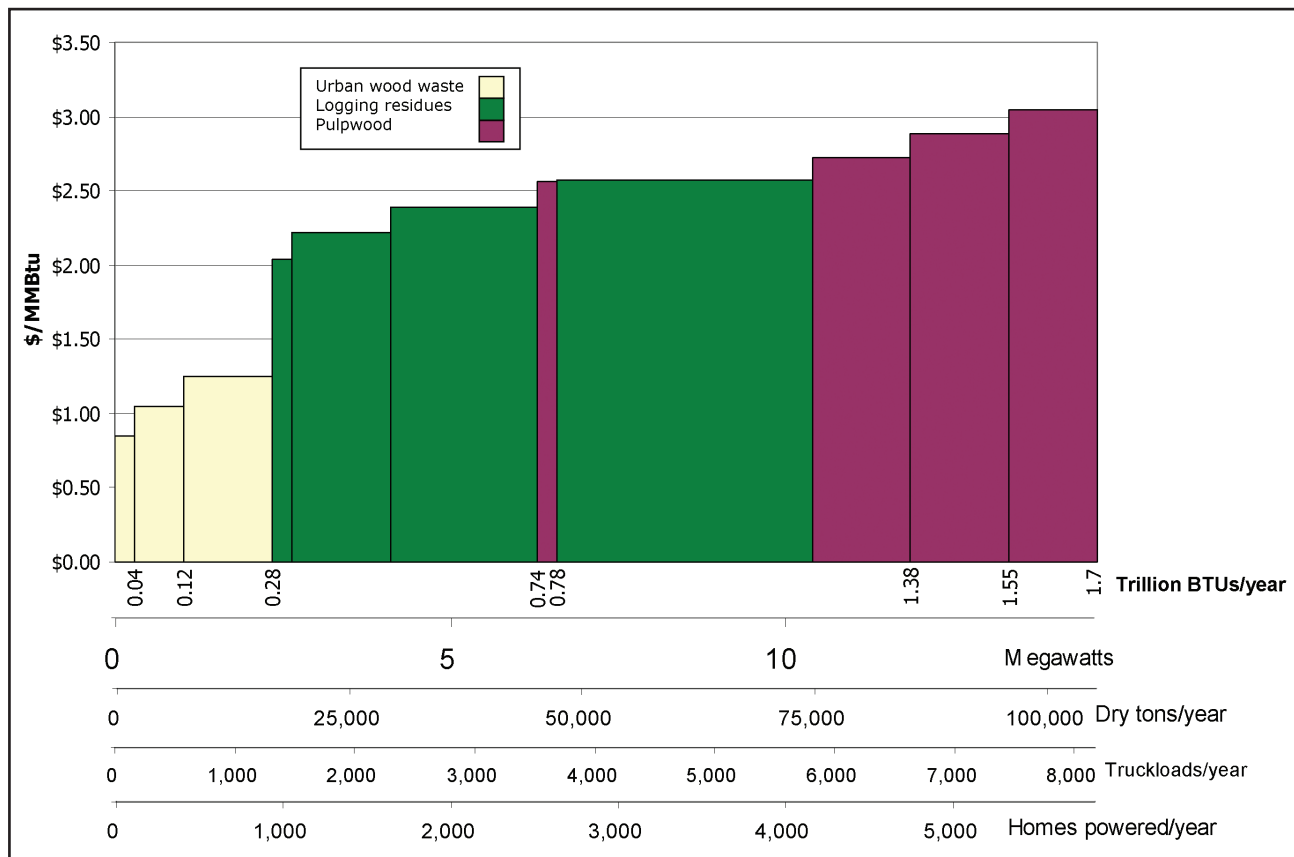


Figure 2. Bars for each source represent the wood available within 15-minute haul time intervals.

\$2.60 per MMBtu. Energy at this cost is competitive with the current costs of coal. Within a one-hour haul radius, up to 0.28 trillion Btu can be provided from urban wood waste alone. With the addition of logging residues, 1.2 trillion Btu can be produced. Other types of wood may be available from thinnings to improve forest health, although estimates of this wood are not available. As the cost of oil increases, all price estimates increase (with petroleum inputs for harvesting and transportation), but so do the costs of coal and natural gas. In other words, as fossil fuels become more expensive, the delivered cost of wood will increase but will become increasingly competitive with nonrenewable fuels.

### Economic Impact Analysis

The potential economic impacts of developing a wood-fueled power plant are an important consideration for both public and private interests in a community. In this economic analysis, two sizes of power plant were considered: 20 or 40 MW. The construction of the plant would be a one-time impact event that is assumed to occur within a year, while the impacts of plant operations continue annually over the life of the plant, for 20 years or

more. Wood fuel costs were calculated from the regional supply curves discussed previously in this report. Economic impacts were estimated using IMPLAN software and databases for each county. These estimates included not only the direct impacts of plant construction and operation but also the indirect impacts from local purchases and local spending by employee households. Further information on the methods of analysis and interpretation of economic impact results is available in the fact sheet, *Economic Impacts of Generating Electricity*.

Economic impacts were evaluated for Oconee County in South Carolina. Fuel typically represented the largest operating cost for a wood-fired power plant. Wood fuel costs were estimated at \$4.1 million and \$10.3 million for the 20 MW and 40 MW plants, respectively (Table 3).

The economic impacts of annual operations for the 20 MW plant were estimated to be \$10.8 million in output (revenue), 220 jobs, and \$6.0 in value added (income). For the 40 MW plant, operating impacts were \$23.2 million in output, 508 jobs, and \$12.9 million in value added. The first year impacts for plant operations are representative of the ongoing annual impacts; however, future impacts could change due to prices of inputs such

Table 2. *Delivered Cost of Available Wood*

| Delivered cost (\$/MMBtu) | Resource/Haul time category     | Trillion Btu available per year within a one-hour haul radius |
|---------------------------|---------------------------------|---|
| \$0.65                    | Urban wood: 0-15 minutes        | 0.01  |
| \$0.85                    | Urban wood: 15-30 minutes       | 0.04  |
| \$1.05                    | Urban wood: 30-45 minutes       | 0.08  |
| \$1.25                    | Urban wood: 45-60 minutes       | 0.16  |
| \$2.03                    | Logging residues: 0-15 minutes  | 0.04  |
| \$2.21                    | Logging residues: 15-30 minutes | 0.16  |
| \$2.39                    | Logging residues: 30-45 minutes | 0.26  |
| \$2.56                    | Pulpwood: 0-15 minutes          | 0.04  |
| \$2.57                    | Logging residues: 45-60 minutes | 0.43  |
| \$2.72                    | Pulpwood: 15-30 minutes         | 0.17  |
| \$2.88                    | Pulpwood: 30-45 minutes         | 0.17  |
| \$3.04                    | Pulpwood: 45-60 minutes         | 0.15  |

Table 3. *Economic Impacts of 20 and 40 MW Power Plants*

| Plant Size (MW) | Wood Fuel Cost (\$Mn) | Annual Operations Impacts (first year) |                   |                    | Plant Construction Impacts |                   |                    |
|-----------------|-----------------------|--|-------------------|--------------------|----------------------------|-------------------|--------------------|
|                 |                       | Output (\$Mn)                          | Employment (Jobs) | Value Added (\$Mn) | Output (\$Mn)              | Employment (Jobs) | Value Added (\$Mn) |
| 20              | 4.08                  | 10.76                                  | 220               | 5.98               | 4.18                       | 45                | 2.35               |
| 40              | 10.30                 | 23.16                                  | 508               | 12.86              | 5.01                       | 54                | 2.77               |

as fuel, unexpected maintenance activities, and general economic inflation.

Total construction costs were valued at \$48.7 million for the 20 MW plant and \$86.8 million for the 40 MW plant, including land, site work, construction, plant equipment, and engineering fees. The economic impacts of capital expenditures for construction of a 20 MW plant were estimated at \$4.2 million in output, 45 jobs, and \$2.4 million in value added. Construction impacts for the 40 MW plant were \$5.0 million in output, 54 jobs and \$2.8 million in value added. These construction impacts were relatively low because this county does not have a manufacturing sector for turbines and boilers, key components of a power plant, resulting in most of the construction expenditures leaving the local economy.

Often it is helpful to predict the distribution of economic impacts across various sectors of the local economy. More

than 60 percent of all jobs would occur in the agriculture and forestry sector, which supplies wood fuel to these facilities. However, there would also be significant employment impacts in the sectors for professional services, retail trade, and government, reflecting the indirect effects on the local economy associated with purchased supplies and employee household spending.

## Conclusions

Economic concerns are important to discussions of using wood for energy in the South. For many communities, the conversation begins with the recognition that there might be enough wood at an affordable cost. Our supply analysis suggests that, indeed, enough wood at a reasonable cost is available in Oconee County to make a continued conversation possible. Up to 1.2 trillion Btu (i.e., 10 MW or energy to power 4,200 homes annually) of woody

biomass are available at less than \$2.60 per MMBtu in the Oconee County woodshed. These general estimates could be improved with more site-specific analysis and information.

Additional assessments of local conditions, population density, distribution of wood, competition from pulp mills, restoration activities, and other factors would improve the accuracy of these biomass resource assessments. The following caveats should be considered when interpreting the results presented in this profile:

- The supply considered in this profile includes only urban wood waste, logging residues, and pulpwood. It excludes stumps and waste from wood industries.
- Because only county-level data were available, homogeneous distribution of resources within counties is assumed. Resource distribution within counties and location of bioenergy generating facilities will influence the actual economic availability of woody biomass suitable for energy generation. More detailed local analysis might consider the distribution of biomass resources within counties, especially for site selection of bioenergy facilities.
- The inclusion of other resources such as mill wastes or thinnings from forest management and habitat restoration through USDA Forest Service stewardship contracts would increase available resources.
- This analysis is not intended to be a definitive resource assessment but is rather meant to provide a starting point for discussions about the feasibility of using wood for energy. Resources can be excluded or added as more information becomes available, and prices can be modified to reflect local conditions.
- A rise in the price of petroleum would increase the cost of the resources shown here, as well as costs of conventional energy sources like coal.
- Some assumptions made in this analysis are subject to change. For example, large-scale bioenergy development in the area could increase competing demand for wood resources.
- Rail transportation, which could reduce transportation costs and make biomass resources from other areas more available, was not considered in this analysis.
- Construction and operation of wood-fueled power plants may have significant local economic impacts. These impacts vary widely among selected counties, depending upon the makeup of the local economy.

- Wood fuel represents one of the largest expenditures for a power plant and gives rise to large impacts in the local forestry and forestry services sectors. Other sectors of the local economy are also impacted through the indirect effects associated with purchased supplies and employee household spending.
- Economic impacts of a 40 MW power plant are greater than for a 20 MW plant, although not in proportion to the power output, due to economies of scale.

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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Authors

Matthew Langholtz, Postdoctoral Research Associate and Douglas R. Carter, Associate Professor, School of Forest Resources and Conservation; Alan W. Hodges, Associate In Food and Resource Economics; and Annie Oxarart, Outreach Research Associate, School of Forest Resources and Conservation, University of Florida, Gainesville FL; and Richard Schroeder, President, BioResource Management, Inc., Gainesville FL.



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