WOOD to ENERGY

Community Economic Profile

Alabama: Lee and Shelby Counties

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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 Alabama 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, Lee and Shelby counties were selected for analysis in this community economic profile.

An impressive 71 percent, or 22.9 million acres, of Alabama is covered with forests—ranking it second in size only to the state of Georgia. These forests support an abundance of plant and animal species including 300 species of trees and woody plants. Covering five physiographic regions, the state's forests range from dense pine stands and coastal hardwood swamps in the South to complex hardwood ecosystems that span the mountainous Tennessee border. Approximately 95 percent of Alabama's forests are privately owned by family landowners and the forest industry.

Timber is the dominant crop harvested in 34 of Alabama's 67 counties. Forest manufacturing operations support nearly 65,000 workers with an annual payroll of $2.2 billion, making it the leading industry in the state (Alabama Forestry Commission 2005). The remaining 5 percent of the forested land is public land: 24 state parks, 4 national forests, and 13 national forest recreation areas. These areas provide residents and tourists with an array of enjoyable outdoor experiences.

Lee and Shelby counties are in developing regions of Alabama that encompass farmland, forests, rivers, and lakes, the health of which contributes to the state's natural beauty and ecological integrity. Both counties contain a scattering of cities and ample forestland that support pulp, paper, wood products, and secondary wood manufacturing industries. Lee County, on the Georgia border and Chattahoochee River, is home to the bustling city of Auburn (home of Auburn University) and the metropolitan area it shares with the city of Opelika. Auburn University has become a hub of bioenergy and bioproduct research by partnering with the USDA National Soil Dynamics Laboratory and the USDA Forest Service, Forest Operations and Engineering Research Group, to refine harvesting, processing, and transportation methods related to woody biomass utilization (Auburn University 2007). Shelby County is in the north-central region of Alabama. The county is perhaps best known for its small-town charm and the University of Montevallo, a public liberal arts university attended by some 3,000 students. Cities in both counties are nationally recognized as Tree City USA communities.

According to the U.S. Census Bureau (2007), both counties are currently experiencing moderate to heavy population growth. The population of Lee County increased by 9.3 percent between 2000 and 2006, and Shelby County's population grew by 24.3 percent, making it the fastest-growing county in the state. Population growth and increased development usually bring an increased demand for additional energy generation. The combination of increasing populations and existing forested areas allows both counties to consider using wood to produce energy, whether for a large utility or a smaller facility, such as a school, hospital, or industry.

Woody biomass from urban wood waste, logging residues, and forest thinning, 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 Lee and Shelby counties in Alabama. 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 each county are calculated using a software program called ArcGIS Network Analyst Extension (Figure 1).

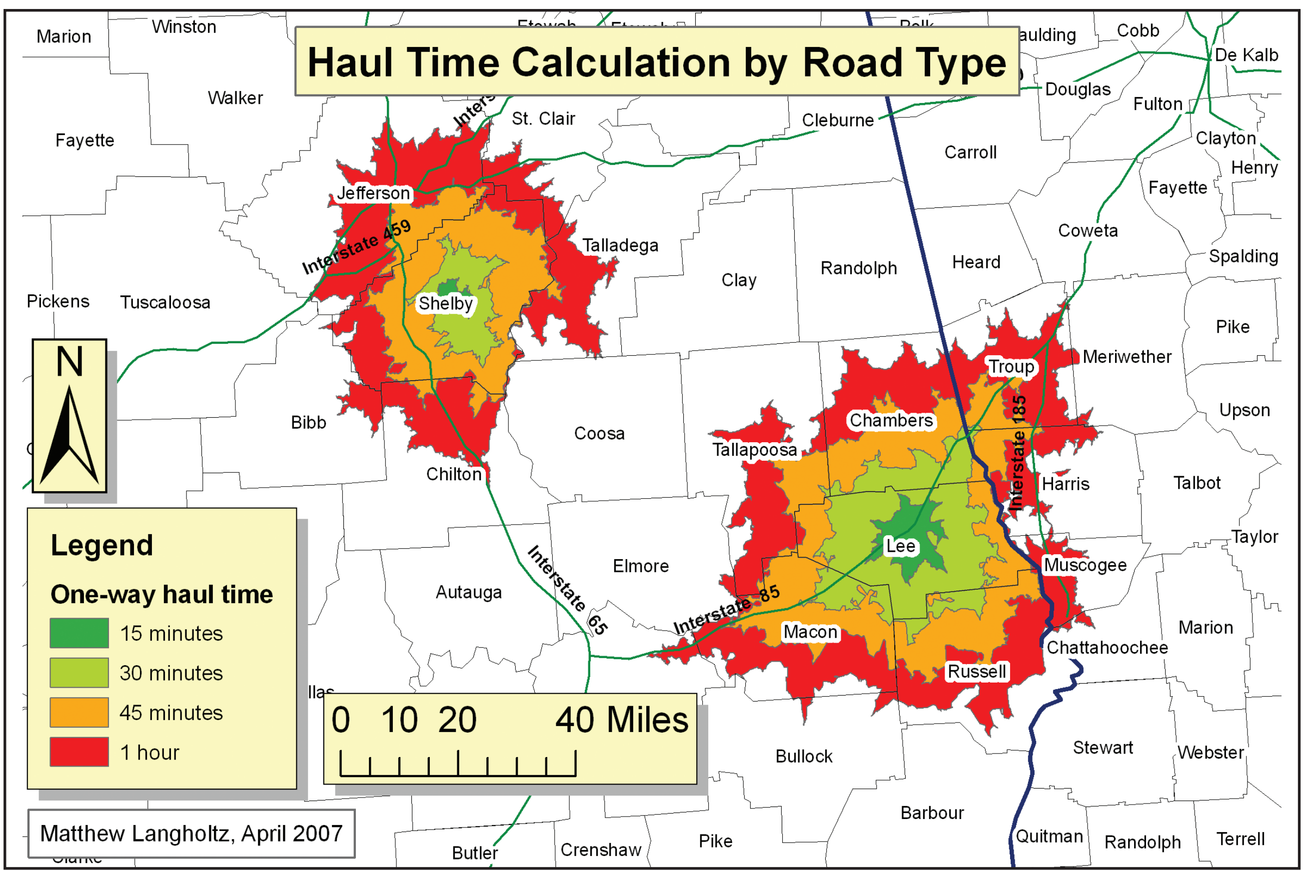

Figure 1. *Wood harvested within each colored band can be transported to the center of each county in 15-minute increments.*

Assuming that haulers drive the speed limit on the quickest route available to them, we calculated total transportation times for the forested areas around the delivery point, and then increased 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 nearby areas, woodsheds may 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 each 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 the two Alabama counties 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, in Lee County, this results in 15,000 green tons of urban wood waste per year.

Table 1. *Three Sources of Available Wood*

County	Available urban wood waste	Available logging residues	Harvested pulpwood
Lee	15,000	48,000	156,000
Shelby	20,500	48,000	142,000

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.

The amount of logging residue and pulpwood for all counties in Alabama 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 Shelby County, there are 48,000 green tons (37 percent moisture) of logging residues available annually from existing forestry operations. There are also 142,000 green tons (50 percent moisture) of pulpwood harvested annually. Because the pulpwood harvest is currently used 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, supply curves can be generated for the two selected Alabama counties. 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. 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 each county center.

Supply Analysis Results

Energy resources and costs for each resource-haul time category for Lee and Shelby counties 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 curves shown in Figure 2. The supply curves suggest that 1.6 and 3.7 trillion Btu, or 14 and 32 megawatts (MW) of electricity, which is enough to power 5,400 and 12,700 households (Bellemar 2003), are available for less than $2.60 per MMBtu in the Shelby and Lee county woodsheds, respectively. Energy at this price is competitive with the current costs of coal. Within a one-hour haul radius, up to 0.4 and 0.5 trillion Btu can be provided from urban wood waste alone. With the addition of logging residues, 1.5 and 3.5 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 petroleum 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 and 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 Lee and Shelby counties in Alabama. Fuel costs were very similar in these two counties, reflecting similar wood resource availability, averaging $4.0 million and $9.7 million for a 20 and a 40 MW plant, respectively (Table 3). The output

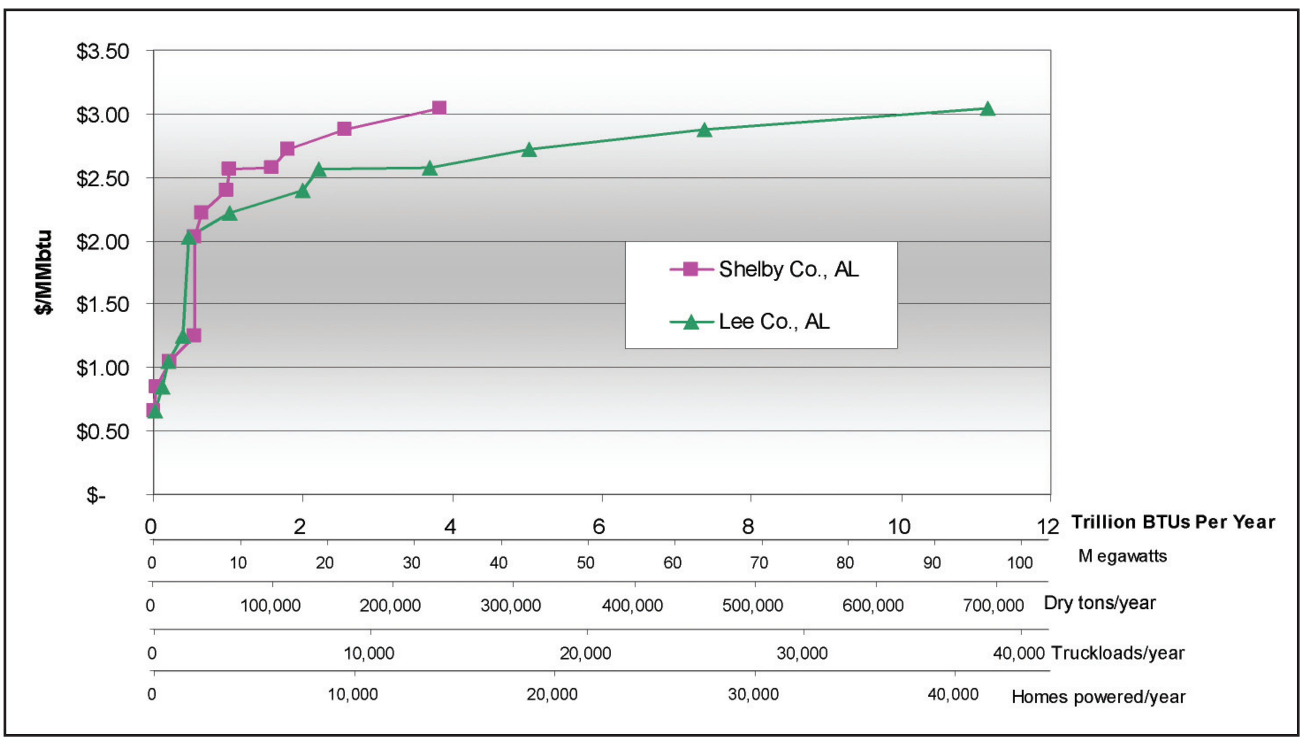

Figure 2. *Supply curves for woody biomass indicate the cost and quantity of wood at 15-minute hauling intervals.*

Table 2. *Delivered Cost of Available Wood*

		Trillion Btu available per year within a one-hour haul radius	
Delivered cost ($/MMBtu)	**Resource/Haul time category**	**Shelby Co., AL**	**Lee Co., AL**
$0.65	Urban wood: 0-15 minutes	0.01	0.02
$0.85	Urban wood:15-30 minutes	0.04	0.10
$1.05	Urban wood: 30-45 minutes	0.18	0.08
$1.25	Urban wood: 45-60 minutes	0.32	0.19
$2.03	Logging residues: 0-15 minutes	0.01	0.08
$2.21	Logging residues: 15-30 minutes	0.09	0.54
$2.39	Logging residues: 30-45 minutes	0.33	0.98
$2.56	Pulpwood: 0-15 minutes	0.03	0.22
$2.57	Logging residues: 45-60 minutes	0.57	1.48
$2.72	Pulpwood: 15-30 minutes	0.22	1.34
$2.88	Pulpwood: 30-45 minutes	0.77	2.35
$3.04	Pulpwood: 45-60 minutes	1.27	3.79

(revenue) and value added impacts of annual operations were similar for the two counties: output averaged $11.9 million and $24.8 million for 20 and 40 MW, respectively, and value added impacts averaged $7.5 million and $15.7 million. However, employment impacts were quite different, with much higher employment in Lee County (210 and 447 jobs) than in Shelby County (125 and 276 jobs), due to differences in the makeup of the local economy and labor productivity. 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 as fuel, unexpected maintenance activities, and general economic inflation.

Total construction costs were estimated at $48.7 million for the 20 MW plant and $86.8 million for the 40 MW plant, including land, site work, building construction, plant equipment, and engineering fees. The economic impacts of capital expenditures for plant construction were significantly different for these two counties, due to the presence in Shelby County of the manufacturing sector for boilers and turbines, which represent a majority of the capital costs for power plant construction. It was assumed that this equipment would be purchased locally, and therefore would have a greater economic impact. In the case of Lee County, this money would be lost from the local economy. Construction impacts in Shelby County were $40.9 million in output, 317 jobs and $18.9 million in value added for the 20 MW plant, and $71.2 million in output, 549 jobs, and $32.5 million in value added for the 40 MW plant. In Lee County, construction impacts were $5.0 million in output, 60 jobs and $2.9 million in value added for the 20 MW plant, and $6.0 million in output, 72 jobs, and $3.4 million in value added for the 40 MW plant.

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 Lee and Shelby counties to make a continued conversation possible. Up to 1.6 and 3.7 trillion Btu (i.e., 14 and 32 MW or energy to power

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

Alabama County	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 MW							
Lee	4.00	12.40	210	7.63	4.96	60	2.90
Shelby	4.03	11.35	125	7.28	40.89	317	18.86
Average	**4.02**	**11.87**	**168**	**7.46**	**22.93**	**188**	**10.88**
40 MW							
Lee	9.55	25.25	447	15.69	5.95	72	3.42
Shelby	10.38	24.33	276	15.76	71.18	549	32.48
Average	**9.96**	**24.79**	**362**	**15.73**	**38.57**	**311**	**17.95**

5,400 and 12,700 homes annually) of woody biomass are available at less than $2.60 per MMBtu in Shelby and Lee counties, respectively. 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 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 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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