WOOD to ENERGY

Community Economic Profile

Georgia: Coweta, Douglas, Murray, and Union 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 Georgia 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, Coweta, Douglas, Murray, and Union counties were selected for analysis in this community economic profile.

With an impressive 24.7 million acres, Georgia contains the largest area of forest cover in the South. Approximately 92 percent of these forests are under private ownership. Georgia's forest industry consists of 198 primary manufacturers which support 12 pulp mills and 1,400 secondary manufacturers (Johnson and Wells 2003). The industry supports over 154,000 employees and annually generates net revenue in excess of $146 million, making it Georgia's third largest industry (McClure 2006). Loblolly and shortleaf pines account for approximately 60 percent of the state's total softwood production forests, while red oak and white oak comprise 43 percent of total hardwood production forests (Johnson and Wells 2003). The USDA Forest Service estimates that Georgia forest owners are growing 15 percent more wood each year than they harvest. The remaining 8 percent of Georgia's forests consist of local, state, and federally administered forests, such as Chattahoochee-Oconee National Forest, Tallulah Gorge State Park, and numerous county parks. Among other benefits, these areas provide residents and tourists with an array of enjoyable recreational opportunities.

Coweta, Douglas, Murray, and Union counties are located in north Georgia and each is home to abundant natural resources and several growing communities. Coweta County is located approximately 30 miles southwest of Atlanta in north-central Georgia. The county offers residents and visitors a heaping dose of southern charm from the captivating Dunaway Gardens to the annual Powers' Crossroad Country Fair, which features over 250 juried artists. The city of Newnan has six historic districts listed on the National Register of Historic Places that represent antebellum and Victorian architecture from the 1800s. Douglas County lies just north of Coweta County and serves as a bedroom community for Atlanta. The Chattahoochee River, which runs along the county's eastern edge and Sweetwater Creek State Park serve as havens of natural beauty and recreation for residents and visitors.

Murray County spans a portion of northern Georgia's Appalachian Mountains along the North Carolina border. Outdoor enthusiasts know the county as the site of Springer Mountain, one of the endpoints of the Appalachian Trail. The county is also home to the Carter Dam, which is the largest earth-rock dam east of the Mississippi. Union County is located in northeast Georgia along the Tennessee border. More than half of Union County lies in Chattahoochee National Forest, which encompasses Georgia's highest peak, Brasstown Bald Mountain. Many of the larger communities within these four counties, such as Blairsville in Union County, Chatsworth in Murray County, and Newnan in Coweta County are nationally recognized as Tree City USA communities.

According to the U.S. Census Bureau (2007), Coweta and Douglas counties experienced particularly heavy population growth of over 29 percent between 2000 and 2006, while Murray County and Union County experienced respective increases of 13.4 percent and 19.5 percent (Table 1).

Continued population growth may lead to increases in development and bring with it the need for additional energy sources. As part of the solution for finding

renewable and reliable sources of energy, some communities may consider using locally sustainable wood resources to generate energy.

The Georgia Forestry Commission estimates that the state's forests could provide in excess of 20 million dry tons of biomass per year to be utilized in bioenergy production once harvesting systems improve. With tremendous timber resources and a well-established infrastructure for transporting and processing wood residues, Georgia has become a hub of bioenergy research. Currently, research is being conducted at the University of Georgia, Warnell School of Forestry and the Bioconversion Research and Education Center, as well as at Georgia Institute of Technology. The combination of increasing populations and heavily forested areas may enable Coweta, Douglas, Murray, and Union 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 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, 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.

Table 1. *Population Data for Selected Georgia Counties*

County	2000	2006	Population Growth from 2000 to 2006
Coweta	89,215	115,291	29.23%
Douglas	92,174	119,557	29.71%
Murray	36,506	41,398	13.40%
Union	17,289	20,652	19.45%

Economic factors, including fuels costs and the creation of 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 Coweta, Douglas, Murray, and Union counties in Georgia. 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).

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.

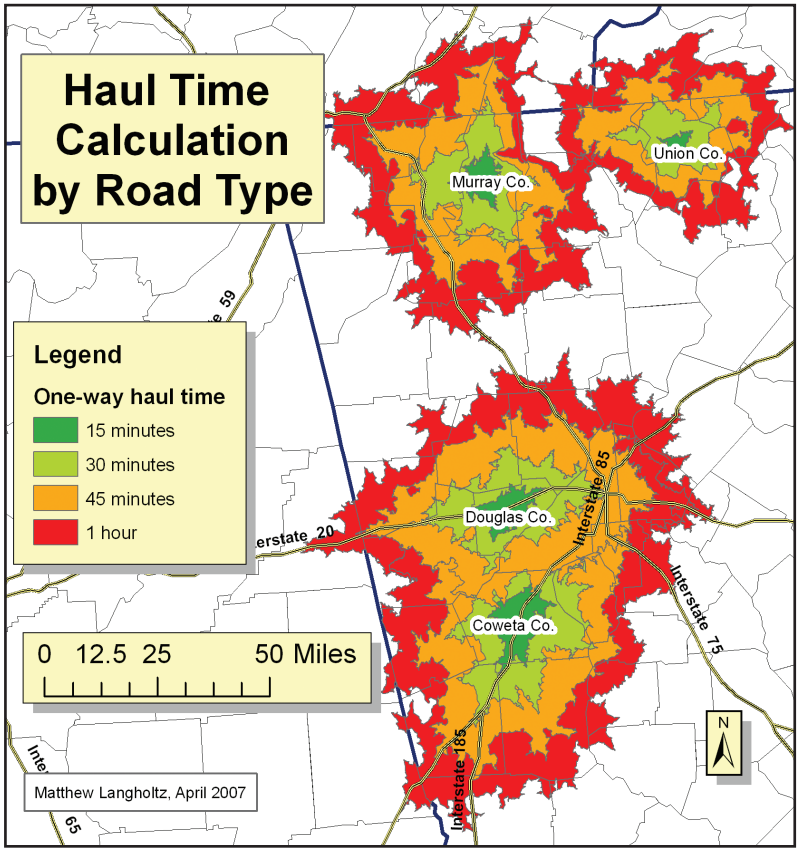

Figure 1. *Wood harvested within each colored band can be transported to the center of each county in 15-minute increments.*

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 four Georgia counties are shown in Table 2.

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 Coweta County, this results in 13,500 green tons of urban wood waste per year.

The amount of logging residue and pulpwood for all counties in Georgia 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 Douglas County, there are 6,000 green tons (37 percent moisture) of logging residues available annually from existing forestry operations. There are also 5,500 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).

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.

Table 2. *Three Sources of Available Wood*

County	Available urban wood waste	Available logging residues	Harvested pulpwood
Coweta	13,500	53,000	215,000
Douglas	14,000	6,000	5,500
Murray	5,000	33,000	113,000
Union	2,400	5,800	7,200

Supply Curve Construction

Given information regarding cost, quantity, and distribution of all three types of woody biomass, supply curves can be generated for the four selected Georgia 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 the four counties are shown in Table 3 (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 anywhere from 0.6 trillion Btu in the Union County woodshed to 6.0 trillion Btu in the Coweta County woodshed, or 5 to 52 megawatts (MW) of electricity, which is enough to power 1,900 to 21,000 households in the South (Bellemar 2003), are available for less than $2.60 per MMBtu, which is competitive with the current costs of coal. Within a one-hour haul

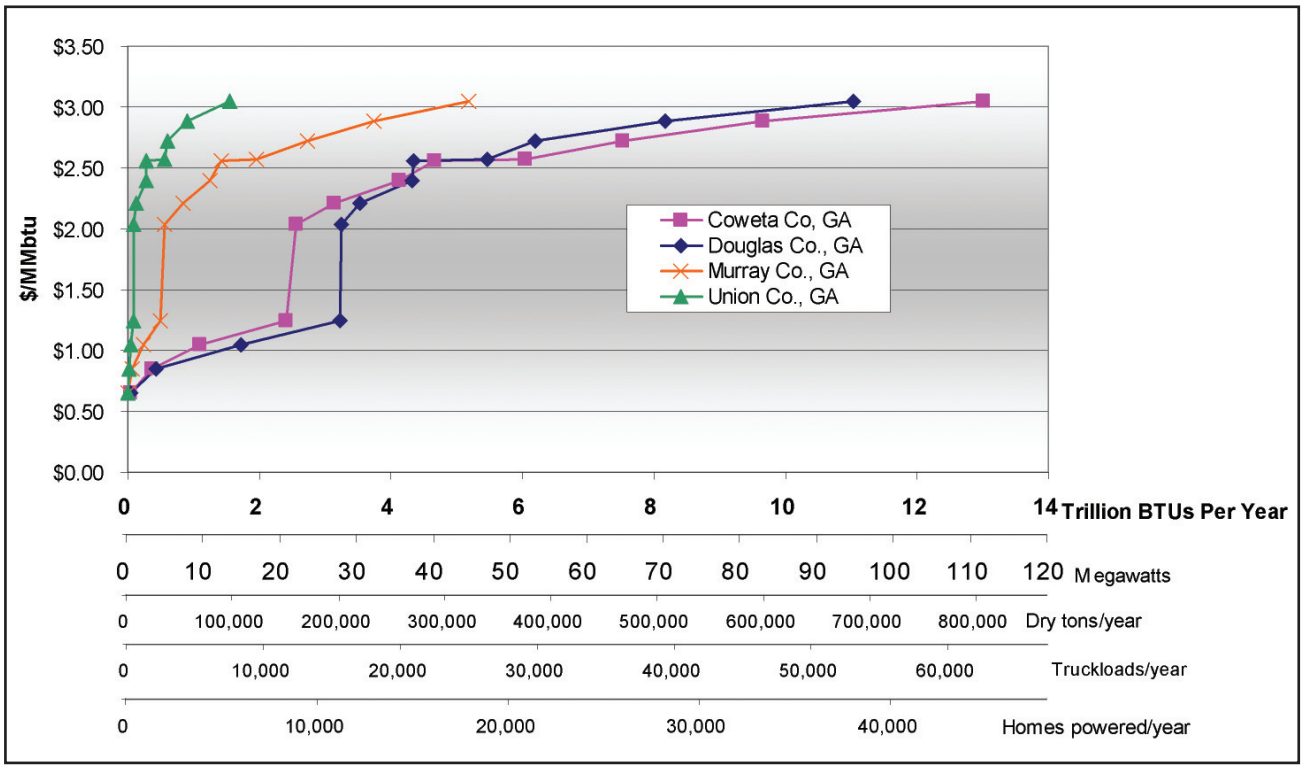

Figure 2. *Supply curves for woody biomass indicate the cost and quantity of wood at 15-minute hauling intervals.*

Table 3. *Delivered Cost of Available Wood*

		Trillion Btu available per year within a one-hour haul radius			
Delivered cost ($/MMBtu)	**Resource/Haul time category**	**Coweta**	**Douglas**	**Murray**	**Union**
$0.65	Urban wood: 0-15 minutes	0.04	0.05	0.01	0.00
$0.85	Urban wood:15-30 minutes	0.33	0.39	0.06	0.01
$1.05	Urban wood: 30-45 minutes	0.73	1.29	0.16	0.03
$1.25	Urban wood: 45-60 minutes	1.30	1.49	0.26	0.05
$2.03	Logging residues: 0-15 minutes	0.16	0.02	0.06	0.00
$2.21	Logging residues: 15-30 minutes	0.58	0.29	0.29	0.04
$2.39	Logging residues: 30-45 minutes	0.99	0.79	0.42	0.15
$2.56	Pulpwood: 0-15 minutes	0.53	0.02	0.17	0.00
$2.57	Logging residues: 45-60 minutes	1.38	1.12	0.54	0.27
$2.72	Pulpwood: 15-30 minutes	1.48	0.73	0.76	0.04
$2.88	Pulpwood: 30-45 minutes	2.13	1.97	1.01	0.30
$3.04	Pulpwood: 45-60 minutes	3.36	2.86	1.45	0.66

radius, up to 0.1 to 3.2 trillion Btu can be provided from urban wood waste alone. With the addition of logging residues, 1.8 to 5.5 trillion Btu can be produced. Additional biomass from non-merchantable timber, estimated to be 0.5 to 1.1 trillion Btu per year in the four counties (General*Bioenergy, Inc. 2005), are no included in this analysis. 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 Coweta, Douglas, Murray, and Union counties in Georgia. Fuel typically represented the largest operating cost for a wood-fired power plant. Fuel costs averaged $3.4 and $8.0 million annually for the 20 or 40 MW plants, respectively, however, costs ranged from $5.7 million to $11.7 million for the 40 MW plant, due to differences in availability of forest and wood waste resources, as well as transportation infrastructure in these counties (Table 4). Douglas County had the lowest fuel cost and Union County had the highest.

The economic impacts of plant construction and operations varied widely among these counties due to differences in the makeup of each local economy. The total operating impacts (first year) for a 20 MW plant ranged from $6.2 to $11.3 million in output (revenue), 54 to 214 jobs, and $3.1 to $6.8 million in value added (income). Total operating impacts for a 40 MW plant ranged from $12.0 to $24.3 million in output, 100 to 482 jobs, and $5.7 to $14.8 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 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. Construction impacts for a 20 MW plant ranged from $3.1 to $7.6 million in output, 31 to 69 jobs, and $1.7 to $3.6 million in value added. Impacts for the 40 MW plant ranged from $3.8 to $10.2 million in output, 39 to 90 jobs, and $2.1 to $4.6 million in value added. Again, the large range of values for construction impacts in these counties reflects differences in the makeup of these local economies.

Often it is helpful to predict the distribution of economic impacts across various sectors of a local economy. More than 60 percent of all job impacts from operations 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 Coweta, Douglas, Murray, and Union counties to make a continued conversation possible. Up to 0.6 to 6.0 trillion Btu (i.e., 5 to 52 MW or energy to power 1,900 to 21,000 homes annually) of woody biomass are available at less than $2.60 per MMBtu in these four Georgia counties. 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

Table 4. *Economic Impacts of 20 and 40 MW Power Plants*

Georgia 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							
Coweta	2.61	9.51	160	5.52	7.55	49	2.67
Douglas	2.47	7.96	75	4.46	7.59	69	3.64
Murray	3.70	6.22	54	3.09	3.13	31	1.74
Union	4.76	11.28	214	6.81	4.02	47	2.23
Average	**3.39**	**8.74**	**126**	**4.97**	**5.57**	**49**	**2.57**
40 MW							
Coweta	6.12	18.41	331	10.71	5.60	59	3.15
Douglas	5.70	14.21	130	7.84	10.16	90	4.60
Murray	8.70	11.99	100	5.73	3.77	39	2.05
Union	11.65	24.34	482	14.82	4.84	57	2.64
Average	**8.04**	**17.24**	**261**	**9.77**	**6.09**	**61**	**3.11**

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 for 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 was not considered in this analysis, which could reduce transportation costs and make biomass resources from other areas more available.
- 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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