Florida: Alachua, Clay, Leon, Nassau, and Santa Rosa 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 Florida 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, Alachua, Clay, Leon, Nassau, and Santa Rosa counties were selected for analysis in this community economic profile.

Florida is the fourth most populated state in the nation, yet it boasts an abundance of natural beauty. About half of Florida, or 16.2 million acres, is covered by forests that contain diverse plant and wildlife species. Florida's forests provide many benefits and opportunities to residents and tourists alike. Approximately 49 percent of Florida's forests are owned by private family landowners, and another 32 percent are owned by private forest industries and investment companies. Near urban areas, these privately owned lands are susceptible to development pressures. The northern half of Florida contains expanding communities, farmland, and 82 percent of the state's timberland, which supports a thriving forest products industry. About 19 percent of the state's land area is publicly owned and maintained by state parks, state forests, water management districts, national forests, and national parks (Florida Division of Forestry 2005). These public conservation lands contain natural habitats such as pine flatwoods, hardwood hammocks, cypress swamps, as well as rivers, lakes, and springs. In addition, many Florida communities enjoy healthy and extensive urban forests that provide benefits to both residents and natural resources.

Nassau, Clay, Alachua, Leon, and Santa Rosa counties are all located in north Florida and each has a wealth of natural resources that contribute to the residential quality of life. Both Nassau and Clay counties are near the Jacksonville metropolitan area, and while they contain some of the city's bedroom communities, these counties remain largely rural. Nassau County lies on the Atlantic Ocean coastline, which provides recreation and tourism opportunities. Clay County features the beautiful St. John's River flowing along its eastern border. Tucked between Georgia and the Gulf Coast, Leon County's largest urban area, Tallahassee, is the state capital. It has two major universities—Florida State University (FSU) and Florida Agricultural and Mechanical University (FAMU)—each of which provide economic benefits and employment for the region. Similarly, the commercial hub of Alachua County is Gainesville, home of the University of Florida (UF) and about half of the county's residents. Equidistant from the Gulf and Atlantic coasts, the county is located in a region of springs, lakes, and rivers. Santa Rosa County is in the western panhandle on the Gulf of Mexico, attracting tourists to its beautiful beaches while hosting successful agricultural and manufacturing industries. Many of the largest cities within these five counties, Tallahassee, Gulf Breeze, Green Cove Springs, Orange Park, and Gainesville, are nationally recognized as Tree City USA communities. These counties are fortunate to contain areas with large amounts of forested lands, prominent natural features, and communities with the small-town atmosphere that many people enjoy.

According to the U.S. Census Bureau (2007), each of these counties is experiencing population growth (Table 1). With this growth comes the need for additional energy resources. Cognizant of environmental and sustainability issues, some communities are considering renewable fuel sources and efforts to promote energy conservation. For example, in Alachua County, public opposition to a proposal to build another large coal-fired power plant has led city-owned Gainesville Regional Utilities to consider proposals for renewable energy sources such as wood

Table 1. *Population Data for Selected Florida Counties*

County	2000	2006	Population Growth from 2000 to 2006
Alachua	217,955	227,120	4.2%
Clay	140,814	178,899	27.0%
Leon	239,452	245,625	2.6%
Nassau	57,663	66,707	15.7%
Santa Rosa	117,743	144,561	22.8%

and municipal solid waste. In Leon County, the city of Tallahassee agreed to buy up to 35 megawatts (MW) of biomass energy from Biomass Gas and Electric Company in 2006. In 2005, Jacksonville's public utility, Jacksonville Electric Authority, planned to purchase up to 70 MW of energy from a biomass power plant proposed by Biomass Industries, Inc. This biomass facility plans to use non-woody biomass, although wood from neighboring Clay and Nassau counties could potentially be used as a supplemental fuel source. Additionally, just west of Leon County in Jackson County, a wood pellet plant is being constructed that will process wood and export pellets to Europe for energy use. Similar wood pellet plants could supply wood domestically if there is a demand. Increases in population; energy demand projections; and the presence of local, sustainable wood resources create opportunities for these five counties to consider using woody biomass to generate electricity.

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 feasbility 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 Alachua, Clay, Leon, Nassau, and Santa Rosa counties in Florida. 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 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 five Florida 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 Alachua County, this results in 26,000 green tons of urban wood waste per year.

The amount of logging residue and pulpwood for all counties in Florida 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 Leon County, there are 32,600 green tons (37 percent moisture) of logging

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 referred to in this document is reported on a green-weight basis.

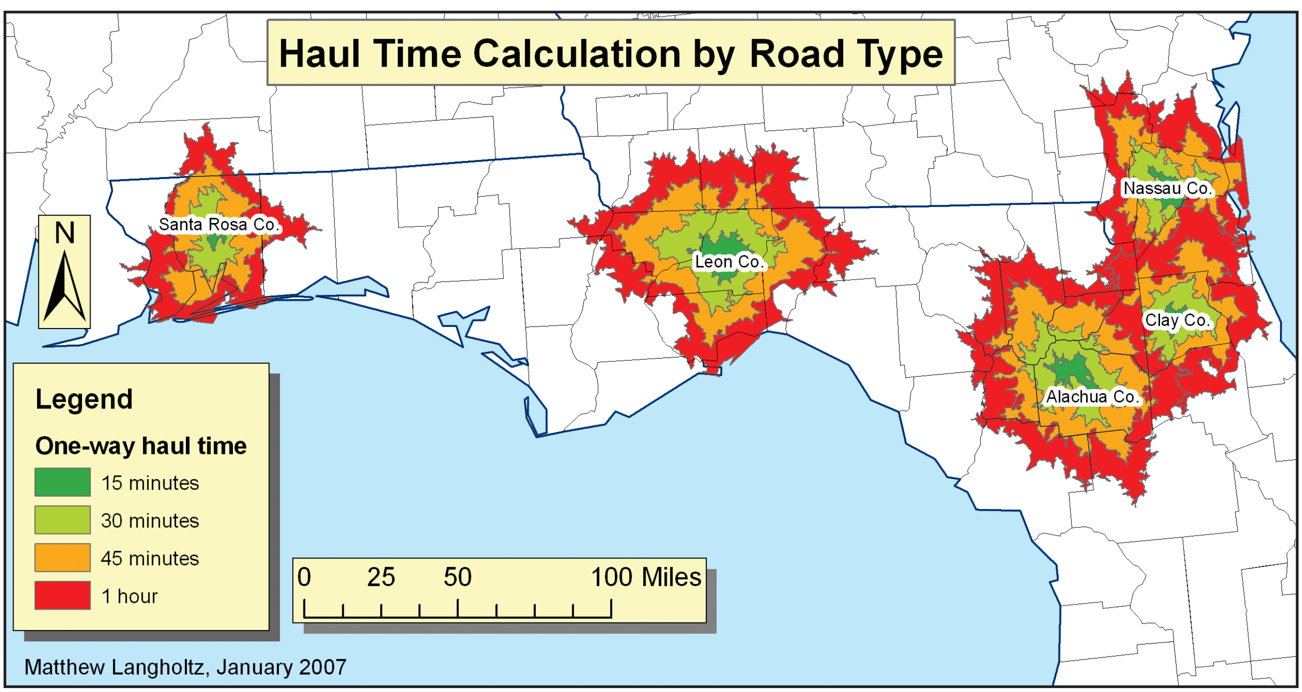

Figure 1. *Wood harvested within each colored band can be transported to the center of each county in 15-minute increments.*

Table 2. *Three Sources of Available Wood*

County	Available urban wood waste	Available logging residues	Harvested pulpwood
Alachua	26,000	85,900	292,500
Clay	19,800	50,000	239,000
Leon	28,500	32,600	156,800
Nassau	7,500	94,500	300,400
Santa Rosa	16,600	55,400	235,900

residues available annually from existing forestry operations. There are also 156,800 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 five selected Florida 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 (or the Deerhaven facility in Alachua County).

Supply Analysis Results

Energy resources and costs for each resource-haul time category for the five counties are shown in Table 3 (resources are ranked from cheapest to most expensive

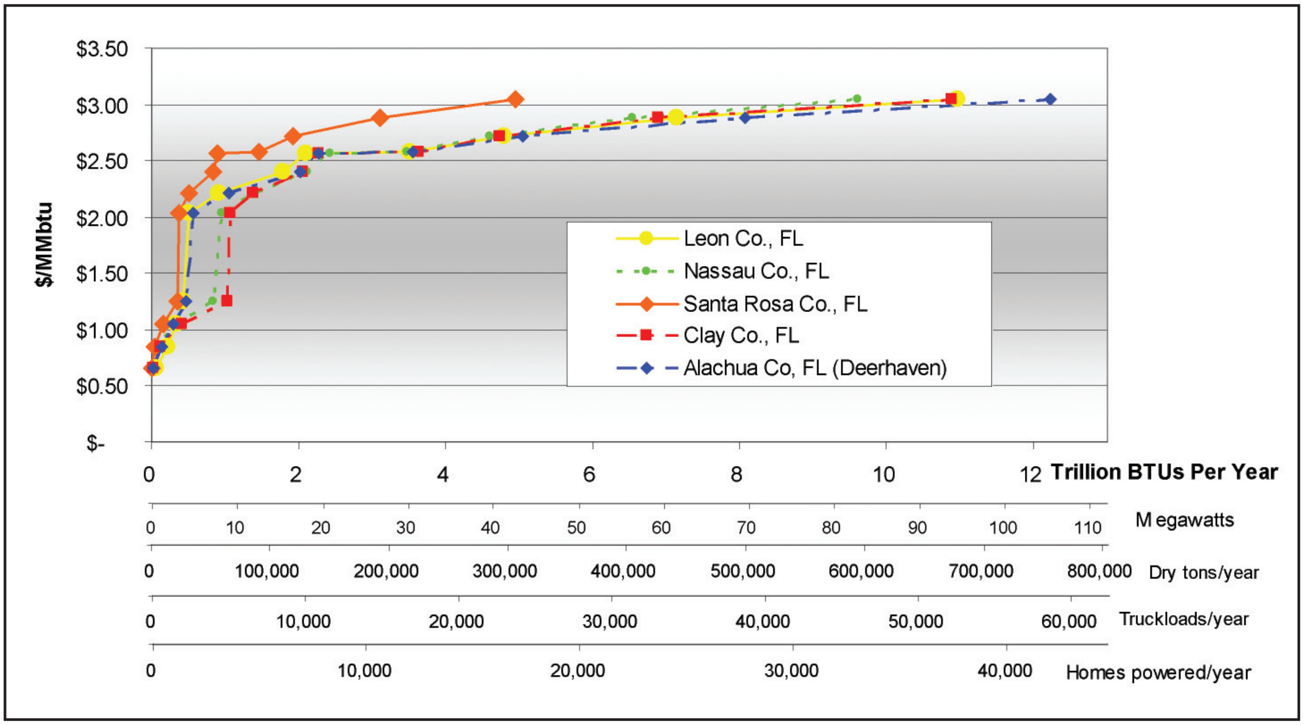

Figure 2. *Supply curves for woody biomass indicate the cost and quantity of wood at 15-minute hauling intervals.*

based on delivered cost of energy). These values were used to construct the supply curves shown in Figure 2. The supply curves suggest that 1.5 to 3.6 trillion Btu, or 13 to 31 MW of electricity, which is enough to power 5,000 to 12,500 households in the South (Bellemar 2003), are available for less than $2.60 per MMBtu in each of the five woodsheds, competitive with current costs of coal (about $3.00 per MMBtu).

Within a one-hour haul radius, up to 0.3 to 1.0 trillion Btu can be provided from urban wood waste alone. With the addition of logging residues, 1.40 to 3.43 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 Alachua, Clay, Leon, Nassau, and Santa Rosa counties in Florida. Fuel typically represented the largest operating cost for a facility, and averaged $4.0 and $9.9 million for the 20 or 40 MW plants, respectively. However, these fuel costs varied across counties from $9.1 million to over $11.2 million for the 40 MW plant, due to differences in availability of forest and wood waste resources, as well as the transportation infrastructure (Table 4).

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**	**Alachua[1]**	**Clay[2]**	**Leon[2]**	**Nassau[2]**	**Santa Rosa[2]**
$0.65	Urban wood: 0-15 minutes	0.02	0.02	0.06	0.01	0.01
$0.85	Urban wood:15-30 minutes	0.11	0.10	0.15	0.04	0.04
$1.05	Urban wood: 30-45 minutes	0.16	0.29	0.12	0.31	0.11
$1.25	Urban wood: 45-60 minutes	0.17	0.62	0.09	0.49	0.19
$2.03	Logging residues: 0-15 minutes	0.09	0.05	0.08	0.12	0.02
$2.21	Logging residues: 15-30 minutes	0.50	0.29	0.40	0.43	0.13
$2.39	Logging residues: 30-45 minutes	0.97	0.69	0.88	0.73	0.34
$2.56	Pulpwood: 0-15 minutes	0.24	0.21	0.32	0.30	0.06
$2.57	Logging residues: 45-60 minutes	1.29	1.36	1.41	1.06	0.56
$2.72	Pulpwood: 15-30 minutes	1.50	1.09	1.27	1.12	0.47
$2.88	Pulpwood: 30-45 minutes	3.03	2.15	2.36	1.95	1.17
$3.04	Pulpwood: 45-60 minutes	4.14	4.01	3.83	3.06	1.85

[1]Delivery to the Deerhaven Facility.
[2]Delivery to the county center.

The economic impacts of annual operations in the first year are also shown in Table 4. The total annual operating expenses (first year) for a wood-fueled power plant averaged $7.7 million for a 20 MW facility and $16.1 million for a 40 MW facility. 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. The impacts varied among counties due to differences in specific makeup of the local economies, and in some cases the absence of key sectors serving wood-fueled power plant operations.

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 largest construction expenses were the boilers and turbines, ranging from $45 to $90 million. The large range of values is due to some counties having industries that produce some of the major items needed for construction, while other counties must import these items from other regions, representing a leakage from the local economy. For example, Santa Rosa County would experience greater economic impacts from plant construction because it has existing industries that manufacture key plant equipment such as boilers and turbines.

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 created 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 Alachua, Clay, Leon, Nassau, and Santa Rosa counties to make a continued conversation possible. Up to 1.5 to 3.6 trillion Btu (i.e., 13 to 31 MW

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

Florida County	Wood Fuel Cost (Mn $)	Annual Operations Impacts (first year) Output ($Mn)	Annual Operations Impacts (first year) Employment (Jobs)	Annual Operations Impacts (first year) Value Added ($Mn)	Plant Construction Impacts Output ($Mn)	Plant Construction Impacts Employment (Jobs)	Plant Construction Impacts Value Added ($Mn)
20 MW							
Alachua	3.84	13.52	196	8.38	8.00	81	4.30
Clay	3.37	11.73	182	7.10	7.60	74	3.70
Leon	4.52	13.41	156	8.55	7.80	74	4.10
Nassau	3.69	10.80	137	6.71	6.70	63	3.30
Santa Rosa	4.70	12.47	147	7.70	37.70	335	15.40
Average	**4.02**	**12.39**	**164**	**7.69**	**13.56**	**125**	**6.16**
40 MW							
Alachua	9.28	27.54	413	17.08	10.80	107	10.80
Clay	9.05	25.30	420	15.35	10.30	98	4.80
Leon	10.57	27.14	318	17.35	10.70	100	5.40
Nassau	9.46	23.06	297	14.56	9.00	82	4.20
Santa Rosa	11.23	25.94	307	16.18	65.50	578	26.30
Average	**9.92**	**25.80**	**351**	**16.10**	**21.26**	**193**	**10.30**

or energy to power 5,000 to 12,500 homes annually) of woody biomass are available at less than $2.60 per MMBtu in these five north Florida 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 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 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.
- Florida's population is still growing. This might increase the availability of urban wood waste resources, though it could decrease overall available biomass 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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