WOOD to ENERGY
Community Economic Profile

Arkansas: Saline 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 Arkansas 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, Saline and Union counties were selected for analysis in this community economic profile.

Arkansas, the "Land of Opportunity," contains an abundance of natural beauty and valuable resources. More than half of the state, or 18.4 million acres, is covered in forests, which provide benefits such as clean air, wildlife habitat, watershed protection, and recreational opportunities (Arkansas Forestry Commission 2005). These forests range from loblolly and shortleaf pine stands in the Quachita Mountains to bottomland oak, cypress, and cottonwood forests in the eastern alluvial plains. With over 200 species of native trees and woody plants, Arkansas ranks ninth in the nation in terms of wood production and is the South's largest producer of softwood lumber (Pelkki 2005).

Roughly 55 percent of the state's land area is covered by commercially owned forests. The forest products industry is the state's largest manufacturer, employing over 100,000 workers and generating revenue in excess of $12 billion a year (Grippo and McCord 2006). In addition, numerous national and state forests and parks offer residents and visitors the opportunity to explore Arkansas's natural wonders and unique cultural history, which includes traditional Ozark Mountain folklore, Civil War history, and remnants of the state's oil boom days.

Saline and Union counties are located in regions of Arkansas that support forests, wetlands, and farmland, as well as several small communities. Saline County is located in the Quachita Highlands of central Arkansas. Its mostly urban landscape contains a patchwork of forestlands. Near the Little Rock metropolitan area, Saline County is growing as it accommodates the city's bedroom communities. Union County is located in the southern coastal plains region of Arkansas along the Louisiana border. Encompassing 1,039 square miles, it is the state's largest county in terms of land area. Much of this land is covered with dense woods of pine and cypress, which are a favorite among recreationists for hunting and bass fishing. Wood products produced in Union County include pallets, furniture parts, flooring, rough lumber, and finished lumber. El Dorado, the county seat, hosts South Arkansas Community College, a symphony orchestra, and an art center—as well as the headquarters of prominent oil and timber corporations.

Both Saline and Union counties are experiencing development. According to the U.S. Census Bureau (2007), Saline County experienced moderate population growth between 2000 and 2006 with an increase of 12.6 percent and is listed as one of Arkansas' fastest growing counties. While Union County experienced a decrease in population of 3.2 percent, projections indicate that the county's population is expected to increase in upcoming years. The abundance of wood resources within these counties along with the anticipated need for additional energy creates the potential to utilize biomass fuels.

The state has approximately 152 megawatts (MW) of total installed biomass capacity, mostly from timber residues (Arkansas Energy Office 2005). Forest industries in Arkansas already generate 50 percent of their energy needs from wood wastes and mill residues (Pelkki 2005). The challenges for public and private landowners are to overcome logistical and economic barriers, which may prevent woody biomass from being established as a reliable fuel source, and to create opportunities for others to adopt the energy generating techniques currently utilized by the forest 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 Saline and Union counties in Arkansas. 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.

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 Saline and Union 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 Saline County, this results in 11,000 green tons of urban wood waste per year.

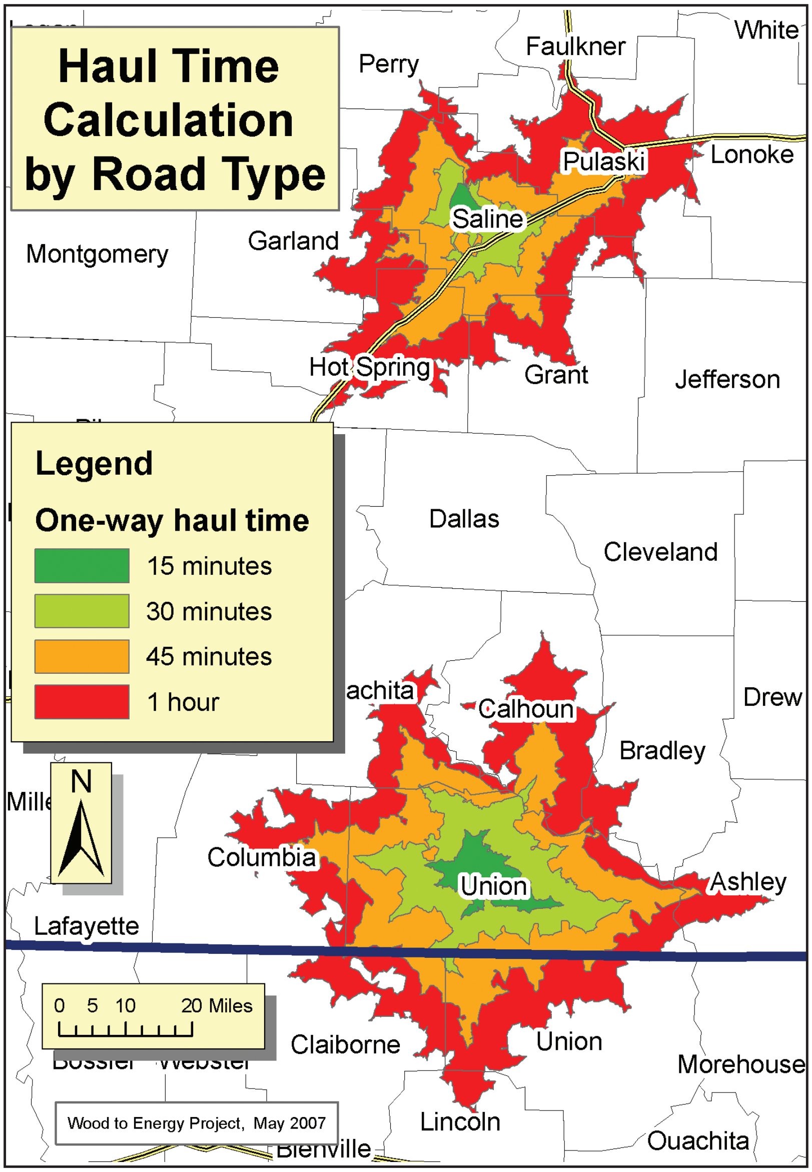

Figure 1. *Wood harvested within each colored band can be transported to the center of each county in 15-minute increments.*

The amount of logging residue and pulpwood for all counties in Arkansas 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 Union County, there are 215,000 green tons (37 percent moisture) of logging residues available annually from existing forestry operations. There are also 470,000 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 counties. Figure 2 shows the price of wood at different quantities that might be 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

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 1. *Three Sources of Available Wood*

County	Available urban wood waste	Available logging residues	Harvested pulpwood
Saline	11,000	66,000	200,000
Union	5,000	215,000	470,000

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 two 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 1.4 to 5.0 trillion Btu, or 12 to 43 MW of electricity, which is enough to power 5,000 to 17,000 households (Bellemar 2003), are available for less than $2.60 per MMBtu in the Saline and Union county woodsheds, respectively. Wood at this price is competitive with the current costs of coal. Within a one-hour haul radius, up to 0.1 to 0.3 trillion Btu can be provided from urban wood waste alone. With the addition of logging residues, 1.4 to 4.7 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*.

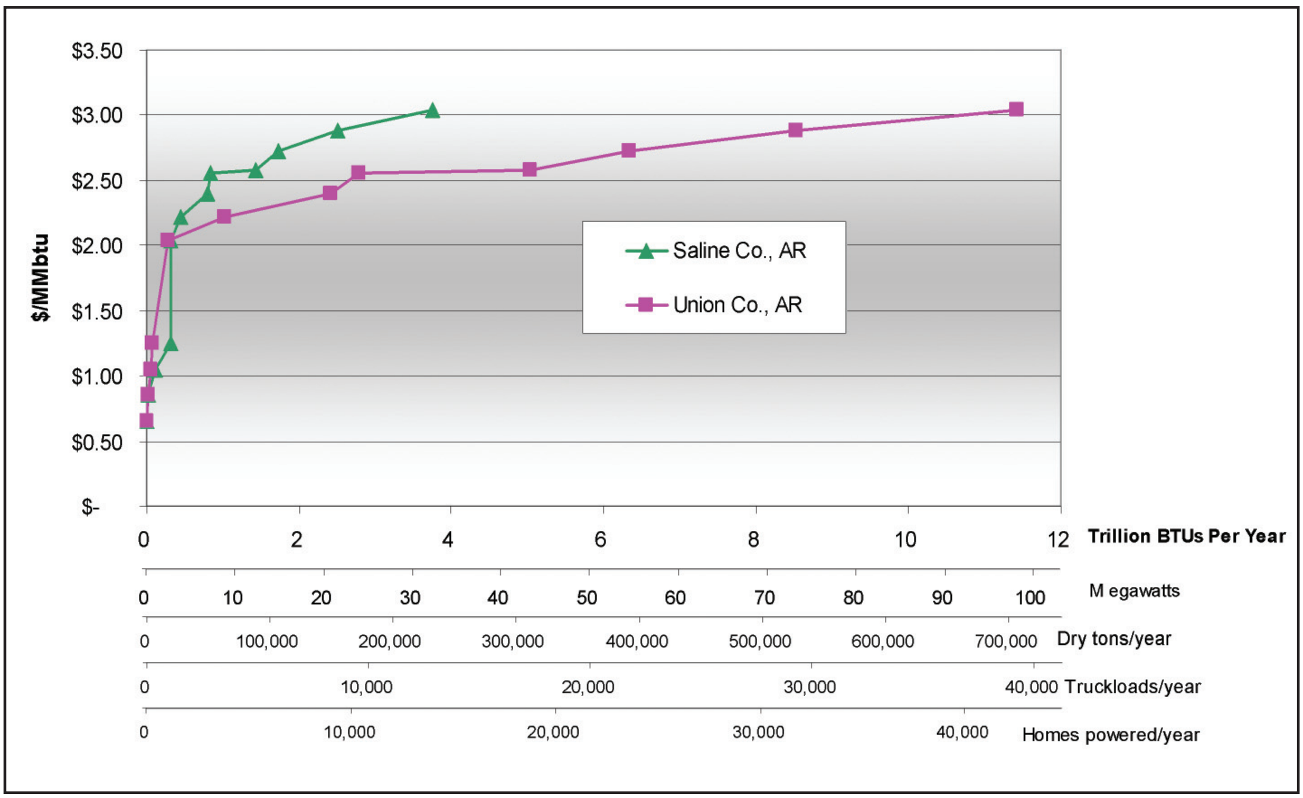

Figure 2. *Supply curves for woody biomass indicate the cost and quantity of wood at 15-minute hauling intervals.*

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**	**Saline County**	**Union County**
$0.65	Urban wood: 0-15 minutes	0.00	0.00
$0.85	Urban wood:15-30 minutes	0.02	0.02
$1.05	Urban wood: 30-45 minutes	0.09	0.03
$1.25	Urban wood: 45-60 minutes	0.20	0.03
$2.03	Logging residues: 0-15 minutes	0.02	0.21
$2.21	Logging residues: 15-30 minutes	0.11	0.73
$2.39	Logging residues: 30-45 minutes	0.36	1.41
$2.56	Pulpwood: 0-15 minutes	0.04	0.37
$2.57	Logging residues: 45-60 minutes	0.60	2.24
$2.72	Pulpwood: 15-30 minutes	0.28	1.29
$2.88	Pulpwood: 30-45 minutes	0.79	2.21
$3.04	Pulpwood: 45-60 minutes	1.23	2.88

Economic impacts were evaluated for Saline and Union counties in Arkansas. Fuel costs were very similar in these two counties, reflecting comparable wood resource availability, averaging $4.9 million and $11.2 million for a 20 and a 40 MW plant, respectively (Table 3).

The economic impacts of annual operations and plant construction were also similar for the two counties, reflecting a similarity in makeup of the local economy. For annual operations, output or revenue impacts averaged $12.3 million and $24.7 million for 20 and 40 MW, respectively, value added (income) impacts averaged $7.2 million and $14.5 million, and employment impacts averaged 223 and 491 jobs. 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 rather low in these two counties, since neither has a local industry for boiler and turbine equipment manufacturing, which represents a majority of capital costs, and therefore this money would be lost from these local economies. Construction impacts averaged $4.1 million in output, 49 jobs and $2.3 million in value added for the 20 MW plant, and $4.9 million in output, 58 jobs, and $2.7 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 Saline and Union counties to make a continued conversation possible. Up to 1.4 to 5.0 trillion Btu (i.e., 12 to 43 MW or energy to power 5,000 to 17,000 homes annually) of woody biomass are available at less than $2.60 per MMBtu in these two Arkansas counties. These general estimates could be improved with more site-specific analysis and information.

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

Arkansas 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							
Saline	4.85	11.57	239	6.98	4.14	52	2.30
Union	5.02	12.84	226	7.39	4.04	46	2.31
Average	**4.94**	**12.29**	**233**	**7.19**	**4.09**	**49**	**2.31**
40 MW							
Saline	11.44	24.24	522	14.47	4.93	61	2.67
Union	10.91	25.18	461	14.51	4.84	55	2.72
Average	**11.18**	**24.71**	**491**	**14.49**	**4.88**	**58**	**2.70**

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 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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