WOOD to ENERGY

Community Economic Profile

# North Carolina: Buncombe and Orange Counties

*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 North 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, Buncombe and Orange counties were selected for analysis in this community economic profile.

From the Blue Ridge and Great Smoky Mountains to the piedmont and coastal regions, North Carolina's abundant natural resources are valuable assets. North Carolina's rich history in turpentine and pine tar production lead to its nickname, the "Tar Heel State." The nation's first forestry school was located in Asheville, making North Carolina the birthplace of forest conservation for the United States. Today, four national forests, Great Smoky Mountains National Park, the Blue Ridge Parkway, state and local natural areas, and many privately owned forests conserve almost 60 percent of the state in forests (USDA 2006).

Western North Carolina's mountainous region comprises the most heavily forested counties of the state with over 75 percent forest cover. The majority of North Carolina's timberland is dominated by hardwood forests, while loblolly and shortleaf pine account for 26 percent of the timberland (USDA 2006). Private individuals own 65 percent of the forests, with corporations, industry, and public land agencies accounting for the remaining forest land base. North Carolina's forests provide the state with cleaner air and water and attract residents and tourists who enjoy its recreational opportunities. These forests serve both as an economic engine and as wildlife habitat for numerous species including birds, white-tailed deer, black bears, and elk. In 2007, the forest products industry was the number one manufacturing industry in North Carolina, employing over 100,000 people with economic benefits of more than $30 billion (North Carolina Forestry Association 2007).

Buncombe County is in the western region of North Carolina in the French Broad River valley, nestled in between the Blue Ridge and the Smoky Mountains. Buncombe County prides itself on living in harmony with nature and acting locally to positively impact the global environment. Asheville, the county seat, is a growing city with large arts and retirement communities and several colleges and universities. Another heavily forested region, Orange County, is located in the rolling hills of the piedmont region in the north central part of the state. Although the county is located in the Raleigh-Durham metropolitan area, only 10 percent of the land base has been developed. Hillsborough, the county seat, is a small town located on the Eno River, and the city of Chapel Hill is home to the University of North Carolina. Buncombe and Orange counties are 62 and 59 percent forested, respectively, and the larger communities, such as Asheville, Weaverville, and Chapel Hill are nationally recognized as Tree City USA communities.

According to the U. S. Census Bureau (2007), both Buncombe and Orange counties have grown in population over the past six years. Buncombe County's population has grown by 7.7 percent, while Orange County has grown by 1.6 percent (Table 1). Coal, natural gas, and fuel oil are currently the major sources of energy in both

Table 1. *Population Data for Selected North Carolina Counties*

| County | 2000 | 2006 | Population Growth from 2000 to 2006 |
|---|---|---|---|
| Buncombe | 206,330 | 222,174 | 7.7% |
| Orange | 118,227 | 120,100 | 1.6% |

counties. In fact, Progress Energy is constructing a new facility in Buncombe County that will supply 130 megawatts (MW) of energy using an ultra low-sulfur fuel oil. Renewable sources of energy are also being considered. For example, in Asheville, the Buncombe County Landfill Gas Project, developed by Enerdyne Properties, generates energy from landfill methane gas. In both counties, several energy producers are using solar power to generate small amounts of energy. To expand their renewable fuels portfolio, Buncombe and Orange County might also consider using wood to generate energy.

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 sheet 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 various levels of consumption. The following summary assesses the economic availability of wood resources for Buncombe and Orange counties in North 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 is common on facilities located on major rail lines, woody biomass is typically transported by truck (and that is the convention used in this analysis). The cost of transportation depends on the time it takes a truck to travel from the harvest site to the facility. A simpler analysis could calculate transportation cost as a function of distance rather than transportation time. However, transportation costs per mile tend to decrease as road infrastructure improves. 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 procurement zones 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.

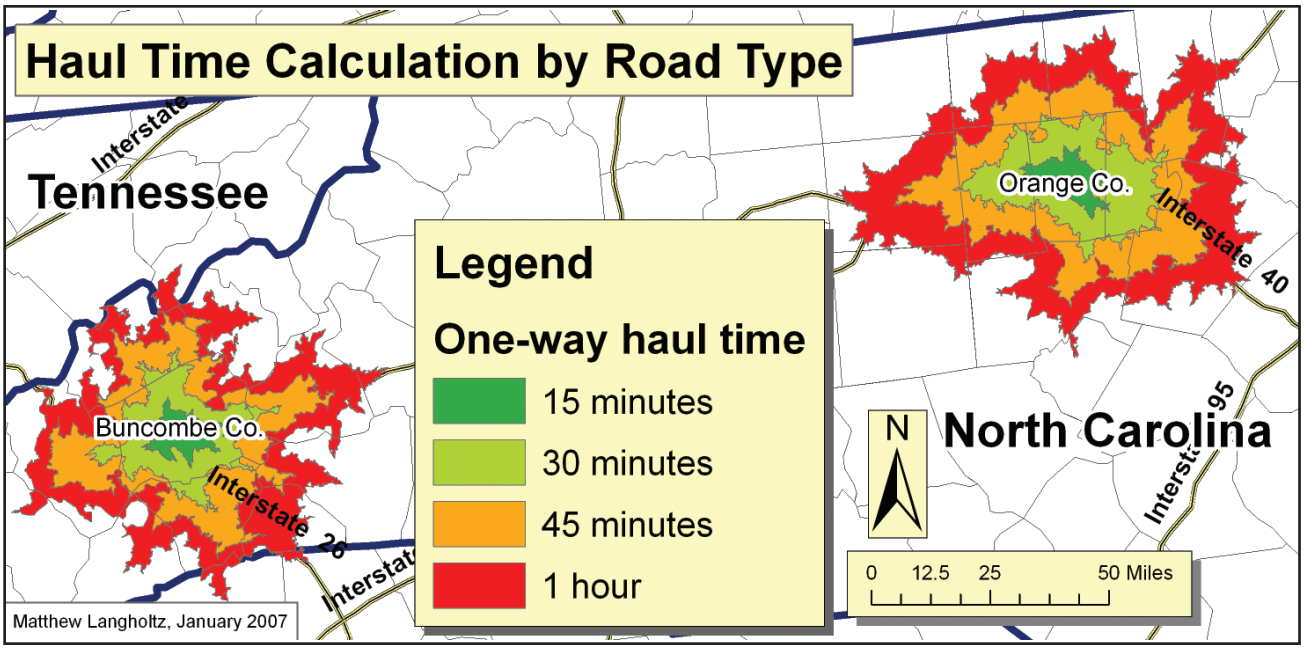


Figure 1. *Wood harvested within each colored band can be transported to the center of each county in 15-minute increments.*

## 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 North Carolina 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). Urban wood waste 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 Buncombe County, this results in 26,700 green tons of urban wood waste per year.

The amount of logging residue and pulpwood for all counties in North Carolina 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 Orange County, there are 22,700 green tons (37 percent moisture) of logging residues available annually from existing forestry operations. There are also 6,400 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

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 will 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.

Table 2. *Three Sources of Available Wood*

| County | Available urban wood waste | Available logging residues | Harvested pulpwood |
|---|---|---|---|
| Buncombe | 26,700 | 20,100 | 900 |
| Orange | 14,400 | 22,700 | 6,400 |

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 Buncombe and Orange 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 both county centers.

## Supply Analysis Results

Energy resources and costs for each resource-haul time category for the two 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 2.0 and 3.9 trillion Btu, or 17 and 33 MW of electricity, which is enough to power 6,800 and 13,300 households (Bellemar 2003), are available for less than $2.60 per MMBtu in the Buncombe and Orange County woodsheds, respectively. Energy at this cost is competitive with current costs of coal. Within a one-hour haul radius, up to 0.5 and 1.4 trillion Btu can be provided from urban wood waste alone in Buncombe and Orange County woodsheds, respectively. With the addition of logging residues, 2.0 and 3.9 trillion Btu can be produced in the Buncombe and Orange County woodsheds, respectively. Other types of wood may be available from thinnings to improve forest health, although this resource was not quantified for 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

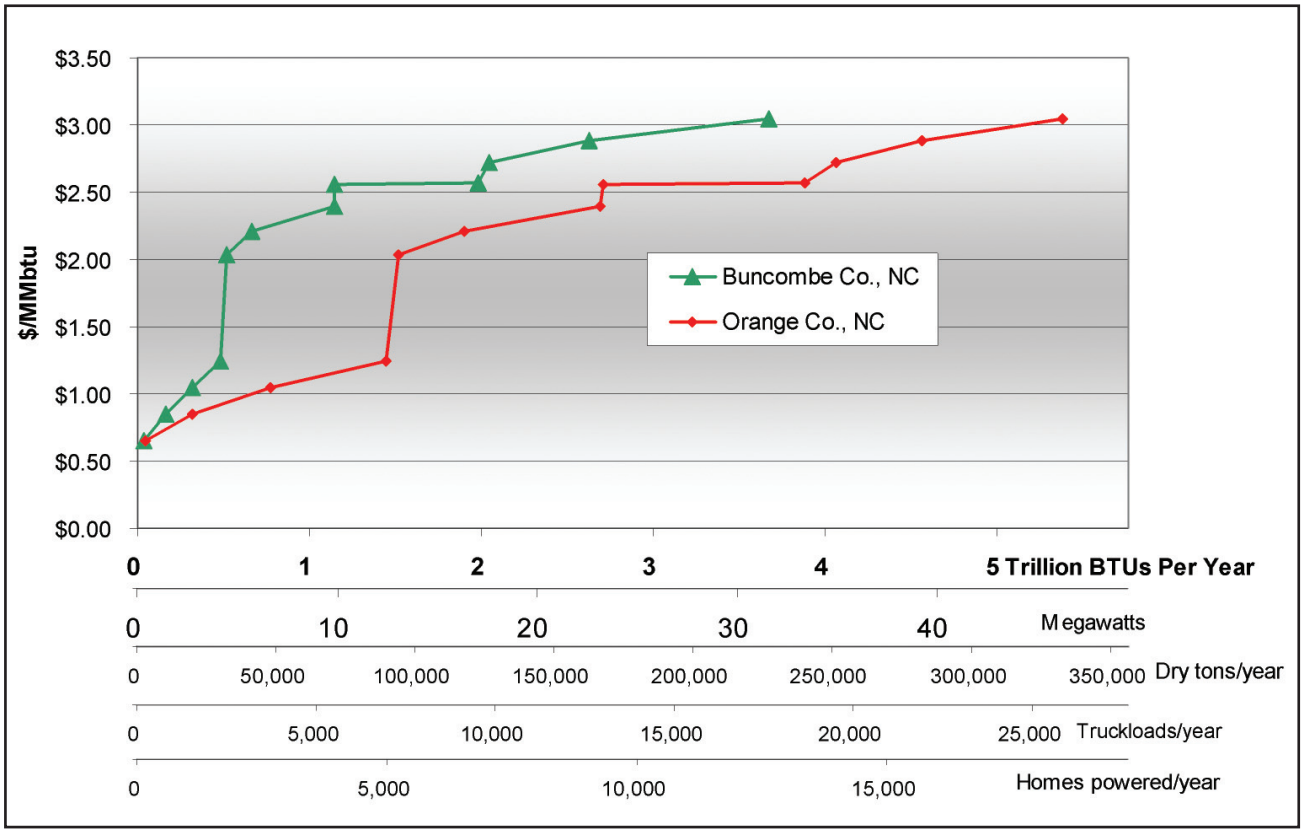


Figure 2. *Supply curves for woody biomass indicate the cost and quantity of wood at 15-minute hauling intervals.*

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** | **Buncombe County** | **Orange County** |
| $0.65 | Urban wood: 0-15 minutes | 0.04 | 0.04 |
| $0.85 | Urban wood:15-30 minutes | 0.13 | 0.27 |
| $1.05 | Urban wood: 30-45 minutes | 0.15 | 0.46 |
| $1.25 | Urban wood: 45-60 minutes | 0.17 | 0.67 |
| $2.03 | Logging residues: 0-15 minutes | 0.03 | 0.07 |
| $2.21 | Logging residues: 15-30 minutes | 0.15 | 0.38 |
| $2.39 | Logging residues: 30-45 minutes | 0.48 | 0.79 |
| $2.56 | Pulpwood: 0-15 minutes | 0.00 | 0.02 |
| $2.57 | Logging residues: 45-60 minutes | 0.83 | 1.17 |
| $2.72 | Pulpwood: 15-30 minutes | 0.07 | 0.18 |
| $2.88 | Pulpwood: 30-45 minutes | 0.58 | 0.50 |
| $3.04 | Pulpwood: 45-60 minutes | 1.05 | 0.82 |

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 Buncombe and Orange counties in North Carolina. Fuel typically represented the largest operating cost for a wood-fired power plant. Fuel costs averaged $3.3 and $8.4 million annually for the 20 or 40 MW plants, respectively, however, costs ranged from $7.4 to $9.4 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). Fuel costs were lower in Orange County than in Buncombe County.

The economic impacts of plant construction and operations varied widely between these counties due to differences in the specific makeup of the local economy. The total annual operating impacts (first year) for a 20 MW plant ranged from $10.8 to $12.8 million in output (revenue), 177 to 242 jobs, and $6.9 to $7.6 million in value added (income). Total operating impacts for a 40 MW plant ranged from $22.1 to $26.7 million in output, 393 to 546 jobs, and $14.1 to $15.8 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. Local construction impacts differed dramatically for these two counties. Construction impacts for a 20 MW plant ranged from $7.9 to $45.3 million in output, 74 to 379 jobs, and $3.9 to $26.0 million in value added. Construction impacts for the 40 MW plant ranged from $10.7 to $78.7 million in output, 98 to 653 jobs, and $5.1 to $44.9 million in value added. The significantly higher construction impacts in Orange County reflect the presence of manufacturing industries for boilers and turbines, key components for power plants. This results in greater impacts as more money would be retained in the local economy.

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

| North Carolina 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** | | | | | | | |
| Buncombe | 3.74 | 12.84 | 242 | 7.59 | 7.89 | 74 | 3.90 |
| Orange | 2.88 | 10.81 | 177 | 6.91 | 45.27 | 379 | 25.95 |
| **Average** | **3.31** | **11.82** | **210** | **7.25** | **26.58** | **227** | **14.92** |
| **40 MW** | | | | | | | |
| Buncombe | 9.37 | 26.65 | 546 | 15.77 | 10.72 | 98 | 5.06 |
| Orange | 7.35 | 22.08 | 393 | 14.07 | 78.73 | 653 | 44.88 |
| **Average** | **8.37** | **24.36** | **470** | **14.92** | **44.73** | **376** | **24.97** |

Prediction of the distribution of economic impacts across various sectors of the local economy is possible. More than 60 percent of all jobs would occur in the agriculture and forestry sector, which supplies wood fuel to these facilities. There would also be significant employment impacts in the sectors for professional services, retail trade, and government sectors, 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 is enough wood at an affordable cost. Our supply analysis suggests that, indeed, enough wood at a reasonable cost is available in Buncombe and Orange counties to make a continued conversation possible. 2.0 and 3.9 trillion Btu (i.e., 17 and 33 MW or energy to power 6,800 and 13,300 homes annually) of woody biomass are available at less than $2.60 per MMBtu in Buncombe and Orange 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 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.
- Rail transportation, which could substantially reduce transportation costs and increase the procurement area for biomass resources, 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.

## References

Bellemar, D. 2003. What Is a Megawatt? http://www.utilipoint.com/issuealert/article.asp?id=1728 (accessed July 13, 2006).

Condon, B. and F. E. Putz. 2007. Countering the Broadleaf Invasion: Financial and Carbon Consequences of Removing Hardwoods During Longleaf Pine Savanna Restoration. Restoration Ecology 5:2. In press.

North Carolina Forestry Association. 2007. Forest products industry emerges as North Carolina's largest manufacturing industry. Press Release. http://www.ncforestry.org/docs/Latest%20News/releases/releasesindex.htm (accessed April 9, 2007).

U.S. Census Bureau. 2007. http://www.census.gov/ (accessed March 29, 2007).

USDA Forest Service. 2006. Forest Inventory and Analysis Factsheet North Carolina 2002. Asheville NC: USDA Forest Service, Southern Research Station. http://srsfia2.fs.fed.us/states/nc/NCFACT%7E1.PDF (accessed April 9, 2007).

USDA Forest Service. 2003. Forest Inventory and Analysis. Timber Product Output (TPO) Reports. Asheville, NC: USDA Forest Service, Southern Research Station. http://srsfia2.fs.fed.us/php/tpo2/tpo.php (accessed November 15, 2006).

Wiltsee, G. 1998. Urban wood waste resource assessment. National Renewable Energy Laboratory, Golden, CO.

*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.*

COOPERATIVE EXTENSION SERVICE, UNIVERSITY OF FLORIDA, INSTITUTE OF FOOD AND AGRICULTURAL SCIENCES, Larry R. Arrington, Director, in cooperation with the United States Department of Agriculture, publishes this information to further the purpose of the May 8 and June 30, 1914 Acts of Congress; and is authorized to provide research, educational information, and other services only to individuals and institutions that function with non-discrimination with respect to race, creed, color, religion, age, disability, sex, sexual orientation, marital status, national origin, political opinions, or affiliations. The information in this publication is available in alternate formats. Single copies of extension publications (excluding 4-H and youth publications) are available free to Florida residents from county extension offices. Information about alternate formats is available from IFAS Communication Services, University of Florida, PO Box 110810, Gainesville, FL 32611-0810. This information was published September 2007.