



Developing Our Biomass Resources

mississippi development authority

MISSISSIPPI

Why Biomass Works in Mississippi

Mississippi has become a model for other states because of our success in developing both traditional and renewable energy sources.

–Governor Phil Bryant



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Mississippi continues to be a national leader in developing a wide range of biomass projects.

Many top bioenergy and biochemical companies choose to work in Mississippi because of the advantages the state offers. Forestland covers approximately 65 percent of Mississippi's landscape, offering an abundant, available woody biomass supply to support the bioenergy and biochemical industries. In fact, millions of dry tons of pulpwood and woody biomass residues are available annually for new bioenergy and biochemical development in the state.

Additionally, annual timber growth exceeds harvest in Mississippi – more than 2.2 units of timber are added to the state's stocks for every unit that is harvested each year.

That means Mississippi could harvest even more of its woody biomass resources – while also tapping into plentiful forest residues – and still ensure the long-term health and sustainability of its forest resources.

While woody biomass is the most abundant biomass resource in the state, Mississippi offers other biomass feedstocks, as well.

- Herbaceous biomass, such as crop residues, dedicated energy crops and perennial grasses
- Poultry litter, manure and other waste products from poultry and livestock
- Municipal solid waste landfills

Agriculture accounts for 26 percent of land use in the state, including pastureland and crops such as soy, corn, wheat

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- *Abundant biomass resources*
 - *A business-friendly environment*
 - *Extensive existing infrastructure*
 - *A well-integrated transportation system*
 - *Dedicated and skilled workforce*

and cotton. This gives Mississippi abundant supplies of crop residues for producing energy, as well as ample space for dedicated energy crops. In total, Mississippi has

approximately 30 million acres of forest and agricultural lands.

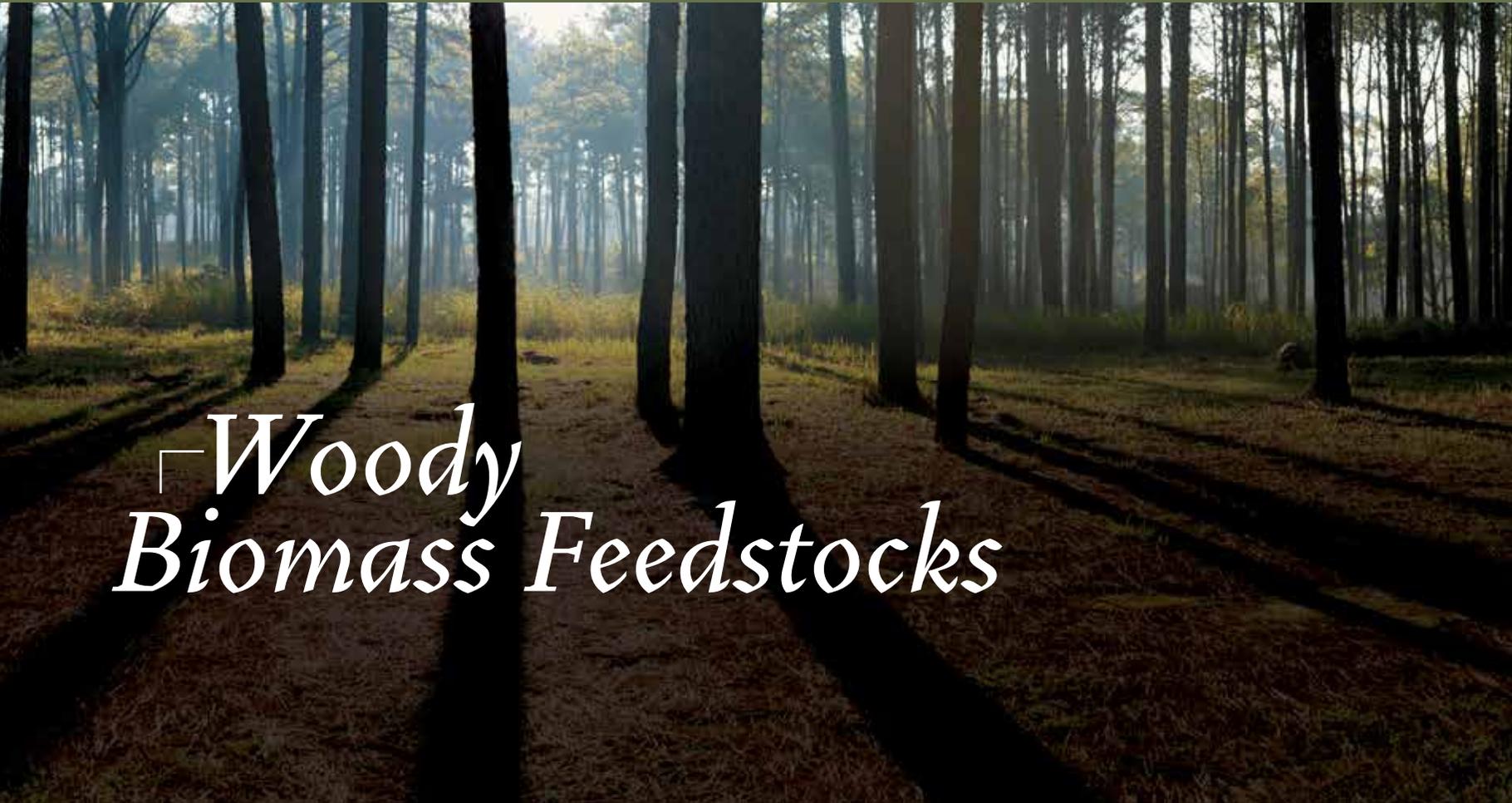
The availability of core transportation and energy infrastructure is an important factor for companies considering where to locate new facilities or expand their operations. Mississippi offers six interstate highways, 2,500 miles of mainline railroad

track and excellent port facilities, including two deepwater operations, and reliable and plentiful energy offerings.

Taken together, Mississippi's abundant natural resources, friendly business environment and well-integrated infrastructure have positioned the state as a premier destination for bioenergy and biochemical companies, both today and well into the future.

Sources of Biomass Feedstocks in Mississippi

While Mississippi offers bioenergy and biochemical companies a variety of feedstock options, woody biomass is the most abundant biomass feedstock in the state.



*Woody
Biomass Feedstocks*

Among the fifty U.S. states, forestland only accounts for approximately 22 percent of the average state's land base. In contrast, forestland dominates the landscape in Mississippi, covering approximately 65 percent of the state; of Mississippi's total forestland, 99.9 percent is classified as timberland, meaning it is both available for and capable of producing meaningful wood volumes for industrial uses.

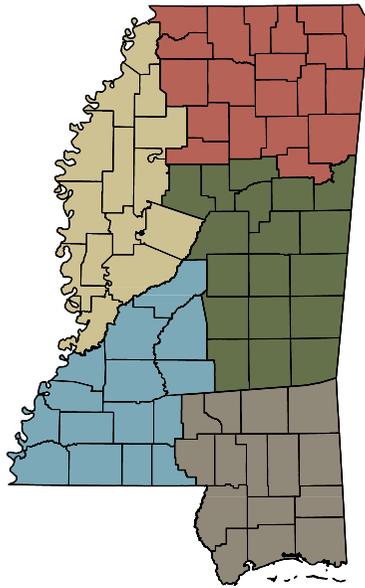
On a statewide basis, Mississippi's aggregate growth-to-removals ratio is 2.2:1, meaning that 2.2 units of wood are added to the state's growing stock for each unit of wood harvested. Based on these figures, an increased harvest can be sustainably managed to ensure the long-term health of the state's forestlands.

An Abundant Wood Basket

With 19.5 million acres of timberland, Mississippi has abundant woody biomass resources available to support bioenergy and biochemical operations. Not only does the state offer a plentiful wood basket, but timberland acreage in Mississippi has also been steadily increasing over the years, with many rural counties gaining timberland through conversion of marginal agricultural lands to forestry land use in recent decades.

Because timber sales and harvesting activities on public lands are often hindered by public policy issues, companies generally favor doing business on privately owned land. In Mississippi, an estimated 72 percent of forestland is privately owned.





The Mississippi Institute for Forest Inventory (MIFI) has divided the state into five districts based on geographic, physical, economic and political characteristics:

- 1. North Mississippi
- 2. Mississippi Delta
- 3. Central Mississippi
- 4. Southwest Mississippi
- 5. Southeast Mississippi

Annual Available Woody Biomass by Type and District (in Tons)

DISTRICT NAME	EST. LOGGING RESIDUES AVAILABLE	EST. MILL RESIDUES AVAILABLE	SURPLUS PULPWOOD GROWTH AVAILABLE	EST. URBAN WOOD WASTE AVAILABLE	TOTAL
Central District	875,000	12,300	2,819,000	18,000	3,724,300
Delta District	332,000	3,000	–	14,000	349,000
North District	507,000	9,300	97,000	30,000	643,300
Southeast District	439,000	9,800	90,000	73,000	611,800
Southwest District	736,000	10,500	289,000	63,000	1,098,500
Mississippi Totals	2,889,000	44,900	3,295,000	198,000	6,426,900

SOURCE: USDA and MIFI

Estimates indicate 6.4 million dry tons of pulpwood and woody biomass residues are available for new bioenergy and biochemical development in Mississippi. At present, the Central and Southwest districts provide the most promising woody biomass opportunities.

Sustainability

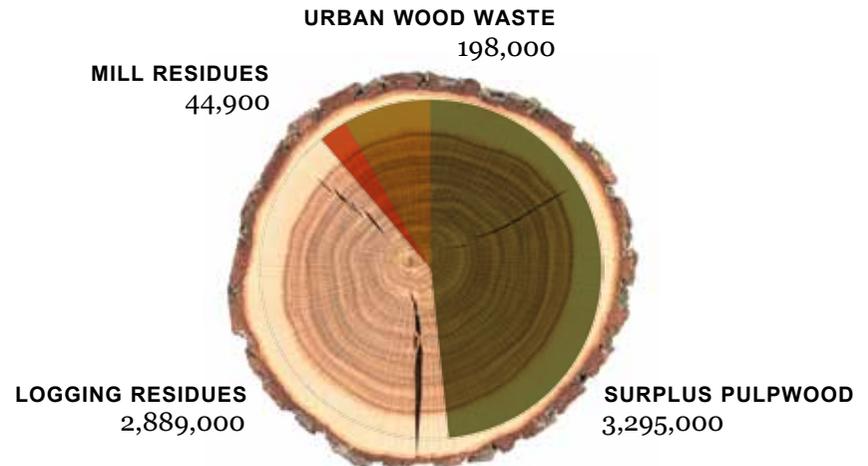
The sustainability of woody biomass resources is important to many businesses that rely on biomass for their operations, and Mississippi offers prospective and existing companies resources that are both plentiful and sustainable. In fact:

- The percentage of Mississippi's total acreage that is timberland has increased 17 percent since 1977.
- Today, timberland accounts for approximately 65 percent of all land in the state.

Based on the amount of wood grown versus the amount of wood harvested in the state, Mississippi can sustainably manage increased wood harvest and still ensure the long-term health of its forestlands.

Available Woody Biomass Resource by Type

(Dry Tons Per Year)

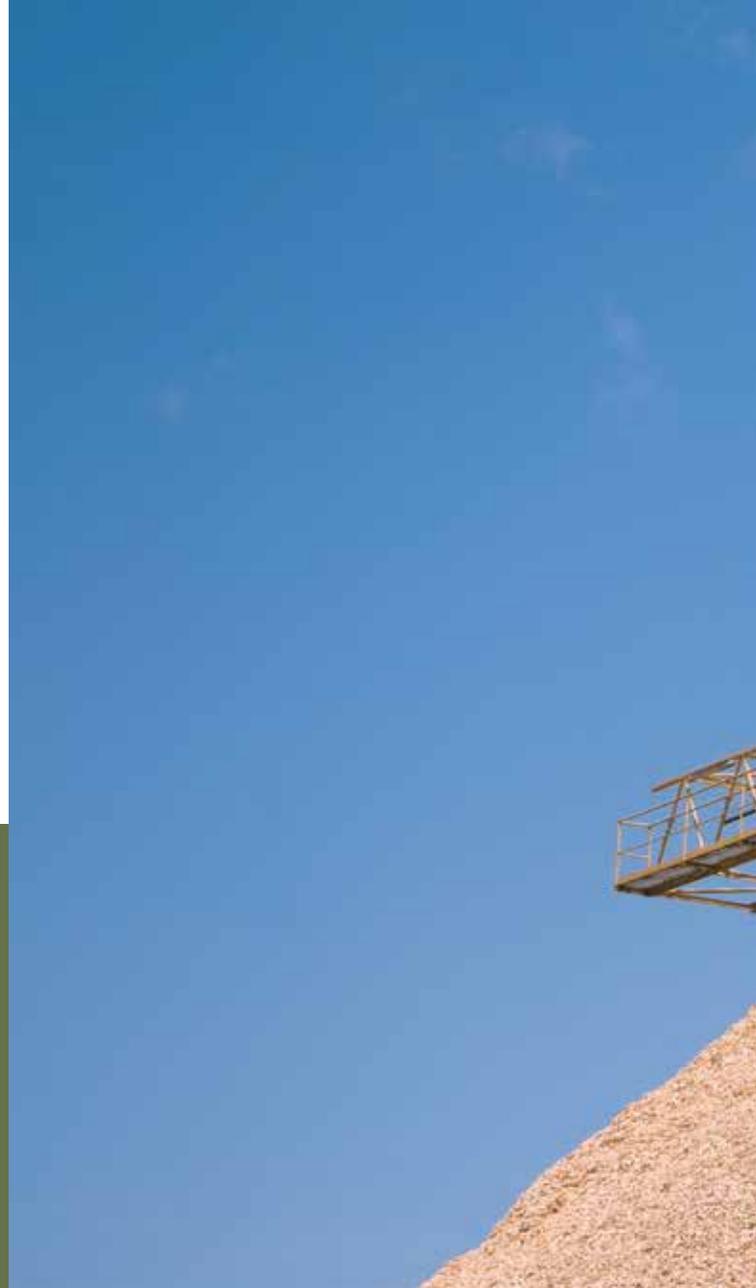


The Potential of Logging Residue

Timber is not the only woody biomass resource in Mississippi. On average, 71 percent of a given tree is used for other purposes, whether for lumber or other wood products. This leaves 29 percent of the average tree – typically its limbs, tops, foliage, saplings and above-ground stumps – that is often unused and left in the forest by the logging industry.

This unused portion of the tree, known as logging residue, offers tremendous potential as a feedstock for bioenergy or biochemical businesses. It is a widely available but unused resource – volumes are large, and demand for them has been minimal. Mississippi currently generates approximately 4.9 million dry tons of logging residues annually, of which 2.9 million is available.

Hardwood trees produce more logging residues than softwoods; in Mississippi, roughly two-thirds of these residues come from hardwood trees, and the remaining one-third comes from pine harvesting operations.





The process of selecting locations for future woody biomass operations is largely resource-driven. Other site selection factors include:

- *Logistics benefits: diverse transportation offerings and proximity to key markets*
- *Availability of appropriate, shovel-ready sites*
- *Access to a qualified and available workforce*
- *A supportive community*

Mississippi has these advantages.



Herbaceous Feedstocks: └ *Crop Residues and Energy Crops*

Mississippi offers plentiful herbaceous feedstocks, largely in the form of crop residues. The state also holds strong potential for dedicated energy crop production.

Crop Residues

Crop residues include biomass left in the field after harvesting traditional crops like corn, wheat and rice. These products can be used to produce bioenergy in the form of heat or electrical power, biofuels and biochemicals. Currently, there are an estimated 7.2 million dry tons of crop residues available for bioenergy and biochemical production in the state.

Annual Quantity of Crop Residues Available by Region in Mississippi (in Tons)

CROP RESIDUE	DELTA	SOUTHWEST	NORTH	CENTRAL	SOUTHEAST	TOTAL
Corn Stover	1,758,000	76,000	168,000	176,000	4,000	2,182,000
Cotton Stalks	573,000	7,000	114,000	75,000	–	769,000
Rice Straw	564,000	–	1,000	–	–	565,000
Soybean Hay	1,378,000	42,000	253,000	45,000	2,000	1,720,000
Wheat Straw	119,000	5,000	31,000	–	–	155,000
Grass Hay	90,000	463,000	425,000	527,000	345,000	1,850,000
TOTALS	4,482,000	593,000	992,000	823,000	351,000	7,241,000

SOURCE: USDA, 2011

Dedicated Energy or Biomass Crops

Dedicated energy crops, by contrast, are grown for the primary purpose of producing bioenergy from the entire above-ground portion of the crop. These include both herbaceous crops like switchgrass and miscanthus and woody crops like pine and poplar.

Outlook for Energy Crops

The U.S. Department of Energy has estimated that dedicated energy crops will account for nearly 40 percent of the total biomass feedstock used by bioenergy and biochemical companies by 2030.

As the use of other feedstocks increases, bioenergy and biochemical companies will more frequently look to dedicated energy crops as a feedstock source. Since all “high-profile” energy crops – switchgrass, miscanthus, sorghum and energy cane – can be grown in the state, Mississippi is expected to be highly competitive in this arena.



Poultry Litter and Farm Wastes

Mississippi is the fifth-largest producer of broiler chickens in the United States.



Mississippi boasts a proud farming legacy and a strong agricultural sector, and the state is home to robust poultry, swine and dairy operations. Among the nation’s top five broiler producing states, Mississippi delivers more than 800 million broiler chickens to market annually, and the poultry industry accounts for the state’s largest agricultural sector. The manure, litter and other waste products produced by poultry and other livestock animals raised in the state yield an excellent source of biomass feedstock.

Poultry litter is a valuable source of plant nutrient and soil amendment, containing nitrogen, phosphorus and micronutrients, but it also has the potential to be used as a feedstock for renewable energy generation.

In Perspective

- More than 1.3 million tons of poultry litter are produced in Mississippi each year, with poultry operations concentrated in the state’s four leading poultry-producing counties.
- If the poultry litter currently produced in the state were converted to biogas, more than 1.7 billion cubic feet of renewable natural gas could be produced annually.

TOP POULTRY PRODUCING COUNTIES	POULTRY LITTER PRODUCED ANNUALLY
Smith County	135,196 tons
Neshoba County	124,296 tons
Leake County	122,060 tons
Scott County	109,458 tons
MISSISSIPPI TOTAL	1,316,732 tons

Poultry farms are the largest source of agriculture waste products in Mississippi. As of 2012, there were seven poultry farms in the United States operating biogas recovery systems. Four of these operations were located in Mississippi.



Gas from Municipal Solid Waste

Municipal solid waste landfills are rich sources of solid waste that can be used for energy production. There are 19 active solid waste landfills in Mississippi, and in 2010, 3.3 million tons of municipal solid waste was deposited at these landfills.

Overview

Pecan Grove Sanitary Landfill, Golden Triangle Regional Landfill and Three Rivers Regional Solid Waste Landfill are prime examples of landfills that are currently producing landfill gas (LFG) for “gas-to-energy” projects in Mississippi. These projects are among several landfill gas-to-energy projects that are underway or planned in the state. Additionally, the U.S. Environmental Protection Agency (EPA) considers several landfill sites in Mississippi to be prime candidates for converting LFG to energy.

Pecan Grove Sanitary Landfill:

- Produces 10,230 metric tons of methane per year and began utilizing LFG to produce energy in 2005
- Processes 3,200 standard cubic feet of methane gas per minute
- Pipes 2,700 standard cubic feet of methane gas to the DuPont titanium dioxide plant in DeLisle, Mississippi

DuPont uses LFG to fire the plant’s boilers, saving the company more than \$1 million each year on energy costs. Additionally, by using LFG to produce energy instead of venting the gas to the atmosphere, the landfill is able to reduce greenhouse gas emissions equivalent to removing 6,500 cars from the road.

Golden Triangle Regional Landfill:

- Mississippi’s first landfill gas-to-electricity facility
- Prevents more than 30,000 metric tons of greenhouse gas emissions per year
- Generates 1 megawatt of reliable green energy annually

The landfill gas-to-electricity project was recognized by the EPA as a Landfill Methane Outreach Program Project of the Year in

2011 and was nominated for several other awards. The project was partially funded through a grant issued by the Mississippi Development Authority (MDA) using funds Mississippi received through the U.S. Department of Energy from the American Recovery and Reinvestment Act of 2009.

Three Rivers Regional Solid Waste Landfill:

- Captures around 600 cubic feet of landfill methane per minute and pipes gas through underground piping to an internal combustion energy-driven generator set
- Generates one megawatt per year, or enough energy to power 800 - 1,000 homes
- Reduces greenhouse gas emissions equivalent to removing 8,200 cars from the road

The Three Rivers Regional Solid Waste Landfill was the second municipal solid waste landfill to install and operate a landfill gas-to-electricity generating facility to support a regional power grid in Mississippi.



Reasons to locate in Mississippi

Extensive Infrastructure

Mississippi's existing infrastructure network is a key advantage for the state when it comes to attracting future biomass sector investment. The availability of core infrastructure and services, such as highways, railroads, pipelines, deepwater ports, commercial waterways and electrical transmission facilities, is a critical site selection factor for bioenergy and biochemical businesses.

A Central Location

Mississippi's geographic location alone offers strategic advantages to businesses. Nestled between Memphis, Tennessee, the U.S. distribution hub and home to FedEx, and the Gulf of Mexico with deepwater port access, Mississippi is central to both the East and West coasts and is crisscrossed by six major interstate highways. The state is located within a day's drive of much of the U.S. business population and offers bioenergy and biochemical companies easy access to key markets, both domestically and internationally.

A Well-Integrated Transportation Network

A fully integrated transportation network allows businesses to take advantage of Mississippi's prime location and contributes to the state's speed-to-market potential. Mississippi boasts diverse transportation offerings, including:

- 30 railroad providers, including five Class I rail providers, and 2,500 miles of mainline railroad track
- Six interstate highways
- 15 ports, including deepwater operations on the Mississippi Gulf Coast, along with ports on the Tennessee-Tombigbee Waterway, the Mississippi River and other inland waterways

Abundant Energy Supply

Mississippi provides businesses abundant, reliable and affordable electricity from a diverse energy mix, along with extensive natural gas pipeline infrastructure. Mississippi's electrical distribution infrastructure is owned and operated by a number of electric utilities. The Tennessee Valley Authority, Mississippi Power Company and Entergy are the state's largest power generation and distribution utilities.

Coal and natural gas are responsible for 76 percent of Mississippi's primary energy generation. Meanwhile, Grand Gulf Nuclear Power Station, home to the nation's largest single-unit nuclear reactor, produces nearly 20 percent of the electricity generated in Mississippi. The state is also home to several ethanol-blending facilities, as well as three refineries, including Chevron's largest U.S. refinery.



Workforce Training

Mississippi workers are dedicated, skilled and productive, and Mississippians are contributing to the success of the many global businesses that call the state home. As the biomass industry grows in Mississippi, so will the need for an educated and trained workforce possessing the skills required by new biomass companies. Mississippi workers – and the state’s workforce development system – are gearing up to meet this challenge.

Through its universities, community and junior colleges and WIN Job Centers, Mississippi offers companies a variety of high-quality workforce training options. State officials work together with company leaders to tailor training programs to meet the specific needs of each business.

The Mississippi Development Authority, the state’s lead economic development agency, works closely with businesses, the Mississippi Department of Employment Security (MDES), community colleges, universities and other workforce development partners to ensure the state is meeting the workforce training needs of both existing and new companies.

Industry Expertise

EMPLOYMENT NUMBERS BY INDUSTRY	2011
Agriculture & Forestry Support Activities	2,387
Forestry & Logging	3,078
Other Chemical Products & Preparation	840
Petroleum & Coal Products Manufacturing	2,373
Professional, Scientific & Technical Services	32,243
Truck Transportation	17,243
Utilities	9,031
Waste Management & Remediation Services	2,854
TOTAL	70,049

SOURCE: MDES





Research and Development

Mississippi universities are conducting biomass-related research on a range of topics with applications for bioenergy or biochemical businesses.

The Sustainable Energy Research Center (SERC) at Mississippi State University integrates studies relating to fuels, economics, policies and feedstock research. Current SERC research focuses on:

- Bio-oil production
- Bio-crude oil
- Ligno-cellulosic conversion
- Feedstocks
- Syngas-to-gasoline

Additionally, SERC and Mississippi State University's College of Agriculture and Life Sciences train professional foresters and agronomists, while the university prepares undergraduates and graduate students in microbiology and chemistry disciplines, as well.

The Systems Research Institute at Alcorn State University is also providing valuable training to students in renewable energy disciplines through the school's Center for Renewable Energy.

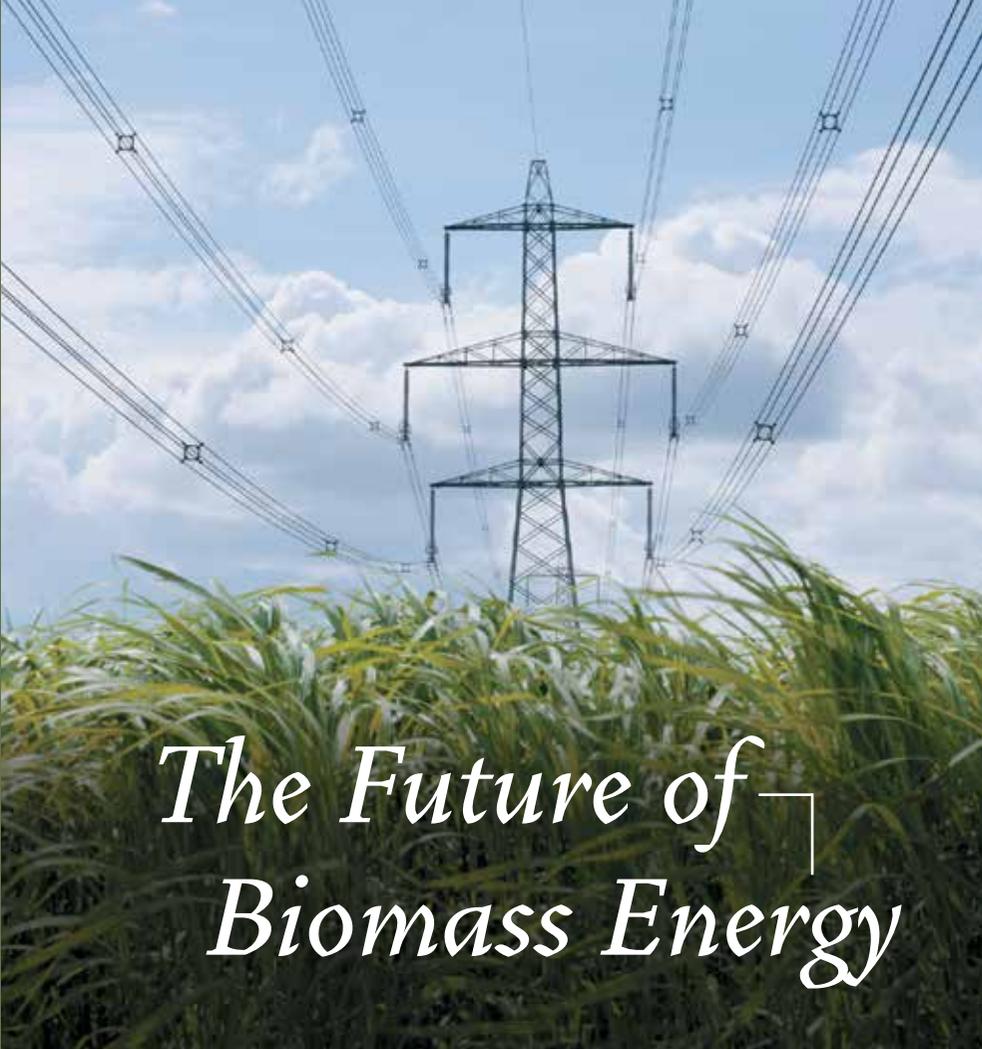


Incentives

Mississippi's economic development team takes a flexible approach to business recruitment that allows for customized incentives and financing programs to meet the requirements of each individual project. MDA staff works closely with potential companies to tailor an incentive package to meet their needs. The state's incentives include:

- Tax credits for job creation and investment
- Financial assistance for employee training
- Incentives for research and development activities

Additionally, Mississippi offers certain industry-specific incentives that can be combined with the state's other financial incentive programs. The **Biomass Investment Tax Credit**, for example, offers a tax credit to companies that utilize biomass or waste heat recovery. The incentive is based on a \$50 million investment and the creation of at least 20 full-time jobs.



The Future of Biomass Energy

An Energy Future

Today, biomass is used as a feedstock for transportation fuels, electric power and biochemical and other bioproducts. While biomass's current contribution to the production of these products is small when compared to oil and other fossil-based products, renewable energy sources are projected to continue to increase as the U.S. pursues greater energy security and diversity.

With regard to liquid fuels, the U.S. Energy Information Administration anticipates that liquid fuel consumption will increase by 2035. And while gasoline and diesel consumption will continue to increase, biofuels are expected to play a major role in the increases of liquid fuel use, as well. In fact, biofuel's use is estimated to increase more than 200 percent by 2035.

Mississippi is well positioned to capitalize on both existing and emerging growth opportunities in the biomass sector, and the state offers ample room for the biomass industry to grow.

According to the U.S. Energy Information Administration, biomass energy consumption increased 28 percent from 2004 to 2008 in the United States, and the EIA projects the use of biomass power and biofuels will increase in the coming decades.



The Future of Biomass in Mississippi

With Mississippi's woody biomass, animal waste, municipal solid waste and herbaceous crop residue resources, the state offers prospective biomass companies distinct and abundant feedstock options.

Cutting-edge companies are looking to Mississippi locations for their biofuel or biochemical production operations. The state's pro-business environment, abundant biomass resources and available workforce have situated Mississippi favorably for future biomass industry growth.

In addition to the bioenergy and biochemical companies that have already announced plans to locate in Mississippi or currently operate in the state, other high-profile technology developers continue to evaluate Mississippi as an excellent location from which to launch or grow their biomass operations.

As biomass conversion technologies relating to dedicated energy crops, algae and microorganisms and other feedstock options become more developed, Mississippi will be an ideal location for this work because of its climate and transportation, energy and research infrastructure.

To learn more about Mississippi's abundant biomass feedstock resources, visit **biomass.mississippi.org**.

To find out how a Mississippi location can help your business grow, contact the Mississippi Development Authority at 1.800.360.3323 or 1.601.359.3155 or visit www.mississippi.org.



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