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### Biomass Energy Resources in Louisiana (Research Information Sheet #102)

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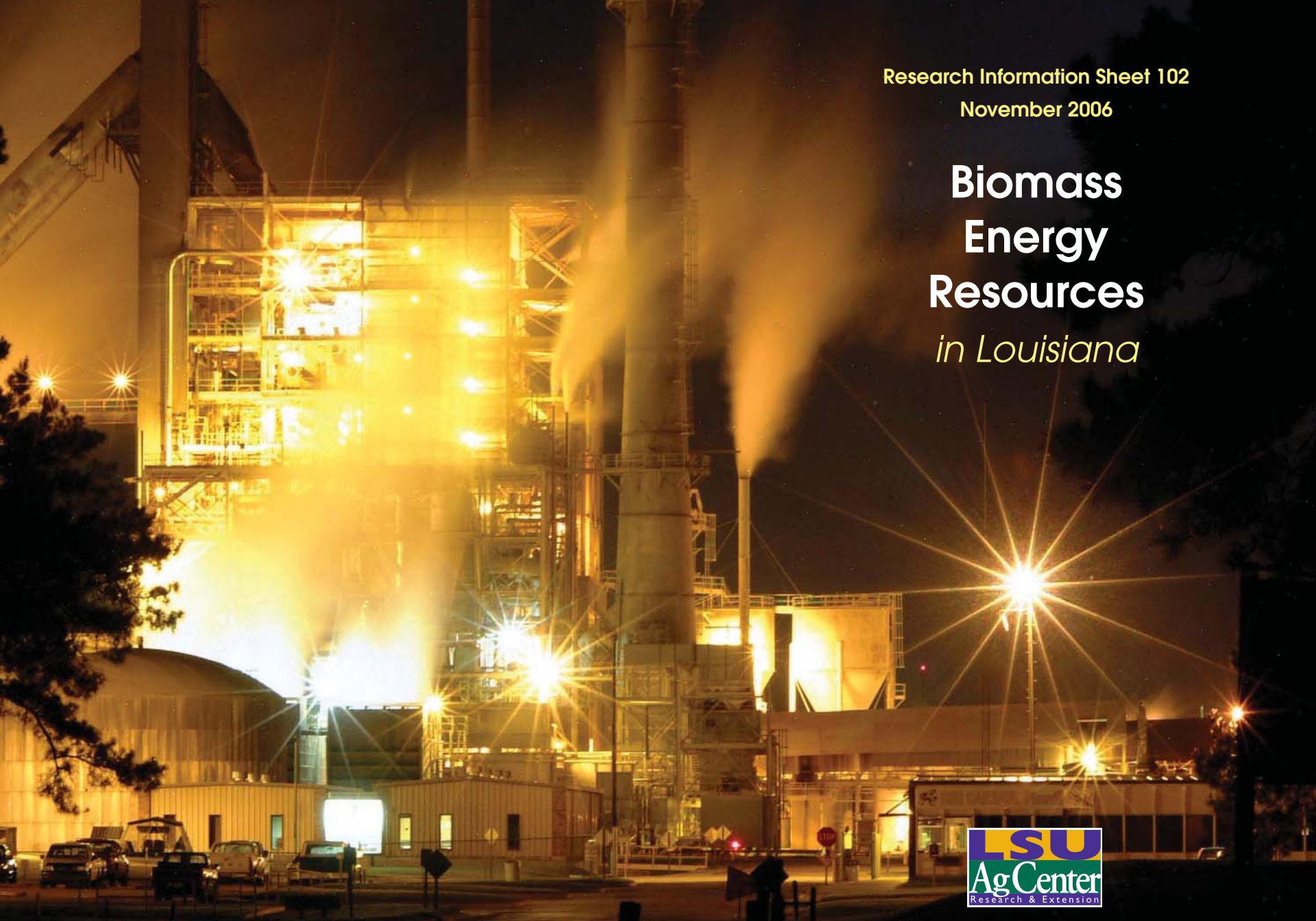
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Research Information Sheet 102

November 2006

# Biomass Energy Resources *in Louisiana*

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## What Is Biomass Energy?

“Biomass” is a general term that refers to all living things (plants and animals), as well as the things derived from them (such as wood, paper, sawdust, grains and straw). “Biomass energy” or “bioenergy” refers to energy (such as electricity, boiler fuels and motor fuels) that can be derived from biomass (usually plants, but excluding fossil fuels). The wood burning in your fireplace is biomass energy as is leftover sawdust and sugarcane bagasse burned under a boiler to produce steam in a mill.

Because plants use energy from the sun to grow, biomass is a form of stored solar energy. To make it more transportable, biomass can be converted into types of natural gas, gasoline (ethanol) or diesel fuel. Some of these processes are economically feasible and are already on the marketplace.

The conversion of biomass energy to transportable forms and electricity is becoming more efficient thanks in part to research funded by the Southeast Biomass State & Regional Partnership (SEBSRP).

SEBSRP is administered by the Southern States Energy Board (SSEB) for the U.S. Department of Energy. Funding from SEBSRP for this project was granted to the LSU AgCenter under subgrant SEBSRP-SSEB-2005-LA01-LSUAC-001. Additional sponsorship was provided by the Louisiana Department of Agriculture and Forestry.



*This California utility plant has four electrical generators (right) that are powered by steam turbines (left) which are powered by boilers fueled exclusively with waste wood, old railroad ties, excess trees thinned from forests, almond hulls and other forms of biomass.*

## Biomass Energy Resources in Louisiana



*Like most pulp/paper mills, International Paper Company's mill near Pineville, La., burns bark and wood waste in its boilers to generate both heat and electrical power.*

## Why Louisiana?

Louisiana contains a wealth of resources such as timber, sugarcane, rice, cotton, corn, soybeans and other crops. The forestry and agriculture industries combined contribute 7 percent of the gross state product. Processing our wide variety of products generates billions of dollars throughout Louisiana each year, creates a prominent job market, contributes revenues and provides consumer products.



Although every effort is made to mill Louisiana's natural and agricultural resources as efficiently as possible, residues are left over from processing, including sawdust, bagasse,

rice hulls, cotton gin trash, etc. Also, in the forests and fields are found harvesting residues, such as treetops, straw, corn stover, etc. Some of these can be used for energy. In addition, with Louisiana's fertile soils and mild climate, there is always the potential to grow crops expressly for energy.

With fluctuating fuel prices, the need for a variety of efficient energy sources has become crucial to our nation's economy and security. With its climate, oil and gas

infrastructure and its transportation network, Louisiana has an opportunity to become a leader in biomass energy.

Louisiana's transportation network is one of the factors that makes the state a potential leader in developing biomass energy. Its waterways lend themselves to cheap transportation of raw materials, while its railways, highways and pipelines can help disperse its products to national markets.



*The Mississippi River at Baton Rouge with the Interstate 10 bridge in the upper left, a railroad in the lower left and forests and sugarcane fields in the background. Louisiana's combination of climate, forests, agriculture, transportation network and existing energy industry make the state a natural location to expand a biomass energy industry.*

With most of the northern, central and Florida parishes covered with timber, the forest products industry is one of the largest manufacturing sectors in Louisiana. This industry is a great asset to our state.

As in all businesses, however, there is always room for improved efficiency and performance. For example, logging residues or slash (treetops and limbs) are usually left in the woods. If used for energy, however, slash could provide enough energy to supply 234,000 homes.



*Sawdust, bark and wood trimmings from this hardwood mill are trucked to a paper mill. Some of the material is used to make paper, while the rest is used for energy.*

Milling residues can be expensive to dispose of and can take up large amounts of space in our state's limited landfills. These residues could be used either to generate electricity or to increase available energy within Louisiana.

Louisiana's forest products industry includes some 100 sawmills, plywood mills, panel mills, veneer mills and pulp/paper mills scattered throughout the state. Together, they produce more than 7 million tons of wood residues annually, most of which are used by the industry for energy. Most mills utilize what they need for their own energy needs (such as lumber drying kilns or veneer driers) and sell the rest to other mills, usually to pulp and paper mills, which require a lot of energy and generate most of their own electricity. Still, some 54,000 tons of residue annually go unused, enough to provide energy for 1,000 homes.

Louisiana's secondary forest products industry (cabinet shops, architectural millwork, furniture makers, pallet manufacturers, etc.) produces 80,000 tons of residues annually, including wood trimmings, sawdust and sanderdust. Most of these residues are already dry – potentially enough energy for 3,000 homes. Yet, nearly all of this material remains untapped.

## Energy From Wood Residues



*Sawdust, planer shavings and bark are used for energy and to make other products.*

## Energy From Agronomic Residues

Louisiana has a prominent agricultural industry, as can be seen by anyone who drives through this state. The sugarcane, rice, soybean, corn and cotton fields are clearly visible to motorists. Their residues are used in various ways.

Rice generates three types of residue: straw, hulls and bran. Rice straw is usually left in the fields during and after collection to prevent topsoil erosion. It is sometimes grazed by cattle or crawfish and then plowed back into the field for nutrients. Possible uses of rice hulls include compost, abrasives for polishing, additives in hand soap, conditioners for fertilizers and energy. In winter, the bran is mixed with rice hulls to make cattle feed.

About 96 percent of the bagasse produced by sugar mills is utilized, mostly as fuel to run the mills. Other uses include paper, ceiling tiles, industrial boards and compost.

Soybean straw (stems) is usually left in the fields to prevent erosion. It also can be used as livestock bedding or burned for fuel.

From an energy standpoint, the residues from all forestry and agronomic residues are similar. For example, any of these residues can be used to make electricity, synthetic gas, ethanol or biodiesel. The choices of products and residue types are determined by economics and availability.



*Bagasse is the biomass residue left after cane processing.*

These residues are potentially available for biomass energy or other uses. Together, they could power 22% of the 1,657,107 homes in Louisiana (2000 U.S. Census).<sup>1</sup>

	Wet Tons	Net Million Btu	Million kWh <sup>2</sup>	Energy Equivalent <sup>3</sup>
<b>Residue Wood</b>				
Sawdust, trimmings, bark	134,323	1,244,665	73	Supply 4,068 homes
Logging Slash	8,432,792	71,678,733	4,216	Supply 234,244 homes
<b>Soybeans</b>				
Straw	1,501,071	8,916,364	524	Supply 29,138 homes
<b>Sugarcane</b>				
Bagasse (dry wt.)	122,702	895,725	53	Supply 2,927 homes
<b>Rice</b>				
Hulls (dry wt.)	85,100	766,751	45	Supply 2,506 homes
Straw	2,180,694	11,928,397	702	Supply 38,982 homes
<b>Sweet Potatoes</b>				
Vines	60,288	253,000	15	Supply 827 homes
<b>Corn</b>				
Stalks, roots, husks	350,043	1,470,000	86	Supply 4,804 homes
<b>Wheat</b>				
Straw	320,064	2,010,000	118	Supply 6,569 homes
<b>Grain sorghum (milo)</b>				
Residue	52,544	221,000	13	Supply 722 homes
<b>Cotton</b>				
Gin trash	57,553	327,000	19	Supply 1,069 homes
<b>Peanuts</b>				
Vines	1,435	6,700	0.39	Supply 22 homes
<b>Oats</b>				
Straw	267,670	1,670,000	98	Supply 5,458 homes
<b>Animal Waste</b>				
Cattle manure/biogas	9,881,919,000cf	5,930,000	395	Supply 21,963 homes
Poultry manure	944,150	4,437,505	261	Supply 14,502 homes
<b>Total</b>		<b>111,755,839</b>	<b>6,620</b>	<b>Supply 367,799 homes</b>

## Annual Wood and Agricultural Residue Production in Louisiana

<sup>1</sup>Approximately 98% of the wood milling residues (bark, sawdust, etc.), 96% of the sugarcane bagasse and 54% of the rice hulls are already being used for energy and other purposes and thus not included in this table.

<sup>2</sup>1 kilowatt-hour = 3,413 British thermal units (Btu) theoretically, but wood-fired boilers with electrical generation commonly run on 20% efficiency.

<sup>3</sup>1 home = 18,000 kW-hours/year.



## Electricity From Rice Hulls

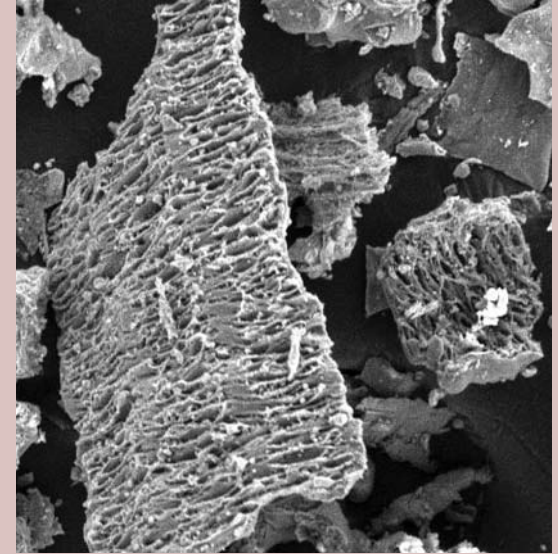


*Agrilectric Power in Lake Charles, La. provides all of the power needed to run the adjacent rice mill and the plant itself with the excess (approximately 84%) being sold to a local power company.*

An example of a business that has quietly and steadily used biomass residue to produce energy is Agrilectric Power. This company is located near Lake Charles, Louisiana and is a subsidiary of The Powell Group, headquartered in Baton Rouge.

The Powell Group realized the need to use the hulls removed from rice during milling at their Farmers Rice Mill. Agrilectric is world-known for successfully producing energy and quality rice hull ash from rice hulls since 1984 with an in-service rate of 94 percent. The 13-megawatt plant (enough to supply 6,000 homes) consumes about 300 tons of rice hulls per day.

By burning rice hulls, Agrilectric has taken an environmental liability and turned it into an asset.



*Rice hulls have high silica content, which is a valuable commodity when in the amorphous state. Rice hull ash is used as a soil amendment, as an insulator in steel manufacturing and as a filter aid in solid-liquid separation. In a high flow rate filter, the irregular shapes (as seen in this electron microscope image) aid in waste water treatments, swimming pool applications and food processing. It is also an excellent absorbent for environmental and oil spills, making it a favorite of nationally known race tracks and racing circuits.*

Using energy for both heat and electrical generation at the same time is called cogeneration (also termed combined heat and power or CHP). It is commonly practiced in pulp/paper mills and sugarcane processing mills.



*Sugarcane processing mills operate only half the year – during harvesting season. The new syrup mill in Lacassine, La. cogenerates electricity. Enough excess bagasse is produced during the processing season to generate and sell 6 megawatts of electricity (enough to supply 3,000 homes) to the grid for the rest of the year.*



Although wood makes an excellent raw material for paper manufacturing, bark does not. Most pulp/paper mills in Louisiana use bark and other residues for energy, and many even cogenerate electricity with it.

Pulp and paper mills don't just use their own residues. They purchase sawdust and other wood residues from sawmills, pallet manufacturers and other industries. The making of pulp and paper requires enormous amounts of energy, but by burning wood residues, the mills provide their own heat energy, plus up to 75 percent of their own electrical power needs. If the paper machines are down for repair, the mill can provide electricity to the grid to help power local homes.

In some cases, pulp/paper mills may mix chipped automobile tires with the wood residues, which improves the burn of the fuel, increases the energy produced and helps rid the environment of used tires.

The leftover ash from the boilers can be used for road surfacing, soil amendment or as an ingredient in briquettes for charcoal.

## Cogeneration



*The Temple-Inland Inc. paper mill in Bogalusa, La. purchases excess sawdust from neighboring sawmills and leftover treetops from logging operations to fire this boiler. After the heat is used to make paper, the leftover steam from the boilers is used to cogenerate about 75% of the 80 megawatts of electricity it uses.*

# Municipal Waste



*Urban wood waste.*



*The Wheelabrator Shasta Energy Company stand-alone power plant in California produces 49 megawatts of electricity (enough for 25,000 homes). It runs exclusively from 2,500 tons (100 truckloads) of biomass per day, including apricot pits (right), nut shells, used lumber and other urban wood waste and excess trees thinned from forests. Its parent company owns or operates 17 waste-to-energy plants nationwide.*

Municipal waste is a problem everywhere, and Louisiana is no exception. Approximately 4.6 million tons of municipal solid waste are generated each year in Louisiana. About half is paper and wood that could be utilized. Another 8-10 million tons per year of industrial waste is generated in forms such as plastic, gypsum and sludge. Many municipalities burn this waste to power turbines that generate electricity for the community. The main barrier to the use of solid waste as a power source is the initial cost of setting up a facility. As the cost of disposal and environmental awareness increases, new alternatives become viable.

Municipal waste also can be used for compost (fertilizer). The Europeans have been using their municipal wastes to produce energy and compost for many years. More than 500 municipal biogas plants are in Western Europe today. They are fed municipal biowaste, industrial organic sludge or sewage sludge. The biogas is used to produce electricity, and the residue that is left after digestion is used as a fertilizer on cropland.



## Landfill Gas



*At this landfill near Baton Rouge, the gas is collected (foreground), filtered, dried and compressed (center) before being piped to Deltech Corporation (white tank in background) to be burned as natural gas.*

When landfills are closed, they are covered with dirt, and the waste is allowed to decompose. During decomposition, landfill gas is produced, which contains about 50 percent methane and 50 percent carbon dioxide. Because methane is the main component in natural gas, this gas burns readily and can be used for most applications where natural gas is used.

Both methane and carbon dioxide are greenhouse gases believed to contribute to global warming. Methane has more greenhouse effect than carbon dioxide. Therefore, the U.S. Environmental Protection Agency requires large landfills to collect the landfill gas and burn it off.

Because landfill gas must be collected and burned anyway, it is a logical engineering feat to utilize the gas for energy. Once the moisture is removed and the impurities are filtered, it can be piped to a nearby facility to fire its boiler. Now it is possible to benefit from the harmful gas that was once a threat to our atmosphere.

Three landfills in Louisiana utilize landfill gas. The Jefferson Parish Landfill sells its gas to nearby Cytec Industries Inc. to fuel its sulfuric acid regeneration plant. The East Baton Rouge Parish Renewable Energy Center (formerly Devil's Swamp Landfill) sells its gas to next-door Deltech Corporation

to fire its boiler at its monomer plant. The Woolworth Road Landfill near Shreveport sells its gas to the General Motors assembly facility to fire its steam boiler, representing one-third of the total energy used at that facility.

Landfills typically produce gas for 40 to 50 years.



*Closed landfills produce a combustible gas that is half methane. Environmental regulations require that the gas be collected and burned. The U.S. EPA has identified 10 sites in Louisiana, such as this Woodside landfill near Livingston owned by Waste Management Inc., which have the potential to utilize the gas for energy.*

# Biodiesel



*One of Louisiana's biodiesel producers is Vanguard Synfuels LLC, located near Pollock. Here, Jay Breville controls the process by computer. Blended biodiesel has been readily accepted by many truckers, claiming improved lubricity, fuel mileage and most tailpipe emissions.*

Cooking oils and diesel fuel are so similar that modified cooking oils can be burned in diesel engines. Known as biodiesel, it is produced mainly from vegetable oil, such as soy, sunflower, canola and palm. It also can be made from recycled cooking oil, trap grease, animal fats and fish oil. In Louisiana, the main crop for the production of oil would be soybeans, although cottonseed, rice, peanuts and corn have potential.

Vegetable oils are easily converted to biodiesel by temporarily mixing with alcohol in a process known as transesterification. This process produces glycerine as a by-product, which can be used for lotions, cleaners and many other products.

Biodiesel can be blended with petroleum diesel at any level. The blend is designated by percentage. For example, a blend of 5 percent biodiesel is known as B5. Biodiesel blends can be used in diesel engines without modification. Using very high concentrations of biodiesel may require a timing adjustment and, in older models, replacement of rubber fuel lines. The benefits of using biodiesel concentrations higher than B20 are debatable with today's engine technologies, but can be addressed with improved engineering design.

Blended diesel fuel yields improve fuel mileage, with improvements of 3 miles per gallon being reported with B20. Tailpipe emissions are mixed – carbon monoxide and sulfur oxides being improved, while nitrogen oxides are slightly higher.



*LSU forestry student Ben Bullock inspects a sample of in-process biodiesel at Vanguard Synfuels. Glycerine can be seen in the bottom, which will be sold for lotions and cleaners. The major obstacles to developing this industry sector are the logistics of separate fuel pumps/tanks and the capital needed to build large-scale facilities.*

Ethanol (ethyl alcohol) was a popular motor fuel from the 1890s to the 1930s. In 1925, Henry Ford predicted it would become the “fuel of the future.” It is the same chemical as the drinking alcohol; however, a chemical is added to make it undrinkable.

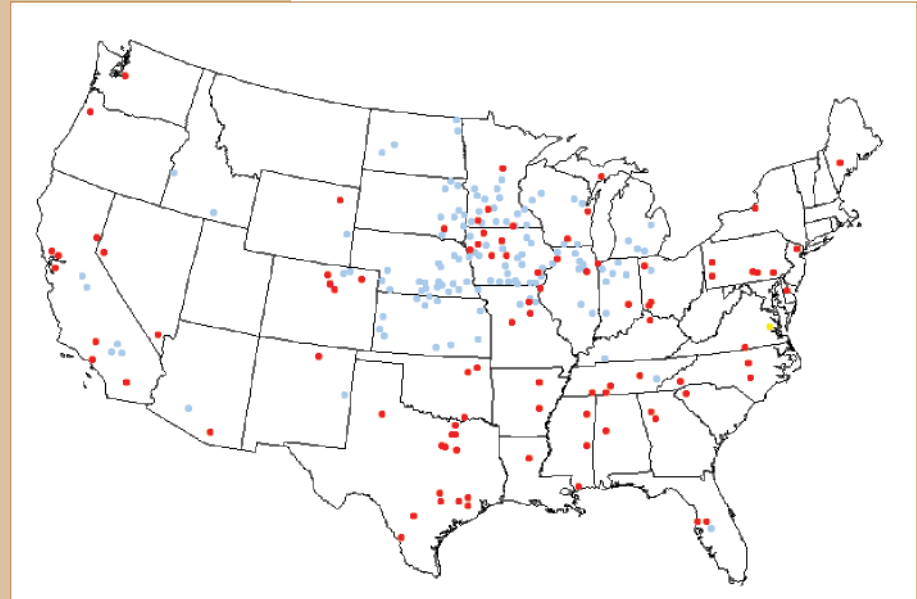
Although the energy content of pure ethanol is roughly 35 percent less than gasoline, its octane is much higher, at 113, compared to premium gasoline at 93. Therefore, ethanol is commonly used in racing engines.

In the United States, ethanol is commonly blended with gasoline as a blend of 10 percent ethanol and is known as E10 or gasohol. In the Midwest, blends of 85 percent ethanol are available, known as E85. It can be burned in most gasoline engines with little or no alteration.

Ethanol also serves as an oxygenate in gasoline. Blends of 5.8 percent to 10 percent (by volume) ethanol helps the gasoline burn more completely, improving tailpipe pollutants. Oxygenates are required in many U.S. cities where the air quality is poor (“non-attainment areas” designated by the U.S. Environmental Protection Agency).

Most ethanol in the United States is made from corn because corn is 72 percent starch (dry weight basis), which is easily cooked into sugars that are fermented.

Ethanol, however, can be made from any kind of biomass, including wood, corn stalks and bagasse (termed cellulosic ethanol). The cellulose (fibers) must first be broken down into sugars, requiring an expensive extra step in the process. Researchers are continually improving the processes. So, even though the economics have not quite proven out yet, many researchers believe cellulosic ethanol will be cost-competitive in a few years.



*In 2006, 101 producing ethanol plants (blue dots – primarily in the Midwest) and 65 biodiesel plants (red dots) were in the United States and more than 44 plants under construction. Three ethanol and two biodiesel plants were planned in Louisiana.*

## Energy From the Forest



*Travis Taylor Logging & Chipping, of Winn Parish, removes understory trees and brush on the Kisatchie National Forest and on private timberlands. Here, the loader (right) feeds whole trees into the chipper (left), which blows the chips into the truck behind it. The chips are utilized for paper and energy at a nearby paper mill.*

In Louisiana, 46,000 acres are destroyed by wildfire annually. Louisiana's warm, humid climate promotes rapid growth of underbrush and small trees, which burn easily and carry wildfires to bigger trees.



Traditionally, foresters use prescribed fires to control the underbrush, thereby preventing devastating fires in the future. Smoke management and liability issues, however, have curtailed burning programs, so alternative ways of controlling underbrush is needed.

One alternative is called mechanical forest fuel reduction. Machines chop or remove underbrush and small trees that burn easily, removing the "fuel" that carries a wildfire. This treatment costs hundreds of dollars per acre, but if the removed biomass is utilized for paper and energy, the treatment can be a near break-even operation economically.

In effect, foresters, loggers and millers work cooperatively to take the energy that would have been wasted in a forest fire and utilize it at a paper mill boiler for heat and electricity. A handful of these operations are in Louisiana, but many more are needed.

Slash (limbs and treetops) leftover from traditional logging operations also could be utilized for biomass energy. Because forest products is one of Louisiana's biggest industries, slash is an untapped resource with great potential.



*These photos show the forest before and after removing biomass that can fuel wildfires. To prevent devastating wildfires, more operations like this are needed, along with more facilities that will utilize this biomass.*

The term energy crops covers plants that are grown specifically for the production of energy. Two types of energy crops that may be of particular interest to Louisiana are grasses and trees.

Four types of energy crop grasses are switchgrass, johnsongrass, giant reed grass and orchard grass. These grasses can be grown in areas that are not suitable for crop production.



*Switchgrass is a perennial bunch grass that is a major component of the tall grass vegetation that once dominated the eastern prairies. It grows 6-8 feet tall and is suitable for either livestock or energy.*



Switchgrass, johnsongrass and orchard grass also make good livestock forage. Giant reed grass (not to be confused with the roseau cane of Louisiana's marshlands) looks similar to bamboo and is a common ornamental plant. Potentially, these grasses can be used in the production of livestock feed, methane or ethanol. These grasses average around 7,900 Btu per dry pound (about the same as wood) and are a potential energy source for Louisiana.

Anyone who has experienced a warm fireplace on a cold day can attest to the energy potential of wood. Fast-growing tree species can be grown in closely spaced plantations for both energy and paper. The harvest cycles must be continuous and short. Growing trees in intensive, short rotations produces a fuel with uniform size, shape, energy content and moisture content. Research has often focused on hardwood species because, after harvesting, the roots

produce sprouts that grow even faster than the original trees. Pine trees, however, also grow fast and uniformly and are already being grown to some extent as dedicated biomass energy crops.

## Dedicated Energy Crops



*Like overcrowded garden plants, young pine trees need to be thinned out. Several logging contractors in Louisiana specialize in bringing whole trees out of the woods, chipping the whole trees into 2-inch pieces and sending the chips to paper mills. The stems make good quality chips for paper, while the limbs are ground into boiler fuel for cogeneration.*



## Why Biomass Energy?



*A good quality of life for Louisiana's future generations will depend in part on developing energy sources that are environmentally friendly and economically stable.*

Louisiana has a long-standing tradition of supplying energy for the nation. Recent events have demonstrated that dependence upon only a few sources of energy can be destabilizing to the economies of Louisiana and the nation. By diversifying its sources of energy, Louisiana can stay at the forefront of energy development. This will help assure economic development and continued job growth.

Environmental concerns dictate that something be done with process residues. It is no longer acceptable or legal simply to push waste material into a pile and forget about it. Stormwater running off this material may develop problems with dissolved oxygen, robbing fish (and the aquatic life upon which they depend) of life-giving oxygen. Also, landfill space is limited.

Research efforts in energy often lead to innovations in nonenergy products. Entrepreneurs often ask, "Can't we develop this material into a product even more valuable than energy?" Thus, innovations in one field lead to innovations in another. Also, ash may be marketed for products such as steel, concrete, absorbents, filters and soil amendments.

Much of the world's largest-known petroleum reserves are in politically unstable regions of the globe. Even when petroleum and natural gas prices were low, many companies found biomass energy to be economically feasible. With the current unstable energy prices and supplies, it is critical that our energy sources be diversified. Louisiana is capable of leading the way in biomass utilization, although many other states stand ready to jump to the forefront through business development programs and research funding.

In Louisiana, we are given dominion over many natural resources, including fertile soils, favorable climate, major waterways, port sites, oil, gas, forests and agricultural crops. It is our responsibility to manage them wisely.



In addition to private research and development (R&D) efforts such as those highlighted in this publication, a federally funded program focuses on biomass energy. The U.S. Department of Energy's Office of the Biomass Program oversees five regional biomass energy programs (reorganized in 2003). This includes the Southeast Biomass State & Regional Partnership (SEBSRP), which is administered by a regional governors' organization called the Southern States Energy Board. This partnership provides grants for education, outreach and technical assistance in biomass energy.

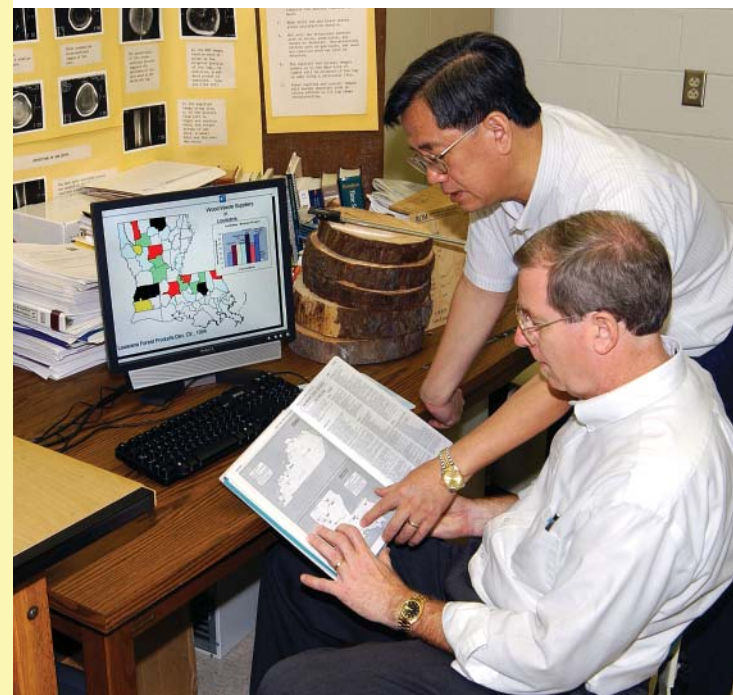
In Louisiana, the LSU Agricultural Center, the Department of Agriculture and Forestry, the Department of Natural Resources and other institutions have done R&D work

relating to biomass energy, often with funds provided by SEBSRP. For example, researchers at the LSU AgCenter are currently working on ways to utilize wood and agricultural residues for energy, reconstituted products (such as panel boards and firelogs) and other uses. They are also assessing the heating values of crops and residues and are updating information on wood and agricultural residue production and consumption.



*Drs. S. Joseph Chang (left) and Cornelis de Hoop, both with the Louisiana Forest Products Development Center, supervise graduate student Anil Kizhakkapurakkal as he correlates properties of wood samples from different parts of Louisiana.*

## Biomass Energy Research and Development



*Drs. S. Joseph Chang (standing) and Cornelis de Hoop, both with the Louisiana Forest Products Development Center, update a database of wood waste and logging slash (residues). Understanding the quantities and distribution of biomass supply and demand is important to facilitating economic development in the biomass energy sector. Scientists at the LSU AgCenter keep this information as updated as possible.*

# Future of Biomass Energy



*Temple-Inland Inc. paper and energy mill, Bogalusa, La.*



## Will biomass energy create jobs?

According to the Renewable Fuels Association, an average ethanol plant (40 million gal/yr) supports 41 full-time jobs and 700 additional jobs throughout the economy and increases state and local tax receipts by \$1.2 million. The Minnesota Department of Agriculture reports that its 17 ethanol plants (in 2006) supported 889 direct jobs and 5,500 additional jobs (total 6,400).

## Is biomass energy here to stay?

It never left! Throughout the times of cheap oil, pulp/paper mills, sawmills and syrup mills continued to burn residues to save on disposal costs while saving on energy costs (co-generating heat and electricity). There have been many technological advances in biomass energy in the last 15 years, making biomass energy increasingly cost-competitive.

Environmental concerns also will assure that biomass energy is here to stay. The utilization of residue materials from industrial processes is important from the standpoint of good resource stewardship, environmental protection, minimizing landfill, economics and providing more useful goods for society. The utilization of residues for energy is usually an option, although the utilization of residues for other products also should be considered.

And there are many other forms of biomass energy. As we become more concerned about our energy security, this industry will expand regardless of fossil fuel prices.

Louisiana is in an ideal location to develop biomass energy because of its climate, fertile soils and transportation, energy and research infrastructure. Expanding Louisiana's fledgling biomass energy industry will diversify the energy, agriculture and forestry sectors and add high-value jobs. With only moderate encouragement, the biomass energy industry will expand and help us ride out any future energy fluctuations.

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**Production**

**Information**





## LSU AgCenter

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